USE OF RFID AT NIKE

A STUDY OF NIKE'S RFID TECHNOLOGY BENEFIT ANALYSIS

MASTERS THESIS

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A STUDY ON NIKE'S RFID TECHNOLOGY BENEFIT ANALYSIS

Thesis submitted to Delft University of Technology in partial fullfilment of the requirements for the degree of

Master of Science
in
Management of Technology

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To be defended publicly on February 5th, 2021

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ACKNOWLEDGEMENT

As my student life comes to an end, these final days I have been reminiscing about how my journey for the masters study in one of the world's elite university started. Just like everyone else, I dreamt of graduating from the top university with a master's diploma in my hand. These last two years were a life changing experience for me. It not only thought me professional skills, but also helped me develop my personality. It was indeed not an easy path, but the ups and downs of this road transformed me in many ways.

I want to express my gratitude towards my committee members. First of all, I want to thank my supervisor Professor Ir. Marcel Ludema for accepting and allowing me to work on the topic of my interest. It was in the very start of the pandemic when I started my thesis work. His immense support and guidance throughout this journey has helped me to finish my research work. I can happily say, that your guidance uplifted my motivation to work on my thesis even in the pandemic situation. Thank you!

I would like to thank my second supervisor Professor Dr. Udo Pesch. His guidance and feedback helped me to stay motivated throughout my thesis. Lastly, I want to thank my chair Professor Dr.Ir. L.A. (Lóránt) Tavasszy. He made sure to give me the right feedback for making my thesis work plausible. Having worked under such a strong committee has certainly helped me gain more confidence on my work.

I want to specially mention my external supervisors Eric Lagrand and Ken Brauckmiller from Nike. Although working in the pandemic situation was not easy, but their guidance and support throughout my thesis work made this journey exciting. Thank you for helping me to network with the all the possible shareholders and motivating me to express my thoughts freely and discuss all the possible outcomes. I can happily say that working with you both has certainly hepled me to explore the topic of my interest. Thank you!

I want to take a moment to thank everyone who has contributed in my thesis work at Nike.

Apart from this, I want to thank my friends from Netherlands and India for believing in me and cheering me up whenever I was down. I extend my gratitude towards Yashasvi, Hitesh, Pratik, Anushri, Siddhi, Saumya, Sampada, Ajinkya, Eliza, Adarsh, Avishek, Snehal, Sneha, Chinmay and Shreyas. Thank you for keeping me sane throughout the period. The words might fall short to describe how grateful I am for all of your support in making this dream come true. Thank you!

Last but not the least, I want to thank my family for believing in my dreams and supporting me in every decision I take. This would have not been possible without you. A

special mention to my brothers, Ajinkya and Sarang thank you for all support and love throughout this journey.

I want to conclude by a quote which resonated with me throughout my masters journey "Take charge and write your own story" You always have to start somewhere, take charge of your life and make the best out of it and enjoy the entire process.

Sukanya Walaskar
Delft, February 2021

SUMMARY

The innovation for creating sustainable growth in the retail sector helps in achieving a competitive advantage. The need for innovation in the sportswear industry has developed recently because of its high demand. For Nike, the world's largest supplier of athletic shoes and apparel and a major manufacturer of sports equipment in the world, this means the need to innovate is critical to sustaining healthy market leadership. The company's target revenue by the end of the fiscal year 2020 is $16 billion USD. To achieve this target, the company is working on the integration of RFID technology under their digital evolution program. This program can essentially be seen in two lights —improving the sales and customer service experience and managing the capability to enable this improvement.

To identify RFID technology as an innovative solution to drive supply chain operations effectively, Nike is exploring opportunities on integrating it with the current process. The research aims to help the stakeholders (inventory planners, retail planners, and demand planners) at Nike in their decision-making process for reducing the operational overhead of inventory management. Though theoretically, the advantages of RFID technology are well defined, the question arises, if these advantages can be seen in the company's existing processes? If not, what are the costs (tangible and intangible) associated with the change of processes?

The extensive literature helped to map the supply chain process and in the identification of the bottlenecks in inventory management at Nike. And additionally, helped in understanding customer persona for understanding the demand for Nike products. The literature review identified the gaps in the inventory management affecting the sales of Nike products.

The major part of the research is about focusing the benefits of RFID technology in the light of revenue through sales and costs associated to labour costs for manually counting the entire inventory. But, the major impact of RFID technology can be seen on the revenue generated through sales. The final chapter of this research elaborates more on this part. From available research and literature on RFID technology, it is understood that the RFID technology helps in gaining rapid data transmission and the benefits are majorly seen in the areas of inventory management. These benefits are inventory accuracy, item level identification, and scanning of hundred RFID tags per second. Nike is working on integrating these RFID tags onto their products to gain inventory management related benefits. With this in mind, the research question is framed as follows,

How RFID technology's integration to the current inventory management system at Nike

increase the revenue through sales and reduce the labour costs?

It was learned that the manual counting of the entire inventory took 150hrs and the counting happened once in six months(300hrs for one year). The other pressing issue due to the manual counting was the inaccuracy of the data. It is obvious to have a human error in the manual work. This inaccurate inventory data then led to inaccurate demand planning, and eventually landed up in having overestimation of inventory in the warehouses. By using the Nike's pilot study it was understood that the labour hours were reduced by 75% from 150hrs to 36hrs for 6 months. This showed an impressive reduction in labour costs (for manual scanning of the products). The second part of the research question deals with the sales upliftment due to RFID technology tags on Nike products. During a pilot study at Nike it was concluded that there is a 4% of upliftment of sales when RFID tags are included on the Nike products. This number could vary, but due to limited study the affect on sales by using RFID technology at Nike, the calculations are done using this number.

To answer the main research question the research is divided into four main chapters and six sub research questions. These sub research questions are formulated in a way to show the flow of the research. The first chapter discusses the background, scope, research objective, and research question. It also includes the academic relevance of the research. The second chapter elaborates more on different research approaches used for conducting the research. The third chapter discusses the background of Nike in terms of the supply chain management for sales in offline and online mediums (multichannel), inventory management, and sales strategy where RFID technology is introduced. The fourth chapter discusses RFID technology benefits in the retail sector. This is done by introducing two case studies. The first case study is about discussing Accenture's RFID retail findings. The second case study is about *Macy* the American retail store having inventory management problems similar to Nike. The fifth chapter is entirely dedicated to discussing how Nike views its RFID technology journey. The sixth and the final chapter provides the calculation and quantification of the RFID technology benefits which is also the deliverable of this research. In this chapter, one will find equations and calculations for validating the benefits of RFID technology. The research is ends with the conclusion, recommendation, and reflection.

The major challenge involved in collecting the data for this research. Nike is the largest footwear and apparel brand serving consumers in different parts of the world. To achieve this, the company has a different supply chain for different regions. And to ease their decision-making process as a whole, the company has two headquarters. The main headquarter in Beaverton, Oregon (The United States) and the Europe headquarter (EHQ) is located in Hilversum (The Netherlands). Thus, there are competing interests at play within a cocreation mechanism that enable the growth of markets within their respective domains while aligning towards the broader goals of the company. So, for understanding the impact of the new technology's adoption, research required to connect with the teams from WHQ and EHQ.

The company's background study gives an elaborated explanation of Nike's supply chain

management, sales, mediums of sales (multichannel), inventory management, and its drawbacks. This aims to show the direction in which the research proceeds. The inclusion of RFID technology at Nike aims at avoiding inventory management related issues. To support this statement the case studies of real life RFID implementation benefits are included in the research. The American retail company *Macy*, integrated RFID tags for similar reasons as Nike (discussed in chapter 4, and 5). The approach used by Macy showed that the complete adoption of Nike will take time (in years). And, the adoption will happen in different phases. In this research, the use of s-curve for showing different adoption strategies is explored. This gives an affect on sales revenue for moderate, rapid, and slow adoption of RFID technology. After doing the calculations for different strategies one thing became clear that mathematically it can be seen RFID technology will show the expected results in the sales revenue. Now, the question would arise on what basis the calculations were performed? Nike conducted a pilot using RFID technology in 2018. The results from that pilot were used to carry all the calculations. This result included an increase in sales by 4%, inventory accuracy to 95%, and reduction of labour hours from 150 hrs every six months to 36 hrs every six months.

For conducting the quantitative analysis of these benefits was not a straightforward task. Here, the challenge was to identify relevant data for calculating benefits. The data was taken from the publically available source of annual reports from FY2015-2019. But not all the data was publically made available, for this few assumptions were made and validated by Nike's research supervisors. Along with this, the equations used in the research are mostly self derived. The logic and reasoning behind each self derived equation are explained before equations in chapter 6. The revenue projections for improved sales with RFID and reduction in labour costs answer the main research question quantitatively. The table 6.11 and 6.12 shows the increase in sales revenue by almost 4% and decrease in labour costs by almost 75%. It should be noted here that the average of different adoption strategies was taken to calculate the increase in the sales revenue by percentage. It will be clear inchapter 6. The profit modeling shown in this chapter is adapted from the strategic profit model(SPM), because, SPM refers to the affect on Return on Assets (ROA) and Return on Net Worth (RONW) due to the company's decision. It was seen in a journal article on SPM to increase the ROA, Nike should focus on increasing their sales, reducing their costs, and/or reducing their assets. The first two points are relevant to the focus of this research. Hence, profit modeling is created based on strategic profit modeling. The research concluded by showing the impact on sales revenue for the period of five years. This period was taken due to Nike's timeline for RFID technology adoption. The reduction of labor costs also shows how majorly RFID technology implementation will increase Nike's return on assets. The recommendations are given related to the challenges associated to conduct the research. The research is finally concluded with reflections on the entire research journey.

As the outcome of the research is to analyse the gaps and come up with the framework showing scientifically that RFID technology will help in overcoming the drawbacks. As the research is dominantly explorative in nature, the quantitative assessment of RFID technology benefits proves to be a suitable tool. This tool may not have a definite application when implementing other technologies. However, it can be used as a reference to

create tools for the implementation of (new)technologies in the future. There may exist concepts that were not covered in this research. This opens to more future investigations on the topic.

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INTRODUCTION

1.1. BACKGROUND

It is a general principle of strategic management that in a market where rivals compete over a market dominance, they tend to identify dimensions of this rivalry. Porter identifies this phenomenon in his book, when he says "As important as the dimensions of rivalry is whether rivals compete on the same dimensions. When all or many competitors aim to meet the same needs or compete on the same attributes, the result is zero-sum competition". For the fashion and retail industry, much of the same applies. Nike, the market leader, and the largest supplier of sportswear goods sits at the top of the market and is quite aware of these facts.

Infact, as the market competition intensifies and the need to carve out a niche market for each competitor grows, there are increasing challenges for a giant such as Nike to remain in play and dominate it as well. This means, above all, the Nike strategy is a cocktail mix of identities. To illustrate, the channels of outreach and the product types available today are investigated. Figure 2.2 shows a cross section of the market competition in the sportswear subsector within the fashion industry, where new entrants (identified by the red colour bars) can be seen to have made big gains over already existing competitors such as H&M and Next.

Thus, in order to retain its market dominance, Nike seeks to re-invent itself while preserving its stronghold in existing markets, retail chains, and customer segments as it strengthens its position in new domains of athletic fashionwear and new collections of sports equipment. Thus, the cocktail of contradictions that Nike has come to adopt and skilfully manoeuvre shows its ambition to establish its presence on online retail platforms, while retaining conventional outlets. Along other dimensions, it means acquiring enough sophistication in its products to gain entry into the mainstream fashion market

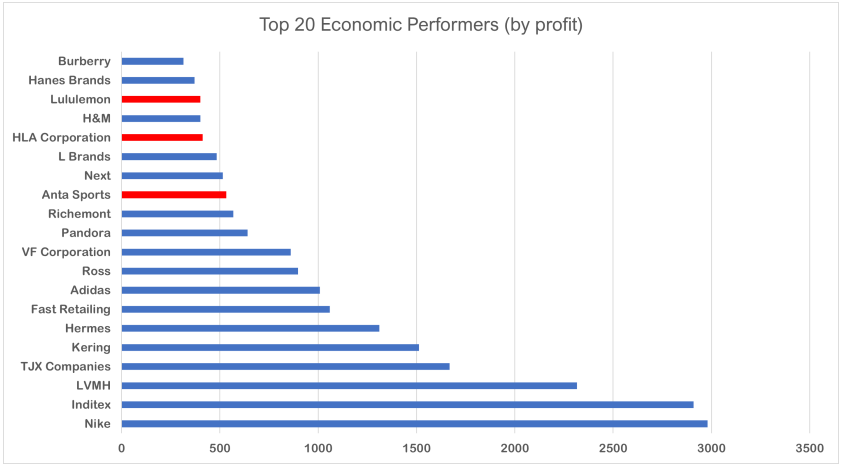

Figure 1.1: Economic Performers for the year 2018, categorized by profit (USD millions). Source: McKinsey Global Fashion Index (MGFI)

while not losing sight of the niche sportswear segments; appealing to a wider base of demographics across gender, age profiles, and international presence in Asia and Africa.

It is within this context the analysis and isolate elements of this corporate strategy that enables growth and profitability are discussed. It becomes relevant then to quote a key finding of Douglas and Cooper in their landmark research paper, "the most remarkable paradigm shift in today's modern business is that individual businesses no longer compete as a solely autonomous entity, but rather as supply chains". This phenomenon, referred to as competitive inter-connected networks feature competition not only among firms individually but a composite of Suppliers—Brands—Stores (Douglas&Cooper,2000). Viewed within the context of our earlier quote from Porter, this pearl of wisdom then appears as a natural conclusion of an exercise in product differentiation in a highly concentrated industry.

The product differentiation for such a competitive market is of utmost importance. Nike wants to achieve product differentiation through digital evolution, which sheds light on two major streams, namely, customer service and infrastructure. The mediums of communication through online presence, marketing, advertising, user friendly payment modes come under the umbrella of customer service. But the focus of this research paper inclines towards the improvement of infrastructure for serving the increasing demand for Nike's product. For on time delivery, product availability on shelves, and visibility of products in the inventory, an efficient inventory management system is imperative. And, to achieve this milestone, RFID technology is a suitable option. As the advantages of RFID technology include, item by item scans, mitigating human error in data accuracy, and locating the products at inventory.

Nike's participation in using RFID technology comes from the goal of achieving data ac-

curacy for efficient inventory planning. The rapid data transfer by RFID will be useful in taking action to improve the business. But, to integrate RFID with the existing process and fuel the information for inventory management will take some time. Currently, Nike has tools for inventory planning but the major drawback with the existing system is data inaccuracy. And the use of RFID is expected to eliminate this drawback. Alongside the implementation, the transitioning of the employees from the traditional work style to the new way of working with RFID can also be investigated. But this is not the scope for this research. The scope lies in analyzing Nike's strategy for RFID technology implementation and to quantify its benefits at Nike. Because consumer responsiveness of a company can be seen through many activities, but analysis of RFID as an investment, will be a method to establish the feasibility of using RFID technology for inventory management to improve consumer responsiveness.

The research will deep dive into the existing process, inventory management KPI's, drawbacks, and RFID's advantages over existing process. As the final deliverable will help Nike to move entirely to RFID integration from the current process.

The next section will expand the understanding of the scope of this research.

1.2. SCOPE

The scope of this research is to assess the benefits of the increase in revenues and reduction of labour costs by the use of such technologies in the retail sector. RFID technology has been in existence since the 1940s. But, in the last couple of decades, the technology has seen rapid adoption in the retail sector.

Nike's chairman announced to a group of Wall Street analysis that the company would be putting RFID tags on its footwear and apparel in the year 2019(Retail Info Systems, 2019). To maintain the competitive advantage, investment in RFID is considered to be a viable option for today's competition.

This research aims to answer what will be the effect of RFID on costs and revenue associated with sales? Due to the recent covid19 pandemic, the company experienced a sales boost through its online shopping medium. Nike understands that the customers have become more sophisticated and this leads to an increase in demand. The investment in RFID technology is a potential approach to serve these customers, at the right time, at right place, and with the right product. The scope of this research is to quantify the benefits of RFID integration for the next three years. Because of Nike's tentative timeline of RFID implementation and practical case study of *Macy* on RFID technology full adoption timeline. The research is applied to the context of supply chain management and will be aimed on becoming useful for future RFID technology's implementation in retail operations.

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1.3. RESEARCH OBJECTIVE AND RESEARCH QUESTION

1.3.1. RESEARCH OBJECTIVE

Theoretically, RFID provides a rapid transmission of data. This data can be useful in reducing the excessive inventories and shortages which may lower the inventory costs (Uttarayn Bagchi, Alfred Guiffrida, Liam O'Niell, Amy Zeng, and Jack Hayya, 2007). The technology has various advantages over the manual process and is well defined in the literature, but while integrating the technology into the current process it is always helpful to quantify the advantages in terms of increase in revenue and reduction in costs. This will scientifically and empirically analyze if the integration of the technology is profitable or either.

Traditionally, Nike sells its products in their brick and mortar stores. But due to the recent covid19 pandemic, many shops were closed for undefined days. In spite of this, the company witnessed more sales through their website. Furthermore, Nike's annual reports show the trend that online sales have done exceedingly well in the past six months and the company expects more growth digitally. But the major drawback in fulfilling this high demand accurate inventory. Nike identified that this could be solved by adopting RFID technology. The advantages like inventory accuracy and inventory visibility will allow Nike to fulfill the current rising demand. The objective of this research is to scientifically analyse the use of RFID technology at Nike for sales growth by empirical calculation of revenue growth and reduction of labour costs. Below are the sub-objectives articulated to achieve the research objective,

- *Understanding Nike's sales system and inventory management* – A background study of the Nike's supply chain system including the sales through online and offline medium and inventory management. This also includes the drawbacks and hurdles due to current inventory management affecting the sales of the products.
- *Understand Nike's RFID vision* – An overview of the Nike's vision and timeline of RFID adoption. This will be supported by case studies of similar retail store named Macy and other case study of 117 retailers RFID's adoption all over the world.
- *Understanding RFID technology benefit at Nike* - Quantifying the benefits by using results from Nike's RFID technology pilot study. This includes different adoption strategy by using s-curve approach. The profit is shown by adapting strategic profit model.

1.3.2. RESEARCH QUESTION

The research is theoretical and quantitative in nature. Even though the companies like Adidas and Puma have stated the benefits of using the technology, it is imperative to scientifically analyze the advantage of this technology at Nike.

The research question of *"How RFID technology's integration to the current inventory*

management system at Nike increase the revenue through sales and reduce the labour costs?". This question is formulated to achieve the thesis objective. By answering the above question, it is expected that the research will help the inventory management team at Nike. The question is designed in a way to provide insights about the technology and state its advantages in the longer run.

The sub-questions to answer the research question is given below, it is hoped that they will help in shaping the research. These sub research questions will be answered in the subsequent chapters. The sub-questions are,

- What are the drawbacks in Nike's current inventory management system?
- How did RFID technology came into picture?
- What are the benefits of RFID technology in the retail industry?
- How does Nike visualizes its RFID technology integration journey?
- How to model implementation of RFID technology for quantifying benefits?
- How are these benefits calculated in terms of increase in sales revenue and reduction in labour costs?

1.3.3. ACADEMIC RELEVANCE

As mentioned in the earlier section, the focus of the research lies in empirically showing RFID technology's advantages for Nike. To show this, the final deliverable of this research is quantifying the benefits of the RFID technology on revenue and costs. This technology is envisioned to improve the supply chain operations because by the use of RFID "inventory can be tracked more accurately in real time resulting in reduced processing time and labour" (Lee Y, ChengMF, Leung YT, 2004). This gives the academic relevance of the paper. It is to empirically showcase the theoretical benefits of RFID technology in the company's supply chain process. By using the theoretical aspects of RFID technology benefits in supply chain management and inventory management process. From the Management of Technology's view, the academic relevance lies in understanding the diffusion of disruptive technology in a company. This will be shown by drawing different RFID adoption strategies using the s-curve method. The technology has added a vital contribution in the field of supply chain management. It has been out there for quite a sometime but its importance for improvement in supply chain operations has been recognized and acted upon recently (Uttarayn Bagchi, Alfred Guiffrida, Liam O'Niell, Amy Zeng, and Jack Hayya, 2007). This paper aims to quantify one such advantage of inventory accuracy at Nike.

1.3.4. THESIS OUTLINE

The thesis outline gives the underlined research strategy used to analyse and answer the research question. This research consists of chapters that ultimately provides with an-

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swering the research question. This research is exploratory in nature and predominantly qualitative, it consists of both empirical findings and theoretical findings.

And, the research is structured as shown below. This shows the content of each chapter.

Table 1.1: Thesis outline

Chapter	***Title***	***Overview***
Chapter 1	Introduction	Background of the topic, Scope, Research Question, and Research Objective
Chapter 2	Thesis Methodology	Research structure and sub research questions, Research approach, Exploratory research, The step by step research approach
Chapter 3	Overview of Nike's Supply Chain Management	Company background, Supply Chain Management (SCM) and Sales Systems at Nike, Nike's Multichannel Retail, Inventory Management at Nike, Digital Evolution in Nike Retail : RFID and New Sales Strategy
Chapter 4	RFID technology in retail industry	RFID technology, Case study: RFID in Retail, Case study: Macy's RFID implementation
Chapter 5	RFID at Nike	The big picture, RFID as a capability, Nike's RFID technology pilot, Nike's RFID technology vision and value proposition
Chapter 6	Modelling and Quantification of RFID technology at Nike	Profit Modelling, Modeling of RFID Implementation at Nike, Improved inventory accuracy due to RFID technology, Sales uplift due to RFID technology, Revenue Projections for Improved Sales with RFID Technology, Reduction of labour costs
Chapter 7	Conclusion, Recommendation, & Reflection	Conclusion & Recommendation for the research

To achieve the research objective a roadmap needs to be followed. The next chapter discusses the research structure and research approach for each chapter.

2

THESIS METHODOLOGY

The intent of this chapter is to provide an overview of how the research was conducted. This becomes especially important considering the exceptional situations as they emerge out of the current Coronavirus pandemic as its restricted possibilities of exploration and communication within interdisciplinary research fields.

Before diving into the thesis methodology and research, figure 2.1 gives an idea of why and how the research is conducted. The following section discusses elaborately the research flow.

2.1. RESEARCH STRUCTURE AND THE SUB RESEARCH QUESTIONS

In the Introduction chapter, the research objective and the research question was framed. The objective of this research is to show how the integration of RFID technology in the current inventory management process at Nike will increase their sales revenue and reduce the cost of sales. Here for the cost of sales, the research *only* focuses on the reduction of labour costs as the other variable costs like equipment, warehousing, shipping, material costs, direct and indirect costs information is not readily available.

For RFID technology, Nike conducted a pilot in the year 2018, and from this pilot, a very limited amount of information is available to conduct the research. The company was set to integrate RFID technology this year (2020), but due to the covid19 pandemic, there was a slight change in their timeline. Also, the amount invested in the RFID technology integration was not made public this means the aim of this research is *not* to directly show the cost benefit analysis, but *to* show the increase in sales revenue compared to previous sales revenues figures (in USD). Hence the research question is framed as, *How RFID technology's integration to the current inventory management system at Nike in-*

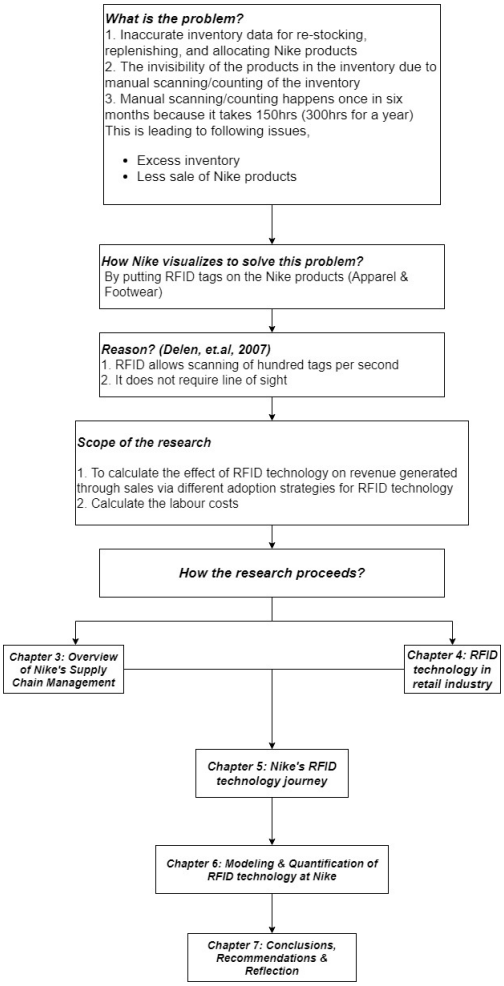

Figure 2.1: The research flow

crease the revenue through sales and reduce the labour costs?

The main research question is answered in a quantitative way. For the calculation, the data was used from Nike's annual reports FY2015-2019. The equations used for performing the calculations are self derived and the logic and reason behind every equation are explained in detail in chapter 6.

To answer the main research questions, the sub research questions are discussed in the introduction chapter. The following section will show how these sub research questions are answered in the subsequent chapters.

Chapter 3: Nike's background study

The intent of this chapter is to provide the background of Nike in terms of its supply chain management and inventory management. The chapter dives into showing different mediums of sales. Here the different mediums is termed as *multichannel* meaning both *online* and *offline* shopping medium. The following section discusses briefly the inventory management tools used at Nike and the drawbacks observed in their tools. It was later realized that these drawbacks lead to inaccuracy of data for replenishing and allocating the Nike products leading to excess inventory and thus leading us to the focus of the research. To solve this issue, in 2017 under the digital evolution program, Nike announced that they will accommodate RFID tags onto their products. The following sub research questions are designed to get specific observations from broad generalizations making it *deductive* in nature,

- SQ.1 *What are the drawbacks in Nike's current inventory management system?*
- SQ.2 *How did RFID technology came into picture?*

By answering these questions, it must become clear what are the drawbacks and a very brief introduction of RFID technology under Nike's digital evolution program to overcome these drawbacks. These sub research questions are answered in this chapter in a subsequent way.

Chapter 4: RFID technology in the retail industry

This chapter is entirely dedicated to showing the advantages and theoretical findings of RFID technology in the retail sector. For showing this, the following sub research question is answered,

- SQ.3 *What are the benefits of RFID technology in the retail industry?*

The chapter starts with the academic findings of the RFID technology in the section named RFID technology. Since the research aims to help the team dedicated to RFID technology integration with inventory management at Nike, it became imperative to add real-life case studies to show the impacts of RFID technology for similar settings. The first case study used is Accenture's 2018 study on RFID in the retail industry. This case study was used to show the broader adoption of RFID technology among retailers all around the world, wherein Accenture reached out to 110 global retailers to take their input on RFID technology. For showing the real-life RFID technology implementation, the case study of Macy (an American retailer store) is discussed thoroughly. The reason behind selecting Macy's case study is the availability of the working paper by Northwestern Retail Analytics. Macy's case study showed similar problems as that of Nike. This made it more interesting and relevant to incorporate in the thesis.

Chapter 5: RFID technology at Nike

This chapter focuses completely on showing Nike's take on RFID technology. And answers the following sub research question,

- SQ. 4 *How does Nike visualizes its RFID technology integration journey?*

It starts by summarising the situations, complications, and questions concerning the introduction of RFID technology in Nike's current process. This chapter shows how RFID technology can be considered as a capability rather than just a simple technological update. The Open Group Architecture Framework (TOGAF) introduced in this chapter reflects the possible strategic vision of RFID technology at Nike. Following this section, Nike's RFID technology pilot is discussed in brief. It was learned from this pilot that the available information and the research on the impacts is limited. This lead to designing the key point indicators for RFID technology using the academic source. The chapter is concluded by showing Nike's vision and value proposition of using RFID technology. This includes the tentative timeline of RFID technology adoption. This became useful for designing the quantitative assessment (the final deliverable) for the RFID technology adoption in terms of sales revenue, and labour costs.

Chapter 6: Quantitative assement of RFID technology at Nike

The final chapter aims to answer the main research question of *How can RFID technology reduce costs of sales and increase sales revenue at Nike?*. This is answered by empirically showing its effects on sales revenue and labor costs reduction by using Nike's pilot findings and annual reports from FY2015-2019.

This chapter takes the final form in the shape of an empirical, yet quantitative estimation of the impact of the RFID implementation on Nike's sales revenue. To do this RFID's impact calculation certain assumptions were made (partly due to limitations of disclosure of sensitive data), alongside recommendations to Nike for a possible scenario planning (in terms of new working processes and expected returns on investment). Most of the equations used in this chapter are self derived. The logic and reasoning behind deriving these equations is explained before the equation.

The chapter starts by showing the profit modeling used for showing the benefits of RFID technology. Now, the modelling of RFID implementation at Nike begins by discussing the different modes of opportunity loss. It gives the theoretical explanation of why the scenario of *over estimation of demand* is used to calculate the benefits. Followed by derivations and calculations for increased sales revenue and decreased labour costs. Since the 100% adoption of RFID will take years, different adoption strategies (moderate, cautious, and rapid) are discussed. This gave different variations in the revenue projections.

The following sub research question is framed to quantify the RFID benefits,

- SQ. 5 *How to model implementation of RFID technology for quantifying benefits?*
- SQ. 6 *How are these benefits calculated in terms of increase in sales revenue and reduction in labour costs?*

The structure of the research is shown in the below figure,

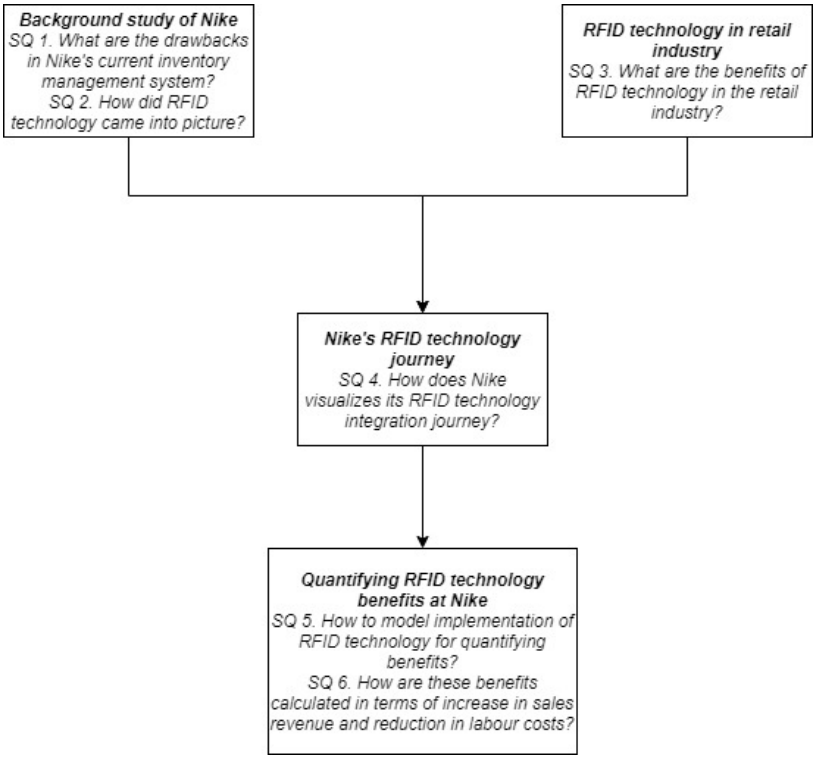

Figure 2.2: Structure of the research

Limitations A critical evaluation of the work presented here reveals a limitation over the scope and applicability of the analysis provided here. For instance, as discussed above, the current pandemic and its residual effects would continue to affect the market sales and consequently, the possible value proposition of a RFID technology enabled supply chain and inventory system.

2.2. RESEARCH APPROACH

The initial steps of the research are standard. It included researching on the available literature on RFID technology in the supply chain and retail sector. There is a lot of (theoretical)literature available on the impact of RFID technology on supply chain management and inventory management and few of these relevant literature study is used in this research. To understand the real life RFID implications, the availability of relevant studies is very little. This was the biggest challenge in this research. The reason being Nike's newness to the adoption and integration of RFID technology in their current system making it important to study how similar retail companies worked with RFID technology and how was their experience for the same.

The brands like Adidas, Lulemon Athletica has adopted the RFID technology before Nike, but, the impact on their sales and costs is not available on the public domain. This demanded the exploratory way of research and is discussed below. The below section also discusses the research approaches that are used and are excluded in this research. Ofcourse there might communications for the excluded approaches within the company, but because of the nonavailability data a different approach was used as discussed in the following section,

Use of Academic literature

Conducting a research on the use of RFID technology in supply chain management gives a plethora of academic articles/journals. For this research the articles/journals used are retrieved from Google Scholar. But the content of these articles/journals are not specific to the research. The articles varied and ranged from customer acceptance of RFID technology to green supply chain by enabling RFID technology. A lot of these articles gave information about RFID technology benefits but their main deliverable was different from the scope of this research. The terms used for searching the relevant articles are, *RFID technology in Inventory Management, RFID technology for RFID, RFID in inventory, RFID in Supply Chain Management, Technology diffusion s-curve, RFID technologies advanatges, RFID at Nike, Nike's inventory management, Supply Chain Management for retail.*

All the results by using these terms gave a theoretical understanding of inventory management process. This is of course included in the research, but, as the inventory management and supply chain process as a whole is different for every company the research was taken forward by conducting formal and informal interviews with the Nike's personnel working on RFID technology. This is discussed in the next section.

Interviews

To gain the information from Nike for the first stages, this meant interviews with multiple teams to understand their perspectives on the RFID integration process and their assessment of its potential impacts on their local business goals.Furthermore, it emerged that in some cases, teams were unaware of the existence or even a possibility of an RFID integration process, thus indicating a knowledge gaps within the decision-makers themselves. This further allowed discussions with these teams on the potential RFID integration with the current process. Thus, allowing an additional perspective on the RFID investment to emerge.

Initially the interview questions were unstructured and deductive in nature. This was to understand the borad problem area. The type of questions were open ended. This was mainly done because of understanding the issue and finding the purpose of the research. The questions like , *How does the supply chain of Nike looks like?, Are there any issues in current inventory management process?, Which teams are working on solving inventory management related issues?.What is current scenario in terms of sales for Nike?, What are the different mediums of sales at Nike?, What are the issues and painpoints for these different medium?, How does Nike plans to move ahead to solve these issues?. How does inventory management looks like?, What are the drawbacks of the current inven-*

tory management?, How does Nike plans to eliminate them?, What are Nike's plan on accomodating RFID technology?. These questions were used for getting the foundational insights on the Nike's supply chain management and inventory management. The answers provided a lead on the RFID technology at Nike to solve inventory management related issues. People from Market Place Analytics team, and Demand and Supply management team were interviewed at first. The output from these interviews led to explore the Just Enough system team, RFID team both in EHQ and WHQ. As the research became focused the nature of questions became structured. As the research started during lockdown period, it was impossible to conduct face to face interviews. All the interview session were conducted through Zoom, Skype, and Microsoft Teams calls.

During interviews it was also learned that the KPI's for RFID technology implementation are not well defined. This led to designing of KPI's by using the academic source in chapter 5. To gain the insights on RFID technology the interviews were majorly conducted with the RFID team leads situated in both Beaverton, Orlando (The United States of America) and Hilverum, The Netherlands. The research started in the early months of pandemic. The *work from home* situation affected the frequency and reaching out to people via face to face interview. But, the co-operation of the Nike team members made it possible to conduct more zoom/skype calls for discussing the scope of the research.

For understanding the bigger picture of RFID technology integration, it then became relevant to learn about how the companies similar to Nike benefitted from RFID integration. For this it became relevant on adding case studies of the companies as such. The next section discussed about the inclusion of case studies in the research.

Case Study

Initially the case studies of Nike's competitor Adidas, Puma, Reebok, Lululemon Athletics was taken into consideration. But after doing research it was found out that even though these companies have adopted RFID technology there is no relevant findings available on the public platform. The second case study included is Accenture's retail case study. It provided a holistic view of RFID technology from 110 global retailers. The benefits posed in this case study helped in creating a stronger case for RFID integration at Nike.

The working paper on Macy's RFID adoption made it viable to including in the research. The reason being Macy also focused benefits of accurate inventory similar to Nike. This case study showed that it took Macy three years for 100% adoption and helped in introducing different adoption strategy for Nike discussed in chapter 6.

Strategic Profit Model

To show the benefits of using RFID technology at Nike a profit modelling similar to the Strategic Profit Model(SPM) is adapted. As SPM determines the return on assets and return on net worth. A journal article on SPM stated that the ROA for Nike will be shown if they increase their sales, reduce the costs, and/or reduce the assets. As the focus of the research is on the same lines, a modelling is shown at the start of the chapter 6.

2.3. EXPLORATORY RESEARCH

Exploratory research is defined as, "A research where a very little knowledge or information is available on the subject under investigation" (Uma Sekaran, and Roger Bougie, 2016). Since the adoption of RFID will be entirely new for Nike's current inventory management, it became relevant to use the exploratory research approach. This also because the research demanded the gathering of information through informal discussions, interviews, case studies, and academic literature.

2.4. THE STEP BY STEP RESEARCH APPROACH

This section discussed about the research approach for shaping up each chapters (3-6). It is discussed as below,

Chapter 3: Nike's background study

In this chapter, the main deliverable was to understand in brief Nike's supply chain management, inventory management, sales system, and drawbacks/issues related to the sales system. For this chapter the dominant approach was by conducting formal, informal interviews. Due to covid19 restrictions, it was not possible to conduct face-to-face interviews, but telephonic interviews helped in gaining a lot of relevant insights. By using academic literature on supply chain management and inventory management also helped in describing these processes in a much simpler way.

Chapter 4: RFID technology in the retail industry

For this chapter, the use of academic literature on RFID technology was used. This helped in describing the advantages of RFID technology. To relate these advantages in a real-life scenario, case studies from Macy's and Accenture were included.

Chapter 5: RFID technology in Nike

As this chapter is entire to discuss how Nike visualizes its RFID technology journey, internal Nike resources like retail tool and interviews with Nike personnel was majorly used here.

Chapter 6: Quantitative assessment of RFID technology at Nike

To show the different adoption strategy the article on the s-curve of technology diffusion was used. The values of calculating effect on sales revenue and change in labor costs were taken from Nike's annual reports (FY2015-2019).

Each chapter is designed in a way to answer the main research question. The research is concluded by chapter 7 with conclusions and recommendations on the RFID integration.

3

Overview of Nike's Supply Chain Management

Thus far the questions propelling this research and the approachis taken to answer them were discussed and understood. The discussion now moves towards the subject at hand, that is Nike, its background, its future plans for a digital evolution and how an RFID-enabled supply chain organization viewed. This chapter seeks to answer the former, that is to provide a background over the company structure, its current operations, and logistics systems.

Going forward, the chapter identifies the appropriate business functions as they pertain to the scope of the current inquiry, followed by an overview of Nike's multichannel retail push, inventory management at Nike as an enabling service layer to support the multi-channel retail policies, and the bigger picture of Nike's digital evolution vision.

3.1. Company Background

Headquartered in the United States of America, and with its European corporate division headquartered in the Netherlands, Nike drives global sales for sportswear with undisputed domination over its competitors. At the heart of its market push, lies Nike's efforts at product differentiation through different value streams namely, —through its footwear, equipment, and apparel offerings.

The company's sales record boasts strong performance over the last decade, with its markets expanding across different business centers, most notably the Asia Pacific and African countries (listed as Emerging Markets, Greater China, and Japan regions). However, a quick look at their divisional markets performance laid bare the deficiencies in

their 'brick-and-mortar retail' economics as was identified as a result of Nike's poor performance in 2017 which saw an erasure of nearly 22 billion USD of market value. This lacklustre performance was attributed to an increase in competition coupled with falling effectiveness of customer outreach.

The importance of this incident can be understood in the context of a generic treatment of the market factors affecting the competition in the sportswear industry. For instance, if one were to use the Porter's Five Forces model to attribute this chink in Nike's armour, that would prove difficult given the strong effects of the higher barrier to entry for new competitors, poor bargaining power of suppliers, and higher strength of market dominance when it comes to Nike's retail capacity. Then how would this anomalous behaviour be explained? This is done through the twin factors of technological democratization (cheaper manufacturing alternatives have enabled younger, smaller competitors to come up) and the increase in pathways available to access clients (online sales through online retail websites such as Amazon and Walmart took away a chunk of customer sale revenues). Additionally, from a marketing perspective, Nike's brand value has historically been associated with messaging that resonates with the intended customer segments, in what is popularly referred to as the 'coolness factor'. With the dropping sales due to the increase in competition, Nike also witnessed its close rivals, namely Adidas and Under Armour adopt a new approach towards redesigning their product offerings, thus diminishing Nike's product portfolio differentiation among its competitors.

In an attempt to stave off competition, Nike's strategy evolved to enable a digital factories future, wherein partnerships were formed to introduce greater automation into its labour-intensive shoe making processes with a key goal to cut costs and accelerating the production process. An additional downstream consequence of this strategy was to enable affordable offerings to a wider range of customer segments, whose preferences were subject to almost constant changes. This successful intervention paid in terms of both revenue as well as a cost perspective. It was estimated that through a combination of automated shoe making processes coupled with cheaper, digital product development methods, Nike looked towards a near 400 million USD reduction in their labour and material cost investments (Digital Initiative, 2017). This digital strategy does not only extend towards product development and shipping alone but has facets in the marketing and logistics division as well. These factors, namely the development of a multi-channel retail capability as well as a digitized supply chain management system are parts of the broader Nike's digital evolution strategy and will be discussed going forward.

Within the purview of the current scope, and especially considering the far-reaching outcomes of a Nike-wide digital evolution strategy, it becomes necessary to identify the structural factors at play and their respective portfolios. The figure 3.1 shows the company's organizational structure as a function of their business functions, grouped together as a business process (marked by colour codes).

Although digital evolution strategy affects all four business functions and processes, the impact of the RFID-enabled supply chain management affects the core functions of —Demand & Supply Management, Marketplace Operations, Retail operations, and the

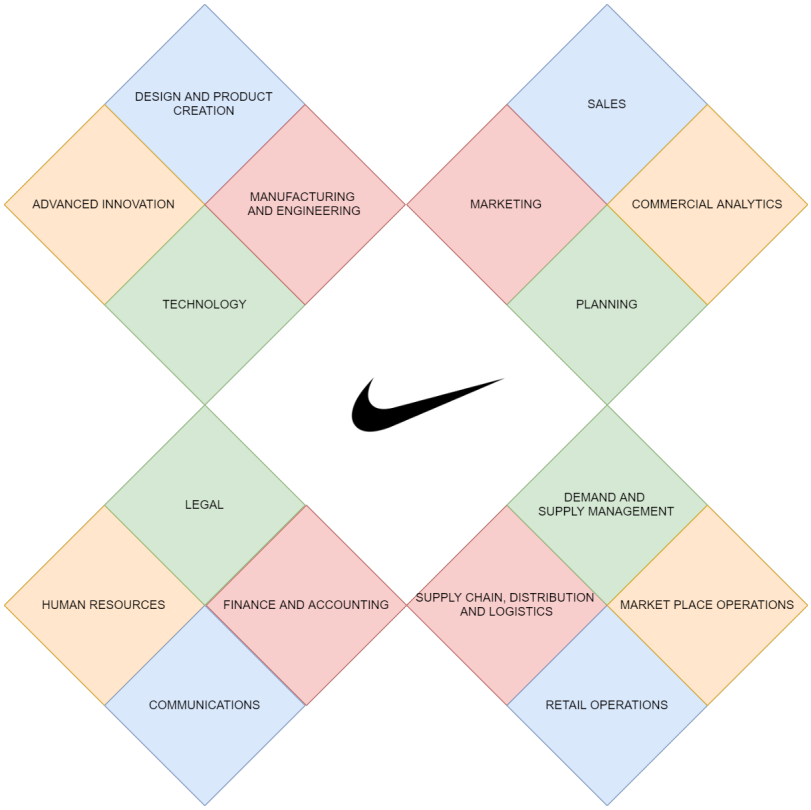

Figure 3.1: Nike's organizational structure(*Adapted from Nike's available team structure, 2020*)

supply chain distribution & logistics. The affected stakeholder, ofcourse does lead to secondary effects on their sibling business functions and related processes. This perspective informs the approach of this research work wherein, key metrics driving the evaluation of RFID implementation as an investment are derived based on the performances and key performance indicators of these business functions. The discussion will now go through some details of the existing supply chain management and sales systems at Nike, followed by an overview of the multichannel retail capability at Nike.

3.2. SUPPLY CHAIN MANAGEMENT (SCM) AND SALES SYSTEMS AT NIKE

The success of an enterprise depends on the resilience of its supply chain operations, chiefly since this system acts as the bearer of the uncertain market stresses as the markets change all while operating to increase profits. As such, the nature of competition within a broadly undifferentiated market space, with limited or no capacity for prod-

uct substitution (as is true for the sportswear industry) becomes closely aligned with the nature and depth of a firms' supply chain and logistics system. This view was, first supported by Lambert and Cooper, in the year 2000 as they characterized the shift from competing for autonomous entities towards inter-connected networks competing among themselves. To quote Lambert et al. "*Instead of brand versus brand or store versus store, it is now suppliers—brand—store versus suppliers—brand—store, or supply chain versus supply chain*".

This philosophy is especially embedded into Nike's business strategy, whose brick-and-mortar retail strategy focuses on maintaining extensive and complex supply chain operations. To establish and support a wide area network of manufacturing and supply, Nike relies heavily on manual labour workforces in emerging markets to enable a cheap manufacturing pipeline. However, as discussed previously, there are digital interventions being made in these segments as well. Nonetheless, manufacturing is only part of the system and not the entire whole. The supply chain mechanism, though complex, is needed to ensure that core activities of demand and supply forecasting, inventory management, strategic planning, manufacturing, order fulfillment, and transportation are executed properly. The below figure shows a brief idea of Nike's supply chain operations. The focus of the research is on the highlighted part. The later section discusses the drawbacks of Nike's current inventory management system and how the integration of RFID technology is aimed to avoid these drawbacks.

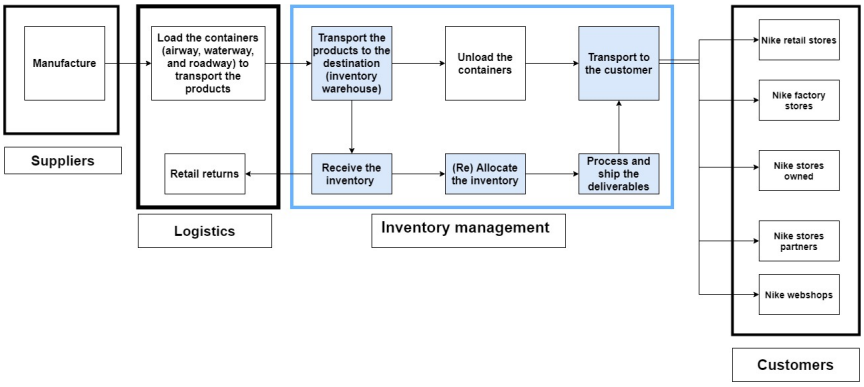

Figure 3.2: Nike's Supply Chain system (*Adapted from Nike's knowledge repository, 2020*)

Nike's manufacturing plants are located in Asia. The products manufactured here are transported to the customers via airway, roadway, or waterway mediums. When the products are transported they are received at the inventory warehouse. For the EMEA region, this inventory is located in Laakdal, Belgium. Here, the allocation of products takes place as per the demand planning. The next step to transport these products to the respective customers. The channels of sales are, Nike retail partners, Nike Store Owned, and Nike Store products. The description of these channels is discussed in the following paragraphs.

For this research, the focus is mainly on demand and supply planning, and inventory

management for online (Nike's website, app) and Offline (Nike stores) shopping medium. Furthermore, from a cost and revenue perspective, it becomes important to understand the pipeline of Nike's Sales and SCM as it underlines the cost of sales and costs of excess inventory. These data points are sourced through publicly available data (tax filing, corporate accounts of operations overhead, and revenue trend breakdown across different value streams), however, they are validated through interviews with Nike personnel and are used to build scenarios for a possible investment in RFID-enabled retail operations.

To characterize sales and revenues, it becomes essential to understand and recognize revenue sources (from the Nike multi-channel retail revenues outlined in figure 3.3) and their division. For instance, *wholesale revenues* and *retail revenues* characterize a major portion of Nike direct revenues considered for RFID impact. The wholesale revenues emerge from bulk sales Nike of goods to wholesalers then distributed to retailers, these would then involve proceeds from goods sold to the Nike Retail Stores (NRS). Retail revenues, on the other hand, aggregate revenues from different outlets such as —Nike Stores Owned (NSO), Nike Stores Partners (NSP), Nike Web shops, and Nike Factory Stores (NFS). The sales revenue from Nike Webshops is also categorized under revenue from digital sales to customers (under Direct-to-Consumer) alongside Nike Brand in-line and factory stores. From a cost perspective, a characterization of costs associated with operation overhead is in order. *Cost of sales* reflect the inventory costs, including the costs of warehousing and labour, third party royalties, product design costs, and possible returns from foreign currency hedge gains (Nike annual report). The cost of excess inventory is correlated with the cost of sales wherein, revenues as a result of clearing through off-price channels, including Nike Direct Business are accounted for(Nike annual report). But, the scope of this research is to only focus on the reduction of labour costs.

3.3. NIKE'S MULTICHANNEL RETAIL

Nike's Direct sales are the implementation of a diversified sales channel at Nike. This multi-channel retail approach, it should be noted, differs from the omni channel retail capability wherein sales channels are not siloed and instead promote cross-channel communication to provide a seamless user experience to the consumers. As discussed previously, the current state-of-implementation at Nike is not yet configured to omni channel capabilities and is characterized by the delivery of products through different sales channels as shown in figure 3.3.

Not only does this approach allow for a diversification of inventory stock-up risks (reduces the cost of out-of-stock options and excess inventory costs), it also allows for navigation through uncertain changes in the market landscape (PwC, 2012). An example of Nike's Direct benefits are the increased digital revenues during reduced market activities created due to the coronavirus pandemic. For instance, Nike announced earlier beginning of 2020 that Nike owned, and corporate stores (in multiple countries) will be temporarily closed (Nike news, 2020) with no indication of the shops reopening. In the third quarter, the company reported an unexpected loss in more than two years with a

drop of 4% in maker's shares (Business Today, 2020). Due to the closing of shops globally for eight weeks, the wholesale side of the business also suffered a great loss. The effects were 50% reduction in shipments, excess inventory, and higher costs due to order cancellations. Because of this, the gross margin fell by over 820 basis points (Business Today, 2020).

However, in this situation, Nike's digital platform helped to survive in the pandemic with excellent growth. The annual reports from FY2015 - FY2019 show an average of 3% of growth in direct-to-consumer (Nike stores, wholesale and online) revenue. Even though the revenue generated by online sales is less in number compared to Nike direct and retail, but the major share of DTC revenue came from online sales. Over the years a growth of 75% in online sales was recorded (Business Today, 2020). Even though the closure of Nike stores declined their sales, but, in the summer quarter, the digital platform increased the online sales by 82%, giving the revenue of $10.6 USD billion at the end of the quarter on Aug 31st (The Wall Street Journal, 2020). These circumstances have, as indicated offered Nike the flexibility to pivot across different revenue sources reliably, in this case, digital sales (BBC,2020). Nike believes that this will ensure retaining the highest position in the market among the competitors like Adidas, Under Armour, and Puma while allowing consumers safe access to their retail needs.

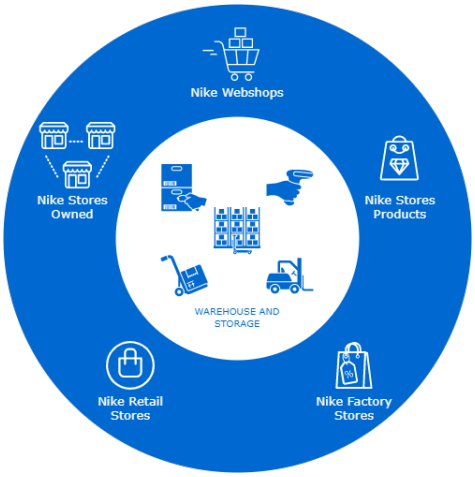

Figure 3.3: Multiple sales channel in Nike's Direct Sales (*Adapted from Nike's knowledge repository, 2020*)

Retail operation supporting all the multi-channel sales approach except that of NFS is driven by extensive demand planning for maximizing revenues while cutting excess costs associated with it. This approach has three steps, that is, *'hindsight, plan, and trade'* (Nike's online and offline teams, 2020). Essentially, Nike relies on the availability of past point-of-sales data coupled with market trends that indicate a better demand forecast (in terms of accuracy). This is critical since there are discrepancies and errors within the sales and inventory data themselves, due to lack of oversight, mismanagement, lack of automation (leading to poorer quality control of information). However, through a

concurrent analysis of data within all these pipelines (past sales data, demand forecasts, and inventory database), a cohesive and more holistic retail operation is enabled and reduces the associated costs and efficiency of demand planning.

3.4. INVENTORY MANAGEMENT AT NIKE

Thus far, the operations supporting the sales channels and the delivery of goods have been identified under the multichannel retail framework. Now the discussion moves towards the back channel operations that enable successful delivery of products and shipments to replenish the demand of supplies (for Nike retailers as well as wholesale distributors). The considerations made here affect primarily the costs, since the cost due to storage of excess inventories (due to overestimation of demand, (Slack, et.al, 2010) as well as the cost of taking an out-of-stock positions (higher than expected demand), implies increased losses and thus associated costs.

The key goal here becomes the reduction of inventory costs, and this is done through two systems which are put in place at Nike, namely —the 'Just Enough' system and the 'Store Inventory Management (SIM)' system. Ziukov (2015), states two fundamental decisions that drive the replenishment choices for maintaining an adequate inventory; building off of these decision templates, given below are the two main decisions Nike takes for allocation and replenishing the products.

- How large the inventory replenishment order should be?
- When an inventory allocation and replenishment order should take place?

The answer to the first question, lies in the data, concerning past sales records and the expected market behaviour in the upcoming financial season. The other question, on the other hand, utilizes the Just Enough system introduced earlier and now explained further.

What is Just Enough System? Just Enough (JE) system is the cloud-based solution for allocation and inventory management, wherein order categorization is done based on *future orders* and *always available order* requirements. These divisions reflect Nike's twin business models, namely the Futures business model —a make-to-order business model, and this constitutes the bulk of Nike's revenue —and the Always Available business model that ensure consumers have the choice of the product desired when/where shopping occurs in all possible colours and sizes. Future orders request, require an explicit requirement specification from the customer placed at least six months prior to the day of delivery. For these two business models, inventory accuracy becomes an utmost important parameter. Because the inaccurate information for either future order or always available order may result in overstocks/stock-outs at the inventory. The JE system is adopted in The USA, Netherlands, Japan, China, and Mexico. The input for the JE system comes from point of sales (POS) data, direct to consumer data, procurement contracts, and Store Inventory Management (SIM) tool (Nike's Just Enough team, 2020).

For the replenishment business model a key consideration to make is that of the Item Fill Rate (IFR). Nike aims at an IFR of nearly 95% for the replenishment of all the products. However, difficulties associated with the quality of data, wherein misrepresentation or inaccuracy may contribute, leads to inaccurate demand planning which then affects the replenishment capacity. Furthermore, to counter the shortfall of inventory stocks, Nike overcommits its resources with buffer stocks to maintain safety against out-of-stock situations. This implies a higher than 95% IFR rates as estimated by demand planning. Although holding excess inventory is useful in uncertain market behaviour and fluctuations, there are limitations to this approach owing to the cost of excess inventory that is created. Slack, et.al., (2010) attributes these limitations due to the following factors:

- Inventory ties up money in the form of working capital. Making the money unavailable for other uses, such as reducing borrowings or making investment in productive fixed assets,
- It occurs storage costs,
- It may become obsolete as alternatives become available,
- It can be damaged or deteriorate,
- It can be lost or expensive to retrieve, as it gets hidden amongst another inventory,
- It may be hazardous to store, requiring special facilities and systems for safe handling,
- It uses space that could be used to add value,
- It involves administrative and insurance costs.

Maintaining excess stocks in inventory also then affects the book-keeping facilities, that is the SIM tool, discussed next.

What is Store Inventory Management (SIM) tool? Apart from maintaining the safety stocks for the replenishment stocks owing to demand variability, the introduction of new products with limited or no prior sales record creates difficulties in planning safety buffers. Nike introduces product variants every quarter and the customer gives the future order six months prior to its sales. This results in over(under) estimation in sales of products. Finally, shorter selling seasons than the replenishment lead time result in shortages and out-of-stock positions. Thus, demand variability, items with limited/no prior sales record, and shorter selling seasons lead to high stock outs or excess products at the end of the selling season (Kang, 2015). The unsold excess inventory is then sold at NFS at 30% discount than the actual price (based on interviews with inventory planners), thus affecting the sales revenues giving low or negative margins (Kang, 2015).

Nike also faces issues like capacity constraints and the inability to track the required products in the back store, hampering the sales. To mitigate the inventory planning

problems, Nike uses the Store Inventory Management (SIM) tool —a centralized repository with a standardized interface for inventory scanning and point-of-sale information. The SIM tool, also known as Point-of-Sale (POS) tool, provides the details like product received and uses the location points to identify if the product is in the stockrooms. However, the tool's accuracy is limited by the accuracy of the inventory data. This inaccuracy in the inventory data can be caused due to multiple reasons such as items missing, damaged items at delivery, and items not received correctly. Furthermore, the limited number of full store inventory counts (a maximum of two per year) leads to inaccurate data for allocation and replenishment of products.

As quoted by Bagchi et. al., "An effective inventory management in the supply chain operations acts as a competitive advantage for firms" (Bagchi, et. al.,2007). To gain this competitive advantage, Nike's digital evolution included investment in RFID technology. And this is considered as a major leap towards achieving the capabilities enhancing the customer service. But what does digital evolution entails? The next sub-section gives a detailed description of Nike's digital evolution. By answering the question, Why is it needed?

3.5. DIGITAL EVOLUTION IN NIKE RETAIL: RFID AND NEW SALES STRATEGY

Due to the introduction of digitalization, the retail sector has witnessed a drastic changes in the last two decades. This includes the dominance of online channel (Christensen & Raynor, 2003). These developments led to the introduction of multi channel strategies. And the major strategy here was to decide which channel to include (Geyskens, et.al.,2002; Deleersnyder, et. al, 2002). Here the scope lied in considering the issues such as management of customers, and integration of retail mix across the channels (Neslin, et.al, 2006). But with more advancements in digitalization (like mobile channels, tablets, and social media), arises more challenges (Leeflang, et. al, 2014).

As has been discussed thus far, digital innovation in retail has enabled Nike sales to stay afloat even under depressed market conditions such as those seen under the current Coronavirus pandemic. Although, pre-pandemic sales revenue exhibited growth in direct and wholesale returns, the added benefit of having a digital outlet for sales has proved as a multiplier. Figure 3.4 shows the trend of annual growth of digital commerce sales revenues heading into the current fiscal year.

From a big picture perspective, digital evolution for supporting operational overhead forms a key component of a composite digital innovation (ranging from product design and development, sales, inventory, and outreach). An example of this improvement is the evolution of the multichannel retail framework towards an omnichannel retail framework wherein concurrent sales channels cross-communicate with each other to provide a seamless user experience. An instance of this evolution is the advent of Offline-to-Online sales (O2O) wherein customer purchase orders placed online are de-

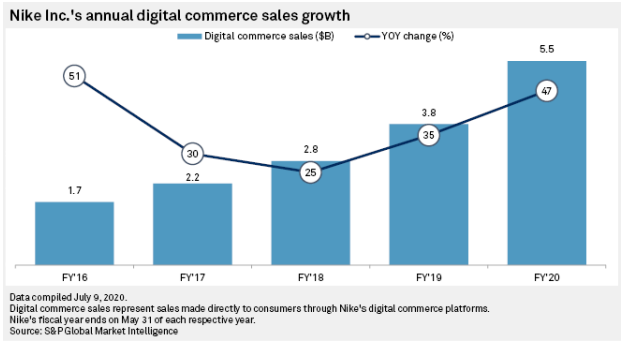

Figure 3.4: Nike's rise in digital sale FY2016 - FY2020(*Source - S&P Global Market Intelligence, 2020*)

livered through in-line stores as a result of cross-communication of inventory stocks. A key enabler of this capability is that of inventory visibility wherein orders placed through an online sales channel can be allocated and replenished through a sibling sales channel such as Nike retail stores. It is in this perspective, that the applications of RFID become apparent. This will be discussed in the next chapter.

3.6. CONCLUSION

The chapter started by discussing the broad picture of Nike's supply chain management and different sales mediums namely offline and online. For the simplicity of calling out these two mediums, it is termed as *multichannel retail*. This is followed by discussing inventory management tools for multichannel retail and their drawbacks.

The aim of this chapter was to answer the first two sub research questions. *What are the drawbacks in Nike's current inventory management system?* and *How did RFID technology came into picture?*. The answer of the first question can be seen *inventory management at Nike* section. Nike has two business model namely, *future orders* and *always available order*. And, for these two business models, inventory accuracy becomes of utmost importance because the inaccuracy of inventory information may lead to either overstocks/ stock-outs at inventory. This chapter helped understand that Nike's current store inventory management tool provides limited information in terms of inventory accuracy. The reason could vary from item missing to items not received correctly. These drawbacks are discovered and in order to eliminate these issues, the introduction of RFID technology is made in Nike's digital evolution program in a very very brief manner. Hence, answering the second sub-question.

Now, the next chapter focuses on making the RFID technology's case strong by discussing the benefits related to RFID technology and the practical case studies where RFID technology benefit is experienced.

4

RFID TECHNOLOGY IN RETAIL INDUSTRY

Having identified the nature of Nike's supply chain management and inventory management, the discussion now moves towards the realization of the digital evolution strategy for Nike's supply chain and logistics capabilities. That this new change can be accomplished through the implementation of RFID enabled monitoring systems, was highlighted at the end of the previous chapter. The following section starts with elaborating more on RFID technology on the retail side.

4.1. RFID TECHNOLOGY

Radio Frequency IDentification (RFID) enables tracking and monitoring of an item's unique identification information through radio wave communications (Jung, et.al, 2007), this information in encrypted into electronic chips (called tags) with the necessary identification information required (Seygin, 2006). A clear application of this technology is to enable inventory visibility or atleast to improve it. Improved inventory visibility in turn leads to better management of stocks, further enabling cross-communication across multiple sales channels. RFIDs have better applications in terms of advantages over another competing (and in-use) technology, namely the barcodes, as listed below (Delen, et.al,2007):

- RFID does not require line of sight.
- RFID allows hundreds of tags to be identified at one time.
- RFID allows hundreds of tags to be read per second.

- RFID tags can store more data.

Furthermore, in terms of the depth of inventory data availability, the use of barcodes enables the data gathering of Store Keeping Units (SKUs) wherein categorization is associated with aggregated feature sets such as brands, size, and/or types. This data depth does not however extend to item level visibility of each entry (product). The use of RFIDs on the other hand enables item-level information visibility (Gramling, et.al, 2003). As a result, a real-time monitoring of the inventories becomes possible (Seygin,2006). Where barcode shows control at the product level, RFID technology uses Electronic Product Code (EPC) for providing a unique identity to each individual product enhancing the tracking and control of inventories within the supply chain. As a result, retailers will know the exact location and quantity of inventories in the stock by using RFID tags, suggesting increased applicability of this technique to other supply chain management systems (Hargrave, et.al, 2009).

As a means to underline the applicability of RFIDs, the next section will discuss the study conducted by Accenture in 2018 followed by a case study of Macy. Accenture's survey conducted from over 110 retailers all around the world featured 69% retailers who adopted RFID technology (Accenture, 2018).

4.2. CASE STUDY : RFID IN RETAIL

This 2018 study featured a comparative analysis of RFID adoption as an investment for 110 global retailers, out which 69% of respondents showed a positive inclination towards the use of RFID for their business applications. The trade-offs associated were between the benefits of omnichannel capability growth, inventory accuracy, and improved customer experience on hand and the high costs of integration on the other. However, the retailers who piloted or adopted this technology reported an 8.3% (average) of return on investment. And, the time between the pilot and full adoption provided an average return of investment of greater than 30%, because of the added efficiencies gained while using the technology. The same study cites the increased adoption rate among North American retailers (95%), attributed to same-day-deliver capability growth. The map 5.1 given below shows the adoption of RFID among retailers across regions.

The lack of adoption across European retailers was attributed to regulations and concerns over privacy and data security (32% of respondents) and others do not want to make the first move against the established industry standards, perhaps due to the cost of transition which may be seen as prohibitive (29% of respondents). This does however, signal a significant opportunity gap in the digitalization of retail inventory management.

As mentioned previously, the use of RFID-enabled inventory management systems allows for more than improved inventory accuracy performance. Additional benefits emerge as increase operating profits (due to better realization of sales capacity as a result of the low cost of inventory stock buffers as well as higher inventory visibility), superior customer experience (since the choice of offerings is always available), and enhanced

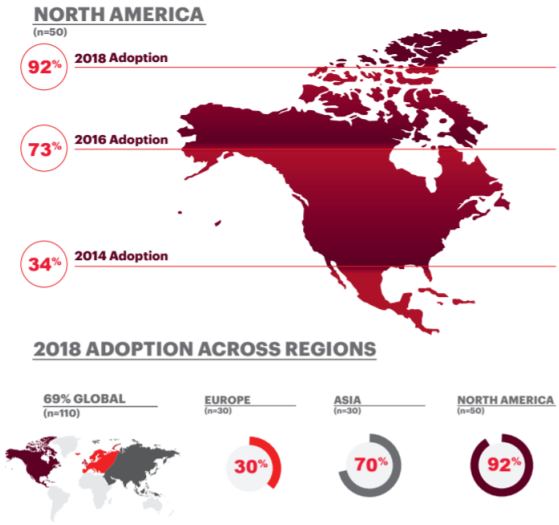

Figure 4.1: Retailers (in %) moving towards complete RFID adoption *(Source - Accenture retail study, 2018)*

opportunities for personalized marketing. The latter emerges out of smart data gathering of personalized shopping experience through several alternatives, most notable of which are smart checkout systems (indicated by 46% of respondents) and some implementation of a connected Internet-of-Things (IoT) in the shopping environment (33% of respondents). Both approaches are enabled, if not boosted, with the implementation of RFID-enabled systems as the rapid transmission of the detailed data and real-time trackability of the products allows for their applicability. As a result, the introduction of RFID as a technology can be seen as a gateway innovation leading to broader and more refined digital disruptions within the inventory management framework as shown in figure 4.2.

Along with functional benefits, quantification of these benefits in terms of returns over investment is also useful. The retailers who have adopted RFID before Accenture's retail study have reported an average return of 6.8% for the pilot stages and for full adoption, the ROI is 9.2%. This makes a strong case for investment for adopting RFID in existing processes. Thus, as can be understood, increased, and sustained adoption of RFID-enabled inventory tools leads to improved average returns over investment. This is furthered by the improved customer responsiveness and higher available utility of the labour involved (due to reduction in repetitive manual tasks). Furthermore, a digital database allows for an improved assessment of business decision making and analytics overall.

The retail study Accenture provided below returns on the pilot and full adoption of RFID reported by 76 RFID adopters around the world,

Figure 4.3 highlights the growth of omnichannel capabilities evaluated at the pilot stage

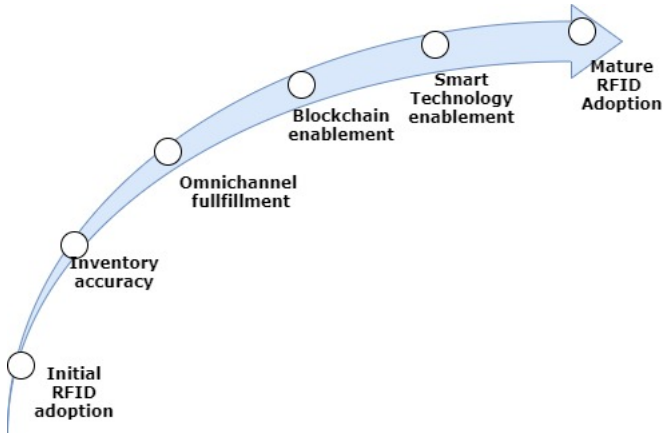

Figure 4.2: Opportunities of RFID's full adoption in retail *(Source - Accenture retail study, 2018)*

Features	***Pilot***	***Full adoption***
Improve in backroom visibility to front of store inventory accuracy	9.4%	9.7%
Reduction in shrinkage	4.8%	10%
Reduction in inventory count time and labour costs	8.6%	8.5%
Reduction in store out of stocks	6.4%	9.1%
Increase in store replenishment	7.9%	9.4%

as well as the full adoption stage, across multiple offerings such as, Buy Online, Pick-Up in Stores (BOPUS) as an O2O feature, Ship-from-Store, Online Order availability, Ship-to-Store, mobile application use as well as a reserve in-store capacity. Though varying across all these offerings, sustained adoption of RFID enabled tools leads to improved growth across all omni-channel capabilities.

Finally, the benefits identified here have been characterized as unique value propositions realized because of sustained RFID adoption. The next section is the case study showing the benefits of RFID in a company like Nike, Macy. Macy is the fastest growing omni channel retailer with its headquarter in America is the famous fashion retailer brand. The company started the use of RFID tags from the year of 2011. This brand also focused on similar problems as Nike while implementing RFID technology to their 850 stores. Including their case study in this research will help in analysing the potential benefits at Nike.

4.3. CASE STUDY : MACY'S RFID IMPLEMENTATION

In 2017, the US-based Platt Retail Institute along with Northwestern University conducted research into the benefits of implementing RFID for the fashion retailer, Macy's

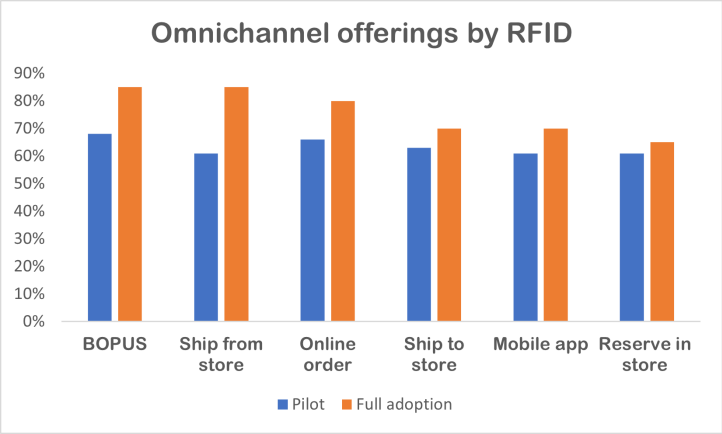

Figure 4.3: Omnichannel offerings by RFID's in retail *(Source - Accenture retail study, 2018)*

(Northwestern Retail Analytics Council, 2017). The study is referred here to provide some context and derive some standard benchmarks for analysing performances along with expected industry standards.

The study identified improvements along the following metrics:

- Improved product visibility
- Reduced inventory requirements
- Enhancement in omni-channel capabilities
- Improved customer satisfaction
- Reduction in labour costs
- Affect on sales and revenue

These metrics are broadly along the same lines of inquiry as detailed in the previous section, as these considerations inform Nike's decision making as well. The results obtained by this study are referred to in this research this is then followed by our own analysis of what trends can be extracted as a generic benefit of RFID implementation outside of the company specific structural benefits.

4.3.1. DISPLAY AUDIT

Here, the primary goal is to achieve compliance with the display of products on shelves or at windows. The affected factors because of improved display compliance are said to be customer satisfaction, sales, and markdown indices. To provide a context, this study was done for the Women's Shoe Departments (WSDs) within Macy's stores. The display audits performed here, which measured the rate of display compliance were then compared with those of other departments within the Macy's store.

The challenges for the compliance with the product (shoe) display was the high time of

scanning and replacement (manual), a limited overview of the new arrivals of stock, and the consumption (through sales or theft) of the products on display. For instance, it was learned that the manual process of sequencing, scanning, and displaying products on the display shelf took 3-4 hours. As a result, the restocking was scheduled twice a week only.

In terms of the total stock inventory, it is reported that around 2016, Macy's shuffled nearly 250,000 Store-Keeping Units (SKUs), that is nearly a quarter of a million, within its logistics center. The distribution towards its retail outlets varied in-stock sizes, with the bigger stores carrying nearly 2000-4000 product types, and a typical store procuring 800 product types into the WSD.

For Macy's store operators, it was critical to ensure that the maximum variety of product types be displayed in order to engage better customer numbers, increase sales and markdowns for all items processed in the inventory, and to allow merchants to be able to view all the data of product types on display and allow for better store allocation decisions to be made.

With the implementation of RFID tagging systems, dramatic improvements were observed:

- Display audits —the audit time for checking the missing items from display shelves was earlier nearly 3-4 hours, which limited the number of audits to 2 per week or 48 per season. This was increased to an average of 134 per store per season due to the drop in the number of hours for scanning and reallocation to shelves.
- Replenishment and customer satisfaction —Prior to the implementation of RFIDs the self-reported numbers for the number of items that went missing from display (either due to failure to replenish or due to theft) was nearly 30%. This number plummetted to an average of 8% following the inital compliance audit. This is also reported to have increased customer satisfaction since there were more styles available on display, leading to higher customer engagement.
- Sales and markdown indices —it is reported that as a result of the implementation of RFID across the Macy's retail stores, the increase in sales was estimated to have been increased by atleast 1%.

It should be noted here, however, that these benefits (though significant) were subject to diminishing returns over the span of 3 years of this study being conducted.

4.3.2. INVENTORY ACCURACY

Inventory accuracy across Macy's retail level logistics distribution was conducted by studying Gross Unit Variance (GUV) across three different product types, differentiated by their brand identity.

Gross Unit Variance, in this study context, is defined as "the difference between merchandise that is on-hand as compared to what is shown in the inventory record as being available." Thus, a variance of zero would indicate a completely accurate log of merchandise availability in the record inventory as well as on-hand.

This study conducted tests across eight New Jersey stores, for a total of three different brand types —Brand#1, Brand#2 and Brand#3. Of these, only Brand#3 was enabled with RFID.

Furthermore, the data on the other two non-RFID brands (control groups) were counted during the physical audits that occurred only once per year in January. For the RFID-enabled brand, however, monthly cycle counts were feasible since the technology allowed for it. This meant that, with the implementation of RFID and with the positive verification of its stated benefits, the following improvements are possible(Northwestern Retail Analytics Council, 2017):

- Improved omni-channel fulfillment due to easier locating capability of desired merchandise
- Enable display compliance for all product types in stock
- Improved customer satisfaction as consumer would be able to get 'anything they want, whenever and wherever they wanted it'
- Reduction of out-of-stock positions due to better accuracy of reorder needs
- Reduced inventory investments and improved sales

The findings for these experiments were as follows:

- Gross Unit Variance —Brand# products were found to have considerably lower variance than the other two brands (20% less GUV than Brand#1 on average and 6.5% less GUV than Brand#2 on average) across the test data spanning over 3 years.
- Markdowns —the RFID-enabled brand performed exponentially better and resulted in very low numbers of markdowns since the retailers were able to make better buying decisions in order to replenish their stocks and thus had to take fewer out-of-stock positions than for the control groups

Based on these results, it is indicated that the reduced markdowns coupled with improved GUV statistics for RFID enabled brand product type is correlated to improved sales, customer satisfaction, and omni-channel fulfillment as well. However, it must be noted that, although this brand did perform well, the nature of the product type itself was not similar to those in the control group. Brand#3 was categorized more as a replenishment product type (with shorter order-to-buy cycles) whereas Brand#1 and Brand#2 were more fashion oriented and thus had longer order-to-buy cycles on average.

4.3.3. BACK TO FRONT

The study also conducted tests over the frequency with which the store fronts were able to source replenishments from their stockrooms, through Back-to-Front (BtF) procedures. Although it is pointed out that this study was not conducted across entirely uniform test cases due to ongoing improvements in the store-level replenishment procedures still being under development, the results obtained are nevertheless interesting.

RFID enabled back to front procedures, it is estimated, allowing for a near real-time approach to replenishment which in turn positively influences sales due to increased customer merchandise visibility. The results from the test, although less definitive, seem to validate these positions:

- Unit sales —as a part of RFID-enabled BtF implemenation, scanning was done either on the back-room inventory or at the selling floor itself, identifying the items missing from display and marked against in a pick-list for sales associate merchandise fill-in. It was observed that through this process, there was an uptick in the unit sales (though higher selling rate of picked items, and thus items that are on display), than for those which are not replenished and not on display.
- No prior sales —the items that were picked and put on display, even if they have not been sold before, still sold at a higher rate than those items which were not put on display (even with priot sales records).
- Sales by Merchandise Category —although performance of selling rate of items put on display varied across categories, the sales nevertheless showed improvement over the items that were not put on display.

The uniqueness of the proposition from the two case studies discussed above allows for the assumption of these benefits to emerge in a likely implementation of RFID within Nike's own digital evolution. This forms a key component of Nike's vision and value proposition for the use of RFID technology, as seen in the next section.

Nike's value proposition is to serve the marketplace by ensuring "*the right product, at right place and at the right time*". The realization of this motto depends chiefly on successful tracking and fulfillment of order requests. An RFID-enabled tool adoption is expected to increase the confidence in product tracking leading to enhanced supply chain operations. This in turn cascades into selling more full priced products, and efficient operations like inventory count. Additionally, this allows for greater product availability to consumer preferences leading to increased responsiveness. Nike aims to achieve its value proposition through phased technology introductions as shown in figure 5.4,

4.4. CONCLUSION

This chapter helped in answering the third sub research question, *What are the benefits of RFID technology in the retail industry?*. The answer to this sub research question can

be found in all the sections. The biggest advantage being, RFID technology allows hundreds of tags to be identified at one time and also allows hundreds of tags to read per second. It is seen from the case studies of Accenture and Macy that RFID technology improves backroom visibility, reduces inventory count time and labour costs, increases store replenishment, and affect sales and revenue. These findings become useful for the research because focus of this research lies in calculating effect on the sales revenue and reduction in labour costs.

The nature of this question was purposely kept as an open ended question. Because it gave the liberty to first understand the general idea of RFID technology benefits and then focus on the practical scenarios. The theoretical benefits of RFID technology in the retail sector are easily available in supply chain literature. But the practically benefits can be analysed only when it is adopted and used in an actual retail setting. The case study by Accenture and Macy provided these practical benefits of RFID on the retail side. The important part here is Macy also focused on the similar aspects Nike is currently focusing on. The addition of these cases studies will help understand the benefits Nike will gain over the years. The next chapter presents the RFID as a capability at Nike followed by Nike's pilot, vision, and value proposition for RFID technology.

5

RFID TECHNOLOGY AT NIKE

This chapter starts by contextualizing the RFID integration at Nike through the viewpoint of its stakeholders, business operations, and cost centres (specifically, North America and EMEA). This narrative edifice is also supplemented through Nike's pilot study.

5.1. THE BIG PICTURE

To gain the context of the problem at hand, the three main questions are asked. What is the current situation? What are the complications/bottlenecks in the current situation? And how can these complications be overcome? And as to the perspective required to answer these questions, a close look is taken at the relevant stakeholders, that is, demand planners, retail planners, inventory management, and sales department.

What is the situation? Nike has a complicated supply chain management system. That is, ofcourse, expected for a company with the kind of market presence that Nike has. There are, however, secondary concerns relating to capability management that enables the efficiency of this supply chain to increase.

To understand the lacunae in the capabilities in place and the pain points experienced, interviews were conducted with the inventory management teams and the following issues were identified (Adapted from discussion with Nike's inventory management team, 2020):

- Manual intervention in inventory count
- Inaccurate past sales data
- Product (in)visibility
- Excess inventory
- Capacity constraint
- Product misplace

The view of these bottlenecks was further put in perspective by assigning them business roles alongside functions such as obtainment, generation, appropriation, and inventory —all in turn dependent on what would be the forecasts (Thomopoulos, 2015). Furthermore, these business objects —processes and functions both —were aimed at maximizing sales and revenue. That formed the optimization goal for the inquiry into the changes needed for these capabilities.

And in this fashion, when the effects of these factors were studied, it emerged that they led to the loss of potential sales revenue at Nike. For instance, lack of product visibility during the warehousing and inventory process, affects Nike's demand-and-supply capability throughout the seasons where product demand peaks. This then leads to a shortfall in revenues, as the missed products are then sold (if found) at discounted prices at Nike Factory Stores (NFS). This loss is also compounded due to inventory costs that were associated with the storage of these 'missing' items as well.

Another example of sales getting affected due to inventory mishandling is of inaccurate sales data. This is relevant since as mentioned above, the lack of product visibility does lead to 'virtual' incapacity of meeting demand through the supply (the missing items are only discovered at a later stage). In order to make up for this shortfall, Nike uses a demand forecast system based on the actual sales volume at the respective Point-of-Sales locations to bridge the gap between the demand planning output and the actual inventory capacity present at these stores.

This approach, although reasonable, introduces two dependencies. It relies exclusively on the accuracy of the sales information and the costs of excess inventory by accounting for a certain percentage of items to be missing (as a random error term). The system at Nike responsible for recording Point-of-Sales information does not have high accuracy, however. This is manifested in the form of missing data points for sales records as either the items do not get displayed for sale (thus, unaccounted) or previously missing items are re-discovered and not accounted for in the sales records.

The Sales Inventory Managment (SIM) system is responsible for handling these events. A key reason for this is the high cost of automation of the existing SIM processes (which becomes a preventative reason limiting automation), which involves manually scanning warehouse shelves for the numbers and types of the products in inventory. Coupled with low frequency of these scans (twice in one year per warehouse), the system inaccuracy compounds the errors with sales-reinforced demand planning besides introducing capacity constraints due to the finite storing capacity of the warehouses themselves.

What is the complication? Having understood the scope of our consideration in terms of the business units active and the possibility of the existing capability infrastructure, the attention now shifts towards asking what is the hold-up? Why are these issues not being addressed?

As mentioned previously, Nike does take into account the inaccuracies in sales as well as inventory data and seeks to address those through overcompensation of demand numbers. This strategy, although feasible in the short-run, is a band-aid at best. The recurring

losses and the cost of keeping up such an enterprise have led Nike to evaluate other options, including automating its inventory process in order to reduce redundancies and inaccuracies of process handling. Another appeal of this process, is ofcourse, the shorter time cycle (for receipt and delivery of items).

The complications associated with introducing changes to this system (SIM) has to do with the rigidity and the strong coupling of the various business functions (and their KPIs) with the existing system. Now, the model view of the KPIs for a team/ department with a function within the broader Nike supply chain is seen in the fig 5.1. Due to confidentiality concerns, the KPIs shared in this document are not for a specific Nike team and have been adapted from the SCOR model(2017) to introduce a generic flavour. The key theme however is an applicable and relevant figure.

With the introduction of new technologies such as that of the RFID, certain KPIs and metrics for those get affected due to the nature of the technology as well as figure 5.1.

Reliability	***Perfect Order Fulfillment***
	% Orders delivered in full
	Delivery item Accuracy
	Delivery Quantity Accuracy
Responsiveness	***Delivery Retail Cycle Time***
	Pick Product from Backroom Cycle Time
	Receive Product at Store Cycle Time
	Stock Shelf Cycle Time
Costs	***Direct Labour Costs***
	Indirect Costs Related to Production
	Costs of Goods Sold
Asset Management	***Days Sales Outstanding***
	Inventory Days of Supply
	Percentage Defective Inventory
	Percentage Excess Inventory
	Return on Working Capital
	Return on Supply Chain Fixed Assets
	Inventory

Figure 5.1: Nike's KPI after using RFID technology(*Adapted from (Apics, 2017)*)

The integration of RFID aims to provide inventory accuracy and reduction in labour hours. This relates to reliability and costs KPI's as shown in figure 5.1. The delivery item accuracy will then help in becoming more responsive to consumers demands and also keep a track of excess and defective inventory. Due to confidentiality of data these KPI's are taken from the literature and validated with the Nike analytics and RFID team. The chapter 6 will show the impacts on annual sales, and costs of sales by the introduction of these KPI's.

These KPIs not only affect the evaluation of team performance but infact also affect the

corporate policy and practices that are relevant when interfaced with business partners such as retailers and customers. Due to this dependency on the existing SIM system, it becomes necessary to evaluate the changes introduced to the system (by RFID) from within financial as well as operational point-of-view.

Finally, below is the list to indicate the nature and extent of complications with the existing SIM tool:

1. Low level of automation and frequency of scanning reduces accuracy and reliability of data. Efforts to digitize or automate the existing processes (without modifications) poses cost concerns as limited runway is available for innovation capital
2. The new processes should not deviate from existing process too much as the retraining required (for staff already trained with SIM procedures) will pose a cost of transition and adaptation
3. Uncertainity of expected improvements due to the introduction of the new process coupled with the time taken to implement the updates as a major release variant

What are the questions? Having outlined the major concerns regarding the current operating procedure and the complications associated with a transition therein, the questions for a candidate technology becomes generally, the feasibility, viability, and the desirability of such a change.

These bottlenecks are all interrelated and in order to reduce their effects an efficient inventory management tool is required. Nike identified that this can be alleviated by using RFID technology. The vision and value proposition for using the RFID technology is discussed in chapter 3. Nike deployed RFID tags for few stores and the results were impressive. But before discussing Nike's pilot, it is important to understand RFID as a capability at Nike. As the pilot's data can be used to understand Nike's expectation[**?**] [**?**].

5.2. RFID AS A CAPABILITY

This section starts with the characterization of RFID as a capability instead of a simple technological update that is commonplace in today's workplaces. RFID enabled inventory and logistics planning promises to be a force multiplier in the ability to sustain and efficiently conduct its supply chain operations.

The higher organization's strategic vision, in this case, converges or rather is aligned, with the local level developments and supports its adoption within the existing Nike business roles. This is reflected in the figure 5.2, were using The Open Group Architecture Framework (TOGAF), an overview is provided for the convergence of team roles, RFID as a capability and the business goals (both for the line of business, in this case, DTC as well as global cost centers —EMEA, North America, Greater China etc.).

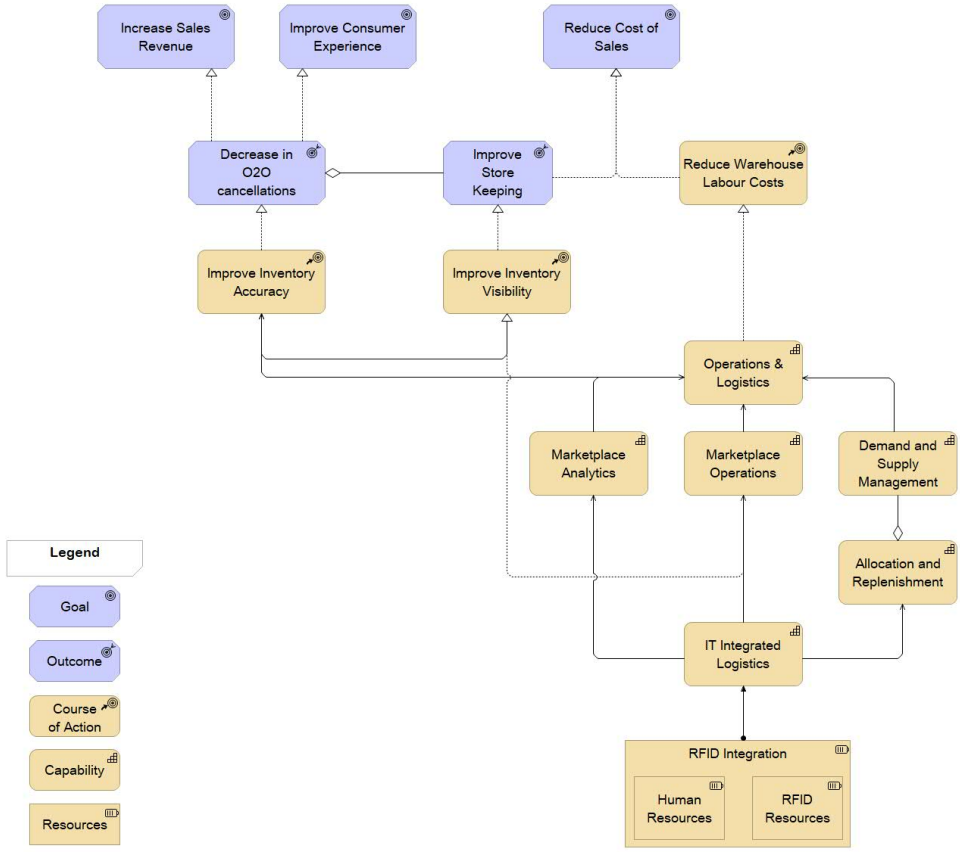

Figure 5.2: Overview of Nike's RFID strategy, showing a convergence of RFID integrated capabilties with global Nike goals. *(Adapted from Nike's RFID retail toolkit, 2019)*

As can be seen in this representation, the global strategic goals, (marked in purple) namely —increased sales revenue, improve customer responsiveness and reduce the cost of sales —align with the local planning and sales goals and are then supported (tentatively) by the stakeholders —Sales teams, Marketplace Operations (MPO) and Analytics (MPA) along with Demand and Supply Management (DSM) teams —as they use RFID-integrated planning methods.

The RFID-Integration resource (composed of personnel and technology) serves an IT system in charge of logistics. This system can be either a centralized repository or a node-locked interface. For our purposes, it is referred to as SIM2.0 (as the current inventory management system is called SIM). This capability, SIM2.0 encapsulates the RFID technology, and thus serves MPA, MPO, and DSM (through an aggregation of Allocation and Replenishment teams). All served capabilities in turn influence the sales capability of the organization.

These capabilities are aligned with the global strategic goals through two sequential process items, Outcomes (in purple) and Course of Action (in yellow). Thus, to achieve an increase in sales revenues, a decrease in Offline-to-Online (O2O) cancellations coupled with an increase in SKUs must occur. This course of actions will then lead to outcomes such as, increasing DTC revenues, improved inventory visibility, and thus improved inventory accuracy. On the other hand, the goal of reducing the cost of sales is served by the reduction of warehouse labour costs and increased inventory visibility as well.

Note that here, the goals, outcomes, and course of action broadly align with those seen previously for the case study of RFID in Macy's retail stores. This is due to the transferable nature of RFID benefits cascading through the existing supply and sales value chains within retail oriented organizations.

The architecture in figure 5.2 also shows the teams primarily affected with the integration of RFID technology in their current process. The Nike's RFID pilot study will discuss how are these outcome (purple color) observed. The purpose of the figure 5.2 is just to elaborate on Nike's vision and expected benefits for using RFID technology. Using the outcome, the next chapter is focused on the quantifying these benefits of increase in sales revenue, and reduction of labour costs.

With this perspective in mind, the following section looks into the pilot study and the subsequent analysis for RFID investment at Nike.

5.3. NIKE PILOT STUDY FOR RFID

In 2018, Nike piloted the use of RFID technology as a means of studying the benefits from its use in its existing sales and supply chain operations. This pilot was conducted over a duration of four months, beginning in February, and was implemented across six stores in North America and EMEA cost centers. These stores were a mix of Nike Owned Stores and Nike Factory Stores located at Groningen, Muiden, Seattle, Portland Mlk, Boston and Paramus.

The available metrics from the study are inventory accuracy, unit sales improvement, and reduction in labour hours. These metrics were themselves calculated over observations in changes of the following processes —label printing, receiving the products, stock counts, product search, replenishment, and display compliance.

Based on these observations, the following results can be summarized:

- Inventory accuracy —the actual performance of the RFID implementation over this indicator dramatically over-performed resulting into an increase to 95% inventory accuracy level instead of the 75% expected accuracy.

- Sales uplift —the expected increase in sales per unit was about 1-2% however, this increase was observed to be 4%.

- Labour hours —prior to the use of RFID-enable processes, the manual processes described previously took nearly 150 hours for full store count that was conducted once in six months. This dropped dramatically to 6 hours for a monthly cycle count (thus the checking frequency also increased), and thus to 36 hours over a six month period.

This improved inventory accuracy and visibility provided confidence to serve the consumers and enabled Buy Online Pick Up in Store (BOPUS) services. Thus, enabling these Nike stores to blend both online and in store shopping experiences. Furthermore, these results also enable multiple inventory counts, and rapid product search and provide efficiency for in-store operations.

5.4. NIKE'S VISION AND VALUE PROPOSITION ON USING RFID TECHNOLOGY

Nike's vision for RFID technology is to "*create a unique digital identity*" for all the Nike products. This holds true for all value streams, right from the production through consumer engagement. For improving the product visibility and inventory accuracy across the supply chain (product creation to point-of-sale), RFID will be implemented onto label tags and hang tags across all NFS, NSO, and other retail outlets. The company expects significant returns, enabled by improving customer service through responsiveness. The future plan is the integration of Quick Response (QR) codes with RFID tags. This technology will help to authenticate the Nike products and ensure delivery through authorized retailers (Nike RFID retail toolkit, 2019).

Recall the supply chain system at Nike discussed in section 3.2. Nike's vision is to improve the highlighted part to provide better service to Nike retail partners, factory stores, and webshops. This will help in understanding Nike's value proposition and vision on using RFID technology.

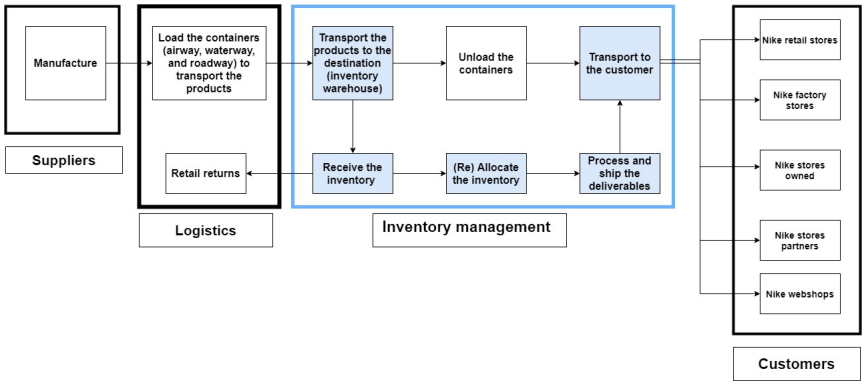

Figure 5.3: Nike's Supply Chain system (*Adapted from Nike's knowledge repository, 2020*)

Nike's value proposition is to serve the marketplace by ensuring "*the right product, at the right place and at right time*". The realization of this motto depends chiefly on successful tracking and fulfillment of order requests. A RFID-enabled tool adoption is expected to increase the confidence in product tracking leading to enhanced supply chain operations. This in turn cascades into selling more full priced products, and efficient operations like inventory count. Additionally, this allows for greater product availability to consumer preferences leading to increased responsiveness. Nike aims to achieve its value proposition through phased technology introductions as shown in figure 5.4,

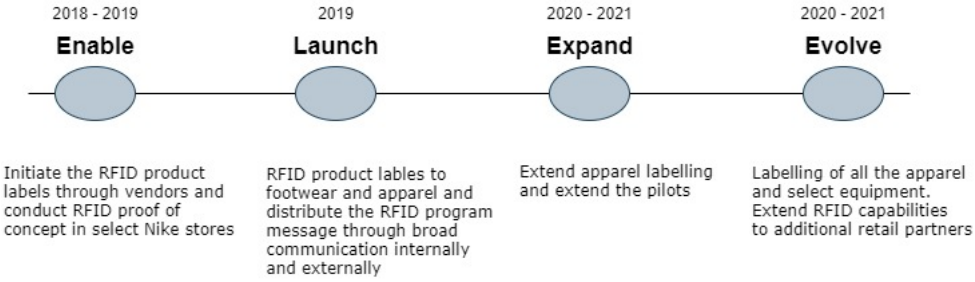

Figure 5.4: Nike's timeline for RFID implementation *(Adapted from Nike's RFID retail toolkit,2019)*

In the expansion strategy for the implementation of RFID tags, the footwear category with RFID tags will be rolled out 100% of tagged items whereas the apparel category will feature only 85% penetration. This difference is because packaging in footwear is uniform (in box sizes) making it easier to apply the RFID tags for footwear goods, however the difference in packaging shapes and sizes for apparels lead to difficulties in establishing complete RFID penetration (Nike retail toolkit, 2019).

5.5. CONCLUSION

Introducing RFID as a capability at Nike helped in understanding how Nike aims to achieve its objective. This chapter also helped in answering the fourth sub research question *How does Nike visualize its RFID technology integration journey?*. The RFID's pilot showed the current focus of the technology's implementation. Whereas, the vision and value proposition showed the timeline of RFID technology adoption. The next chapter shows the projections and analyse the intended benefits assuming the gains to stick for a period of three years (similar to the timeline observed in Macy's case study, after which the law of diminishing returns kicks-in). By showing the impact on inventory accuracy, labour hours reduction, and revenue projections as it was shown in Nike's RFID pilot.

6

MODELLING AND QUANTIFICATION OF RFID TECHNOLOGY AT NIKE

Thus far, the study has introduced the idea of Nike's roadmap for disrupting its supply chain through digital interventions and identified RFID integration as a major milestone towards a digital logistics future for Nike. In this chapter, this research will come to a close through the analysis of RFID integration at Nike, its impact on operations and other business processes, and set the tone for viewing this integration as a first step in the future roadmap of Nike's digitization of its supply and other value chains.

This chapter is divided into different sections. It might be quite overwhelming to understand the flow of the chapter. But, to make it simple here this section will discuss how this chapter progresses. The following section profit modeling shows how the profits are viewed at Nike by using RFID technology. This will be mainly done by showing an increase in the revenues through sales and a decrease in excess inventory. This constitutes the fifth sub research question *How to model implementation of RFID technology for quantifying the benefits.* It should be noted here, this model showcases benefits in terms of revenue generated through sales.

The next section discusses about different modes of opportunity loss. This section is important it will elaborate more on why overestimation of demand is selected to showcase RFID technology benefits in demand planning. This section derives equations for estimated revenue, inventory, and closeout inventory gains. These equations will be used in the calculation part.

The following section is about deriving equations to show improved inventory accuracy due to RFID technology. The purpose of this equation is when it is re-written it shows variance calculation. The following section elaborates more on sales upliftment due to RFID technology and derives the equation for *Revenue* calculation. This equation will

be used for calculating the increase in sales. This equation also includes the values of three different adoption rates. Since the RFID implementation is not a one day task, to analyze the different penetration strategy the s-curve approach is referred to. This provided different adoption rates for a time period of five years. Until here, all the equations are derived which will be used for quantifying the benefits of RFID technology. In the section 6.5, we will see the calculation for improved sales, and variance. Now, the final section shows the derivation and calculation of the reduction of labor costs.

Below is the short summary of the abbreviations used in the following sections,

R	**Revenue**
Ractual	Actual Revenue
Restimated	Estimated Revenue
I	**Inventory**
Iestimated	Estimated Inventory
Ifootwear	Footwear's inventory
Iapparel	Apparel's inventory
Iequipement	Equipment's inventory
V	**average values of goods in inventory**
Vfootwear	average values of footwear in inventory
Vapparel	average values of apparel in inventory
Vequipment	average values of equipment in inventory
Nworkers	**Number of total workers**
Nworkers,footwear	Number of workers for counting footwear
Nworkers,apparel	Number of workers for counting apparel
Nworkers,equipment	Number of workers for counting equipment
Nsold	**average order size**
Nsold,footwear	Order size for footwear
Nsold,apparel	Order size for apparel
Nsold,equipment	Order size for equipment
s	**Number of stores**
p	**Average price**
p(footwear)	Price of footwear
p(apparel)	Price of apparel
p(equipment)	Price of equipment

Figure 6.1: Summary of the abbreviations used for quantifying benefits

6.1. PROFIT MODELLING

Thus far the previous chapters explained that implementation of RFID technology is entirely new for Nike. The learnings from Nike's pilot(Nike's retail toolkit,2018) is given as below,

- Improved sales revenue by 4%
- Improved inventory accuracy (from 60% to 95%)

- Reduction in labour hours

This section has equations derived calculating the RFID improvements mentioned above. In order to show the profit estimation, the strategic model framework is adapted. The strategic profit modeling shows how the decisions made in a company affect the Return on Assets (ROA), and Return on Net Worth(RONW) (Stapleton & Hanna, 2002). The article *Measuring logistics performance using strategic profit model (2002)*, mentions that the strategies Nike can use to increase their ROA are, to increase the sales, decrease the expenses, and/or reduce the assets (Stapleton & Hanna, 2002). In this research, the focus is on increasing the revenue through sales, cost savings due to the decrease in reserved buffer inventory stocks, reducing the labour costs (expenses). The following figure shows the diagrammatic way of how this can be achieved. The figure shows how the first two points will be achieved. The reduction in labour costs is due to less number of hours spent on manual counting of inventory in the warehouse this is explained in detail in section 6.4. It should be noted that the figure is adapted from the strategic pricing model (2002).

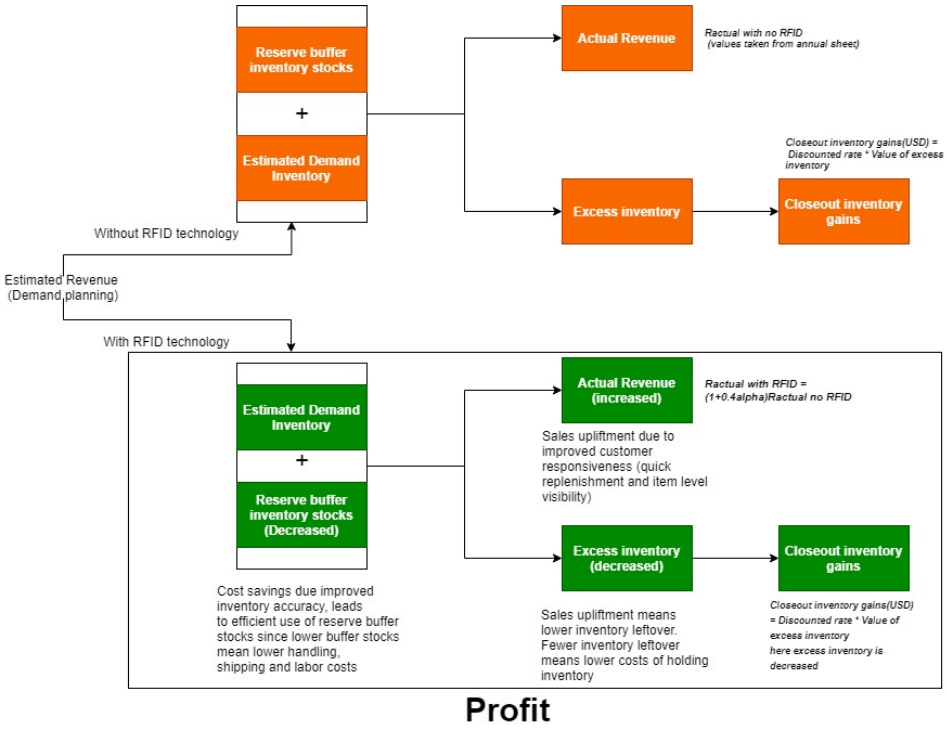

Figure 6.2: Flowchart of profit modelling at Nike after integration of RFID technology *(Adapted from discussions on RFID technology implementation, 2020)*

The figure is read from the left side. The cost savings will be seen when the reserve buffer stocks are lowered due to improved inventory accuracy. Further, this accurate inventory

is then distributed to the retail outlets. Here, the sales upliftment is observed because of the quick responsiveness towards end customers because of quick replenishment activity and item level visibility of each Nike product. It will give Nike an increase in the actual revenue because of RFID technology (shown in green color). Along with this, the sales upliftment will also show lower inventory leftover, and hence the costs associated with holding excess inventory will also be less.

The following sections will elaborate more on how these benefits are achieved. It starts with first explaining why the scenario of over estimation of demand is selected for this research. Followed by the section where the terms like estimated revenue, actual revenue, value of excess inventory, value of total inventory, demand, and closeout inventory gains are defined. The next section shows the derivation of the equations for the variance and sales upliftment. As the implementation of RFID is not a single day task, the next section discusses how the technology diffusion takes place by referring to the s-curve technology diffusion concept. This will provide the adoption rate of RFID for different strategies namely moderate, cautious, and rapid adoption strategy.

Now, all the calculations for revenue projections, variance are shown in section 6.3. For calculating the decrease in labor costs section 6.4 shows the derivation of the equation and calculation of labour costs.

6.2. MODELING RFID IMPLEMENTATION AT NIKE

To begin this analysis, the modeling approaches used for evaluating the benefits of RFID are understood. As has been seen in previous chapters, the RFID integration into the supply chain systems led to an increase of inventory visibility (even at the item level as opposed to stock-type level such as those obtained with EPCs), near-continuous tracking of shipments within and outside of the warehousing lanes as well as improved data accuracy of sales as recorded from a consolidation of point-of-sales systems and back-end warehouse inventories. These factors then lead to improved decision making and planning processes for Nike and thus lead to a reduction of the effective operational overhead as well as improved sales revenue estimation.

These benefits can now be concretized in a tangible metric such as financial gains from improved sales records and reduction of cost of operation for Nike. These metrics are identified as having the closest relationship towards the back-end supply to front-end shop level sales dynamics that can be identified with a direct relationship with RFID integrated supply chains. The dynamics of evaluating how RFID integration leads to improved sales revenue and reduced labour costs are now explained, following which a mathematical model is presented.

6.2.1. MODES OF OPPORTUNITY LOSS

Understanding the manners in which demand planning, and therefore the consequent sales revenue estimation may fall short of the actual performance is now explored as the mode of opportunity loss, opportunity referring to the possibility of making an extra sale. Although there may be multiple factors that may affect the shopping behavior of consumers, such as, means of communication (online buying, franchise retail purchases, retail outlet purchasing), price point competitions (high-end products serve a different segment whereas lower-priced products have different competition dynamics relying on product substitution effects), availability of stores and others, the primary assumption in this analysis is kept simple —whether or not Nike demand planning is able to estimate enough availability of stocked inventories to minimize losses while maximizing sales revenues.

Naturally, this exercise (of demand planning) does consider the aforementioned factors, however, there still remains the complexity of estimating stock availability of each category of products within a certain portfolio segment (*i.e.* different types of footwear offering *viz.* casual, lifestyle, sports, and their own subcategories). This demand planning activity is then understood to be executed through two different modes, that is through either over-estimating or under-estimating the actual demand of the products at hand. This estimation error leads to two possibilities—out-of-stock positions in the case of underestimated demand scenario (where actual demand exceeds estimated demand) or overstocked inventories with losses due to maintenance of stocks and overhead of labour costs.

As an example consider the following quotation 6.2.1, where the impact of increasing inventory write downs and sale of excess inventory at discounted prices and its adverse effect on the brand image is highlighted:

> **Failure to accurately forecast consumer demand could lead to excess inventories or inventory shortages, which could result in decreased operating margins, reduced cash flows and harm to our business.** To meet anticipated demand for our products, we purchase products from manufacturers outside of our futures ordering program and in advance of customer orders, which we hold in inventory and resell to customers. There is a risk we may be unable to sell excess products ordered from manufacturers. **Inventory levels in excess of customer demand may result in inventory write-downs, and the sale of excess inventory at discounted prices could significantly impair our brand image and have an adverse effect on our operating results, financial condition and cash flows**. Conversely, if we underestimate consumer demand for our products or if our manufacturers fail to supply products we require at the time we need them, we may experience inventory shortages. **Inventory shortages might delay shipments to customers, negatively impact retailer, distributor and consumer relationships and diminish brand loyalty**. The difficulty in forecasting demand also makes it difficult to estimate our future results of operations, financial condition and cash flows from period to period. A failure to accurately predict the level of demand for our products could adversely affect our net revenues and net income, and we are unlikely to forecast such effects with any certainty in ad-

vance.

— *p. 77, Nike 10-K Form (Part I), 2019*

Consideration of the out-of-stock position scenario leads to some difficulty in modeling available data. Primarily this is due to the lack of systematic and decentralized data gathering systems, due to which Nike relies on combining actual market performance and its own data collection through point-of-sales sources, which do not yet enjoy the benefits of RFID enabled integration and therefore increased inventory accuracy. Thus this data becomes unreliable to quantify an opportunity loss of sales wherein the purchase of items with no previous sales records (eg. unmarked items which did not sell the previous season or reduced number of available items due to theft), and only available metric would be to identify the number of markdowns requested for replenishing inventory stocks. These data points are not readily available for the scope of this study and require deeper analysis for RFID integration for different retail stores in varied supply chain segments. As such, this particular mode of opportunity loss is not explored or modeled mathematically.

The other mode of opportunity loss, is through overestimation of demand and thus sales revenue estimation. In this scenario, the demand planning overestimates the demand and thus increases operational overhead through the increase of non-performing inventory stocks (i.e. the inventory that does not get sold). Furthermore discounting the event of misplaced or missing items from this unsold inventory, Nike seeks to salvage the value of these goods through the means of 'closeout' of inventory stocks. Closeout here refers, to the selling of these unsold inventories at a discounted price and thus minimizing losses of no sales. Although many modes of closeout do exist, for this research the focus is on single-channel closeout mechanism, that is the Nike Factory Stores (NFS) sales wherein discounted goods are sold at 70% markup rates of the original selling price (note that this analysis may vary for different market segments, that is, high-end products would likely not be sold discounted and not every region would have the same distribution of these factory outlets).

6.2.2. OVER-ESTIMATION OF SALES REVENUES

Due to the overestimation of the demand and thus, sales revenue there leads to increased overhead costs as a result of unsold excess inventory. This cost of excess inventory is then taken as a marker towards the value of the excess goods throughout the sales lifecycle (design, manufacturing, shipment, warehousing, and store display) and can be added to the actual revenue obtained through sales in order to build back the figure of an estimated sales revenue. This can be written as:

$$R_{\text{estimated}}\ (\text{USD}) = R_{\text{actual}}\ (\text{USD}) + \text{Value of Excess inventory (USD)} \tag{6.1}$$

Kindly note, in the above equation $R_{(\text{estimated})}$ gives the value of the revenue because of all the available inventory. where, $R_{\text{estimated}}$ and R_{actual} denote the estimated and actual sales revenue (in USD millions) respectively. For the purposes of this publication, data has been gathered through public sources (`10K Financial Statements` from Nike) and certain broad relationships between different metrics created after consultation with the relevant personnel at Nike.

The actual sales revenue is classified among different categories:

- *Product types* —footwear, apparel, equipment and global brand divisions (not considered a part of Nike Brand revenues and not considered in this study)
- *Retail store types* —Brand Factory Stores, Brand in-line stores, Converse stores, Hurley stores and e-commerce sales
- *Nike revenues by sales channels* —sales to wholesale customers, through NIKE Direct, and Global Brand Divisions

Depending on the application and the purposes of the RFID integration effects, the actual revenues are computed for different purposes. The quantification of the revenue (both estimated and actual) is also possible when the number of stocks in inventory are taken into consideration. The inventory estimates of stocks of goods are then denoted with I_{footwear}, I_{apparel} and $I_{\text{equipment}}$, such that for an annual estimation of demand (number of items), I, the following holds:

$$I_{\textbf{estimated}} = I_{\text{footwear}} + I_{\text{apparel}} + I_{\text{equipment}} \tag{6.2}$$

Kindly note, here the estimation of inventory I consist of the total value of inventory. The estimated revenues in different product categories can then be computed as a product of these number of items and the average net realizable value of the product type. That is, for instance, the net average value of all footwear products when denoted by V_{footwear} (US Dollars per unit), the estimated revenue for footwear sales are given as $I_{\text{footwear}} \times V_{\text{footwear}}$. Similarly, the individual estimated revenues for all product types can be computed using the same method.

$$\begin{aligned}
R_{\textbf{estimated (footwear)}} &= I_{\text{footwear}} \text{ (no. of units)} \times V_{\text{footwear}} \text{ (USD per unit)} \\
R_{\textbf{estimated (apparel)}} &= I_{\text{apparel}} \text{ (no. of units)} \times V_{\text{apparel}} \text{ (USD per unit)} \\
R_{\textbf{estimated(equipment)}} &= I_{\text{equipment}} \text{ (no. of units)} \times V_{\text{equipment}} \text{ (USD per unit)}
\end{aligned}$$

The actual inventory stocks that are required for real demand scenarios, are then denoted as D_{actual} for different product types. For instance, for footwear the number of

stocks of goods in actual demand can be denoted by $D_{\text{actual,footwear}}$, such that the summation of all number of stocks of goods of type footwear, equipment and apparel gives the total actual demand. Although it is understood that the estimation of the inventory stock volume for expected revenue (demand) is either higher or lower than the actual inventory stock volume used, an assumption is made such that there is a fixed ratio of the estimated inventory volume of a certain product type to total inventory volume. For example, if the estimate of the footwear demand turns out to be 60% of total estimated inventory of all Nike product types, this ratio is considered to be the same for actual footwear inventory volume to the total inventory volume of all product type.

Furthermore, the consolidated statement of cash flow provides the *lower of cost or market adjusted costs of all the inventories* with Nike at the end of a financial year, listed as `Inventories`.

It is to be noted here that for a `10k` declaration of financial statements, **these inventories are listed using the 'Last-In, First-Out' (LIFO) cost flow assumption wherein the most recent products added to a company's inventory are assumed to have been sold first. These values, when taken to be the net realizable value of the inventory goods leftover, are then used to compute the inventory closeout amount as means to salvage value of the overestimated demand**.

These closeout gains, as explained above (Nike 10k declaration), are then computed as shown with the simple equation below:

$$\begin{matrix}\text{Closeout}\\ \text{Inventory Gains}\end{matrix}\ (\text{USD}) = \text{Discounted rate} \times \begin{matrix}\text{Value of excess}\\ \text{inventory}\end{matrix}\ (\text{USD}) \tag{6.3}$$

Kindly note the standard equation for calculating closeout inventory may vary. This equation is derived on the basis of Nike's definition of closeout inventory gains. These closeout inventory gains are the gains listed as those under Inventories (assuming complete closeout sales, which is clearly not suited for a real world situation). The discounted rate as mentioned previously is assumed to be at a 70% markup of the item costs. This allows for a computation of the value of excess inventory, which then leads to the computation of the estimated revenues (equation 6.3)

6.3. IMPROVED INVENTORY ACCURACY DUE TO RFID

In order to assess the improvement in inventory accuracy due to the use of RFID, the measure of inventory accuracy must be prepared first. For doing this, the inventory accuracy (IA) ratio (David Weedmark, 2018)is defined as:

$$\text{Inventory accuracy} = 1 - \frac{(\text{variance})}{(\text{value of total inventory})} \tag{6.4}$$

For understanding the financial perspective of inventory accuracy, the above formula is used. There are different equations available for calculating the inventory accuracy. But since the available value is only of inventory accuracy with and without RFID and the value of total inventory can be calculated, this equation is used for calculaing the variance in a simple way. The value of inventory accuracy is already known, this will help in calculating variance. This equation is used for calculating the value of variance. Where, the term *variance* is used to express the net deviation of the total value of inventory (in USD) from the mean or estimated *value of total inventory* (also, in USD). Using this relationship as defined above, the variance estimate in currency terms [1] can be defined as:

$$\text{Variance} = (\text{value of total inventory})[1 - \text{IA}] \tag{6.5}$$

For the current state of operations at Nike, the inventory accuracy was provided as 60% or 0.60 by Nike's own estimates (based on interviews with Nike personnel). This measure was expected to improve with the use of RFID, with the expectation that inventory accuracy would be improved to 0.75, however, during pilot evaluations done by Nike it emerged that inventory accuracy actually increased to 0.95 which was significantly higher than expected even by Nike's own estimates. The quantitative estimates of these improvements in variance as a result of improved inventory accuracy will be presented in the following sections.

6.4. SALES UPLIFT DUE TO RFID

Due to the implementation of RFID within its inventory stockpiles, it becomes easier to gain insights into the item level presence and visibility. This allows for increased accuracy of sales data though point-of-sales database, stocking accuracy, and lower time to scan leading to unit sales pickup.

This is reflected in a 4% sales uplift for an inventory stockpile fitted with RFID (a significant edge over the expected sales uplift of 1-2%). Assuming that a segment of inventory stock is RFID enabled, that particular segment is assumed to show a 4% sales uplift. Thus, consider that a percentage amount (α) of all inventory across product type is enabled with RFID, then the actual revenue witnesses an uplift of 4%, leading to an increase in total actual revenues, as shown:

$$R_{\text{actual, with RFID}} = (1-\alpha)R_{\text{actual, no RFID}} + \alpha(R_{\text{actual, no RFID}} + 0.04R_{\text{actual, no RFID}})$$

thus, this expression becomes:

[1] note here that although for the purposes of discussion, the terms variance and value of total inventory are measured in USD, the numbers used later are based on currency-neutral calculations provided by Nike.

$$R_{\text{actual, with RFID}} = (1-\alpha)R_{\text{actual, no RFID}} + \alpha(1.04R_{\text{actual, no RFID}})$$

or simply,

$$R_{\text{actual, with RFID}} = (1+0.04\alpha)R_{\text{actual, no RFID}} \tag{6.6}$$

6.4.1. MODELLING RFID PENETRATION

The implementation of RFID within Nike's global supply chain is expected to be a process initiated at the top management level and completed over a period of 5 years. The primary goals of such an investment being reduction of operational costs and protected earnings (possibly improvement of sales revenues). These metrics have already been discussed in the previous chapter. For the purposes of this analysis, the penetration of the RFID technology is modeled using the mathematical model that is used to model the disruption of new technology. This model is referred to as the 's-curve' model which shows the model of technology "diffusion" within a given system wherein a process is depicted to have a slow start, then gradually gathers pace until fast growth until it saturates at which point the diffusion slows down and finally plateaus (Brown,1992)

Similarly, this s-curve can also be used in order to show development models of growth wherein a superimposed series of s-curves shows the cyclic nature of slow-to-fast-to-saturation growth cycles, ultimately reaching the final stages of growth. When aggregated this model then reflected an enveloped s-curve. In the present analysis, the s-curve is assumed to have been implemented within each cost center such as Europe, Middle Eastern and Africa (EMEA), North America, South America, Emerging markets —greater China and India as well as Japan.

The aggregation of these adoption models is then assumed to form another s-curve globally, however, for the sake of simplicity, this superposition has not been performed (for different adoption rates in each cost center) and a uniform adoption model is assumed overall cost centers and global supply chains. Note that this assumption is ideal and not well suited for real-world implementation since there are complexities associated with actually implementing RFID at a uniform rate across different cost centers owing to geographical, economic, and logistical factors.

The model equation describes the growth in RFID tagged items in an inventory stockpile (referred to as penetration rate, α) and described by the following equation:

$$\alpha(t) = \alpha_{\min} + (\alpha_{\max} - \alpha_{\min})\left[\frac{1}{1+e^{-k(t-t_o)}}\right]^a \tag{6.7}$$

$$\tag{6.8}$$

here, the terms t denote the time (in years) across which the growth of this penetration rate is measured. t_o refers to the initial starting point of the growth model, for this that

would be the year where the implementation of the RFID technology starts. The difference $t - t_o$ then describes the time elapsed since the introduction of RFID tags within the inventory stockpiles. Parameters a and k denote the exponential growth configurations which determines how the growth rate of the RFID adoption behaves (*i.e* when it plateaus and when the rate picks up speed). Finally, the terms $\alpha_{\max}$ and $\alpha_{\min}$ denote the maximum and minimum target adoption rate that is expected or intended for the RFID implementation.

This model can then be assumed for footwear and apparel separately, with different maximum and minimum adoption targets. Furthermore, in order to study the effect of different adoption strategies, the exponential growth parameter set (k, a) are also varied for three different scenarios, namely —conservative/cautious adoption $(k = 1.0, a = 0.5)$, moderate adoption $(k = 1.5, a = 0.5)$ and rapid adoption $(k = 2.0, a = 0.5)$ models. The cautious adoption model, as the name suggests shows a longer period of slow growth which is followed by a fast growth rate that lasts until the saturation point is almost reached before the target period (of 5 years for RFID implementation) runs out. On the other hand, the rapid adoption model depicts almost no slow growth period and very quickly reaches the saturation period, that is achieves the required RFID implementation level (by the 4 year end mark). Finally, the moderate adoption model, as the name suggests does a balancing act between the two approaches and comfortably reaches the adoption criteria by the end of the estimated implementation window of 5 years.

These models and their respective growth rates also depend on the benchmark or target penetration rates decided by Nike. For the product type footwear, the penetration rate is configured for a maximum rate of penetration of 100% with a minimum penetration of 50%. On the other hand, the penetration rates for apparel are configured between 80% and a minimum penetration of 80%. Accordingly, the growth rates for the rapid approach (**I**), moderate approach (**II**) and cautious approach (**III**) are shown below in Tables 6.1 and 6.2 for footwear and apparel segments, respectively:

Table 6.1: Adoption rate for different strategies, for footwear items

Time (in Years)	1	2	3	4	5
Adoption Rate I (α)	0.8536	0.9693	0.9955	0.9994	0.9999
Adoption Rate II (α)	0.8536	0.9521	0.9880	0.9972	0.9994
Adoption Rate III (α)	0.8536	0.9275	0.9693	0.9880	0.9955

Table 6.2: Adoption rate for different strategies, for apparel items

Time (in Years)	1	2	3	4	5
Adoption Rate I (α)	0.7121	0.7816	0.7973	0.7996	0.7999
Adoption Rate II (α)	0.7121	0.7713	0.7928	0.7983	0.7996
Adoption Rate III (α)	0.7121	0.7565	0.7816	0.7928	0.7973

A graphical representation of the model growth rates or penetration rate is also shown following these values in Figures 6.3 and 6.4 for footwear and apparel segments, respectively.

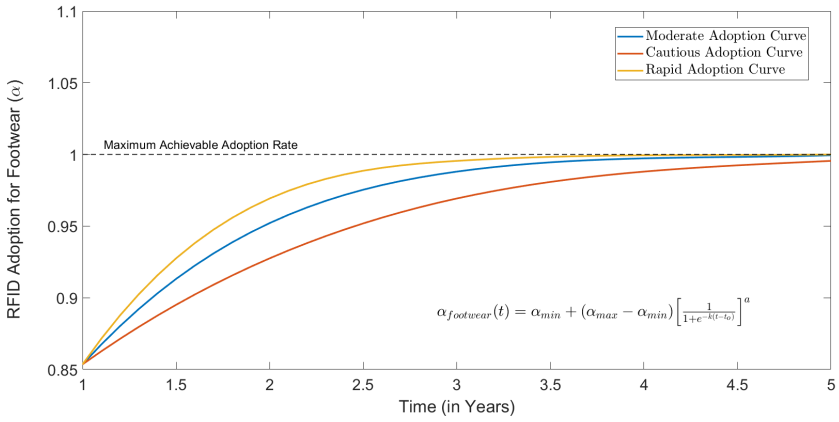

Figure 6.3: Model adoption rate for RFID in footwear segments shown for three different strategies, *viz.* a rapid (**I**), moderate (**II**) and a cautious (**III**) approach.

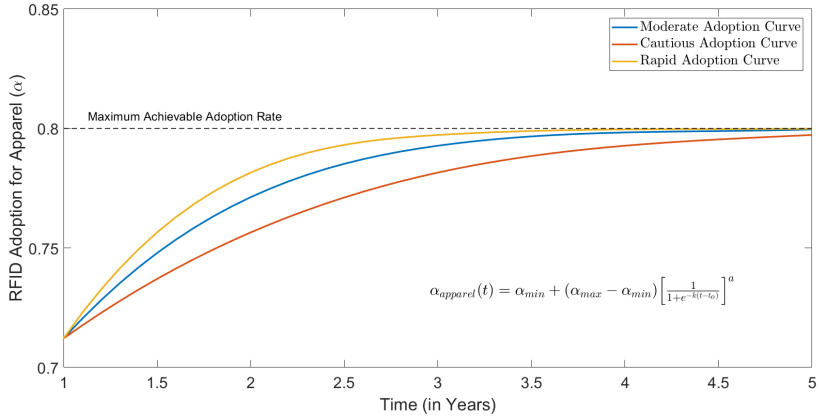

Figure 6.4: Model adoption rate for RFID in apparel segments shown for three different strategies, *viz.* a rapid (**I**), moderate (**II**) and a cautious (**III**) approach.

These penetration rates are now used to understand the improvement in sales uplift and the revenue increase in order to assess comparison with the potential Nike investment as time proceeds. Note here that this model is used to assess the revenue modeling that is the protected corporate earnings, but not extended into the modeling of cost reductions since the assessment requires many assumptions(this is elaborated later), making this adoption model analysis less useful.

6.5. REVENUE PROJECTIONS FOR IMPROVED SALES WITH RFID

As seen thus far, the adoption models are combined with models of sales uplift which leads to increased revenue due to sales, and following improvements in the variance of the estimated value of total inventory are now examined. In order to do this, following from equation 6.5 the value of total inventory is defined using values from estimated revenues from sales, thus giving the equation:

$$\text{Variance} = (\text{value of total inventory})[1\text{-Inventory Accuracy}]$$

In order to assess these values and the impact of RFID integration, calculations are performed by using the consolidated financial statements for the FY 2015-19. This leads to the computation of the improved actual sales revenue, and variance in dollar terms as shown in Table 6.4 and 6.5 for footwear and apparels respectively.

Now, for calculating the value of improved revenue sales the following equation is used 6.6,

$$R_{\text{actual, with RFID}} = (1 + 0.04\alpha) R_{\text{actual, no RFID}}$$

For calculating improved sales for the year 2015, the value of alpha = 0.8536 (table 6.1). This gives the value of $R_{\text{actual, with RFID}} = 18943.45$ Similarly, the improved sales revenue values is calculated for FY2016 - FY2019 for all the three adoption strategies (given in table 6.3 as improved sales revenue (in USD million)).

Now to calculate the variance from table 6.3 the equation is derived as follows,

Recall from equation 6.3, the value of variance is given as ,

$$(\text{Variance}) = (1\text{- Inventory Accuracy}) * (\text{Total value of inventory})$$

By referring to three major points discussed in profit modeling, the inventory accuracy achieved by RFID is 95%. The current inventory accuracy of Nike is somewhere around

60%. Now by referring to the s - curve adoption of RFID technology(adoption rate α), to achieve the 100% implementation for footwear and apparel will take time. The value of alpha i.e the RFID penetration will change for different strategy. So, for example, if α value of inventory has RFID tags it will give 95% of accuracy, and (1- α) without RFID tags will give 60% accuracy. So, the equation to calculate variance will be,

$$(1-0.6)[(1-\alpha)R_{(\text{estimated})}] + (1-0.95)[(\alpha)R_{(\text{estimated})}] \tag{6.9}$$

Now, to calculate $R_{\text{estimated}}$, the equation 6.3 is used here. For simplicity also written below,

$$R_{\text{estimated}}\ (\text{USD}) = R_{\text{actual}}\ (\text{USD}) + \text{Value of Excess inventory (USD)}$$

For calculating the value of excess inventory we use the equation 6.4. For simplicity also written below

$$\begin{matrix}\text{Closeout}\\ \text{Inventory Gains}\end{matrix}\ (\text{USD}) = \text{Discounted rate} \times \begin{matrix}\text{Value of excess}\\ \text{inventory}\end{matrix}\ (\text{USD}) \tag{6.10}$$

The above equation will give the value for excess inventory. Recall from previous section, the discounted rate is the rate at which the excess inventory i.e. inventory in Nike Factory Stores is sold at 70% discount on the actual price. For closeout inventory, It is to be noted here that for a 10k declaration of financial statements, **these inventories are listed using the 'Last-In, First-Out' (LIFO) cost flow assumption wherein the most recent products added to a company's inventory are assumed to have been sold first**. **These values, when taken to be the net realizable value of the inventory goods leftover, are then used to compute the inventory closeout amount as means to salvage value of the overestimated demand**.

Using these two values, the value of excess inventory is calculated by using equation 6.3. By rearranging the equation, the value of excess inventory is calculated as below,

$$\frac{\begin{matrix}\text{Closeout}\\ \text{Inventory Gains}\end{matrix}\ (\text{USD})}{\text{Discounted rate}} = \begin{matrix}\text{Value of excess}\\ \text{inventory}\end{matrix}\ (\text{USD}) \tag{6.11}$$

For the FY2015-FY2019, the values of closeout inventory gains and calculated value of excess inventory is given below,

The above table provides the value of excess inventory. As mentioned before the value of $R_{\text{estimated}}$ is calculated by using 6.1. This value of $R_{\text{estimated}}$ will be used for calculating variance by using equation 6.9. For this, the value of excess inventory from the table

Table 6.3: Calculating values for excess inventory by using closeout inventory gains

FY	Closeout Inventory gains (in USD millions from 10k financial data)	Value of excess inventory (in USD million)
2015	4337	6195.71
2016	4838	6911.42
2017	5055	7221.42
2018	5261	7515.71
2019	5622	8031.42

above is used and improved sales revenue from table 6.3. The calculated values for improved sales revenue and variance is given as below:

For calculating variance for EMEA regions estimated revenue for EMEA is used. By referring to equation 6.1 estimated revenue is calculated. But the value of excess inventory for EMEA is not provided separately. Here the assumption is that, excess inventory of EMEA and global are directly proportional to each other and actual total revenue of EMEA and global are directly proportional to each other. This then provides the equations for solving excess inventory for EMEA,

$$\text{(Excess inventory for EMEA)} = \text{(Excess inventory global)} \times \frac{\text{(Actual total reveneue at EMEA)}}{\text{(actual total revenue at global)}} \tag{6.12}$$

By using equation 6.3 and 6.13, the value for $R_{(estimated)}$ for EMEA is calculated and then it is used for calculating variance for EMEA regions table 6.3.

The same method is used for calculating values in table 6.4. Here the value of α is used from tables 6.1 and 6.2.

As discussed in section 6.1, the below table uses the over arching equation 6.1 for showing the improvement in sales revenue due to RFID implementation for footwear (global and EMEA) and apparel (global and EMEA),

This is to be noted that the improved values may vary but relatively not much than the calculated values. Because these are the ideal mathematical derivation and the values may vary due to unexpected pandemic like crisis.

The revenues from EMEA and the respective calculation follow the same setup as was done for global revenues and variance estimates from equation 6.10. It can be seen here that the improved revenue sales is ofcourse highest for the rapid adoption strategy, con-

Table 6.4: Sales Revenue Estimates for FY 2015-19—Global operations (top) and EMEA operations (bottom) for footwear

FY	Actual Sales Revenue (in USD million)	Improved Sales Revenue (in USD million)[1]			Variance [2,3]		
		I	II	III	I	II	III
2015	18318	18943.45	18943.42	18943.42	2545.08	2545.08	2545.08
2016	19871	20641.438	20627.77	1673.69	1484.08	1838.65	2074.29
2017	21081	21920.445	21914.12	21898.31	1502.98	1579.146	1768.87
2018	22268	23158.186	23156.27	23148.03	1540.136	1563.75	1661.97
2019	24222	25190.783	25190.28	25186.50	1662.27	1668.05	1713.21

FY	Actual Sales Revenue (in USD million)	Improved Sales Revenue (in USD million)[1]			Variance [2,3]		
		I	II	III	I	II	III
2015	4703	4863.58	4863.57	4863.57	750.42	750.54	750.54
2016	4867	5055.70	5052.35	5047.57	464.32	510.34	576.12
2017	4995	5193.90	5192.40	5188.66	409.78	430.63	482.76
2018	5875	6109.86	6109.35	6107.18	469.84	476.90	507.17
2019	6293	6544.69	6544.56	6543.58	497.97	499.78	513.36

[1] *Assuming a constant sales uplift of 4% per unit adoption rate increase.*
[2] *Inventory accuracy for stocks with RFID is taken to be 95%, and a default of 60% unless specified otherwise*
[3] *Variance computed assuming losses due to over-stocking (higher expected sales revenue)*

sistent with the sales uplift connected with the higher proportion of RFID penetration in the inventory stockpile. Similarly, the cautious approach has a slow initial growth phase of RFID penetration and this reflects in the slow pickup in the improvement in sales revenue. This study becomes more informative when studied in comparison with the investment plan for RFID integration. However, at this point, that information is not available from Nike and is not presented in the current analysis.

Figure 6.3 compares the improved sales revenue (total) of all three strategies with respect to each other. This is done to better illustrate the data provided in tables 6.4 and 6.5 and cumulatively assess their collective impact. The figure shows an expected trend, taking the improved sales gain from the moderate strategy (**II**) as the median strategy, the rapid and conservative strategies are evaluated in terms of how much the improved sales revenue deviates from the moderate strategy. As expected, strategy **I** shows large initial gains as compared to the median strategy benchmark whereas the sales improvement due to the cautious strategy trails behind. Note here that the negative values associated with strategy **III** do not mean losses for Nike (as can be seen in tables 6.5 and 6.4 the revenues from RFID for strategy **III** are greater than that for no RFID scenario), instead, this implies lower growth of improved sales revenues compared to strategies **I** and **II**

Table 6.5: Sales Revenue Estimates for FY 2015-19—Global operations (top) and EMEA operations (bottom) for apparel

FY	Actual Sales Revenue (in USD million)	Improved Sales Revenue (in USD million)[1]			Variance [2,3]		
		I	II	III	I	II	III
2015	8636	8882.00	8882.00	8882.00	1589.32	1589.32	1589.32
2016	9067	9350.45	9346.72	9341.37	1407.72	1449.88	1507.44
2017	9654	9961.88	9960.15	9955.80	1432.48	1451.09	1497.71
2018	10733	11076.30	11075.75	11073.36	1574.38	1580.25	1605.70
2019	11550	11919.58	11919.43	11918.35	1687.24	1688.82	1700.33
FY	**Actual Sales Revenue (in USD million)**	**Improved Sales Revenue (in USD million)[1]**			**Variance [2,3]**		
		I	**II**	**III**	**I**	**II**	**III**
2015	2050	2108.39	2108.39	2108.39	487.08	487.08	487.08
2016	2091	2156.37	2155.51	2154.27	415.28	427.11	444.07
2017	2339	2413.59	2413.17	2412.12	449.99	455.84	470.48
2018	2940	3034.04	3033.89	3033.23	562.53	564.63	573.72
2019	3087	3185.78	3185.74	3185.45	585.94	586.49	590.49

[1] *Assuming a constant sales uplift of 4% per unit adoption rate increase.*
[2] *Inventory accuracy for stocks with RFID is taken to be 95%, and a default of 60% unless specified otherwise*
[3] *Variance computed assuming losses due to over-stocking (higher expected sales revenue)*

(median benchmark).

Figure 6.5 shows the phased difference in improved sales revenue as a result of different strategies of adoption. As can be seen that for strategy **I**, for rapid growth of adoption, there is significant potential for improved revenue sales, however, this would also mean a proportional share of the total investment budget for the implementation of RFID systems. Similar adjustments can be made for other strategies as well.

As can be seen from this figure, the improved sales revenue for strategy **III** catches up with the median and rapid sales revenues over time as the saturation for the other two strategies approaches (by 2023). Note here that the calculations for the annual sales revenue for 2020-23 were done based on extrapolated data from the FY 2015-19 sales data in an to attempt maintain the same trend. Ofcourse variation in market factors, especially compounded by the slowdown in global markets witnessed in 2020 due to the Coronavirus pandemic, will affect the applicability of these projections. Those factors are not accounted for here.

Based on the modeling approach shown previously, the results from the available financial data is observed. Figure 6.6 shows the adjusted sales revenues for Nike Brand prod-

Table 6.6: Benefit in sales revenue due to RFID implementation for footwear(Global operations top and EMEA operations bottom)

FY	Actual Sales Revenue (in USD million)	Improved Sales Revenue (in USD million)[1]			Increase in sales		
		I	II	III	I	II	III
2015	18318	18943.45	18943.42	18943.42	+625.45	+625.42	+625.42
2016	19871	20641.438	20627.77	20611.74	+770.438	+756.77	+740.74
2017	21081	21920.445	21914.12	21898.31	+839.445	+833.12	+817.31
2018	22268	23158.186	23156.27	23148.03	+890.186	+888.27	+880.03
2019	24222	25190.783	25190.28	25186.50	+968.783	+968.28	+964.5
FY	**Actual Sales Revenue (in USD million)**	**Improved Sales Revenue (in USD million)[1]**			**Increase in sales**		
		I	**II**	**III**	**I**	**II**	**III**
2015	4703	4863.58	4863.57	4863.57	+160.58	+160.57	+160.57
2016	4867	5055.70	5052.35	5047.57	+ 188.7	+185.35	+180.57
2017	4995	5193.90	5192.40	5188.66	+198.9	+197.4	+193.66
2018	5875	6109.86	6109.35	6107.18	+234.86	+234.35	+234.18
2019	6293	6544.69	6544.56	6543.58	+251.69	+251.56	+250.58

ucts for the FY2015-19 for the moderate adoption strategy (**II**). For these adjustments, it has been assumed that there was 100% penetration of RFID tagging within the footwear portfolio and 80% penetration within the apparel segment and none in the equipment line. This resulted in a best case sales uplift of nearly 4% in unit sales for those items tagged with RFID chips.

6.6. REDUCTION OF LABOUR COSTS

As has been mentioned previously, the introduction of RFID leads to the improvement of inventory accuracy, improved sales revenues and reduction of labour costs. The first two impacts have been assessed thus far. Now the third impact is examined for the implementation of RFID in Nike. Before this is done, it is to be noted here that the mathematical model used here makes use of many more assumptions, some of which may be arbitrary in nature and need to be validated to a greater extent. As a result, the results for a sensitive analysis such as that for varying penetration rates of the RFID use, becomes ill-defined. This is because, in absence of well-defined metrics, calculations that are sensitive to a change of variables may lead to garbage results. As a result, for this part of analysis, the assumption is made that the RFID penetration rate is kept constant at 100% for footwear and 80% for apparel product lines for all years, in FY2015-19.

Table 6.7: Benefit in sales revenue due to RFID implementation for apparel

FY	Actual Sales Revenue (in USD million)	Improved Sales Revenue (in USD million)[1]			Increase in sales		
		I	II	III	I	II	III
2015	8636	8882.00	8882.00	8882.00	+246	+246	+246
2016	9067	9350.45	9346.72	9341.37	+283.45	+279.72	+274.37
2017	9654	9961.88	9960.15	9955.80	+307.88	+306.15	+301.8
2018	10733	11076.30	11075.75	11073.36	+343.3	+342.75	+340.36
2019	11550	11919.58	11919.43	11918.35	+369.58	+369.43	+369.43
FY	**Actual Sales Revenue (in USD million)**	**Improved Sales Revenue (in USD million)[1]**			**Increase in sales**		
		I	**II**	**III**	**I**	**II**	**III**
2015	2050	2108.39	2108.39	2108.39	+58.39	+58.39	+58.39
2016	2091	2156.37	2155.51	2154.27	+65.37	+64.51	+63.27
2017	2339	2413.59	2413.17	2412.12	+74.59	+74.17	+73.12
2018	2940	3034.04	3033.89	3033.23	94.04	+93.89	+93.23
2019	3087	3185.78	3185.74	3185.45	+98.78	+98.74	+98.45

Primarily, the considerations made with the overhead costs associated with the warehouse handling of products are that of reduction in the cost of labour. The reasons for considering these reductions and their calculations are now seen in the following section.

6.6.1. QUANTIFICATION OF REDUCTION IN LABOUR COSTS

Continuing in the same vein as above, the reduction in the cost of labour and handling for leaner inventory stocks is now considered. This reduction in handling occurs not only due to a leaner inventory size but also due to the fact that, similar to the case of Macy's, the use of RFID leads to fewer hours being spent manually sorting and tagging all items in the backdoor warehouse. Recall that in the case of Macy's the number of hours it took to perform these manual audit operations prohibited the number of shifts the workers could take to manually sort and replenish the stocks and thus limited this activity to a maximum of two times a week or even 48 hours per season. Similarly, in the case of Nike, improved hours of inventory handling reduced the 150 hour long manual process (done once in six months) to a mere 6 hour cycle executed monthly, that is 36 hours in a six month period.

This reduction in labour hour requirements (for this particular activity) frees up the labour units to perform other productive activities instead. For the purposes of this anal-

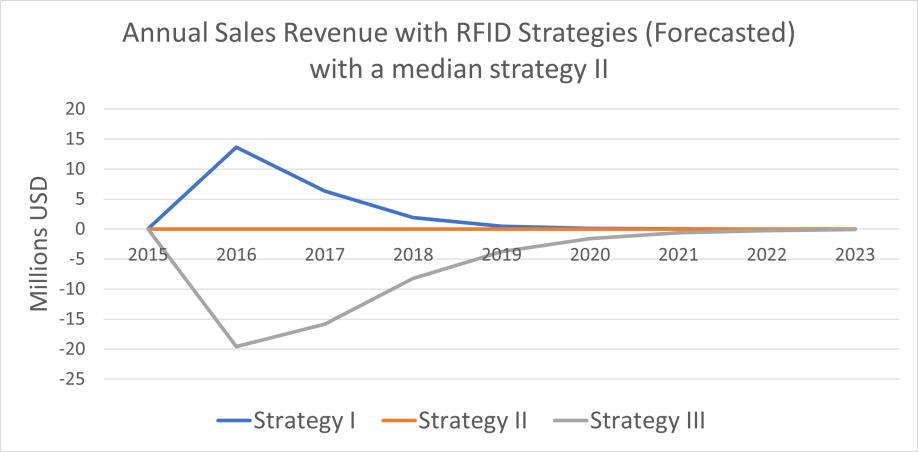

Figure 6.5: Comparison of increased revenue from sales among all the three strategies, with the moderate strategy (**II**) as a median basis

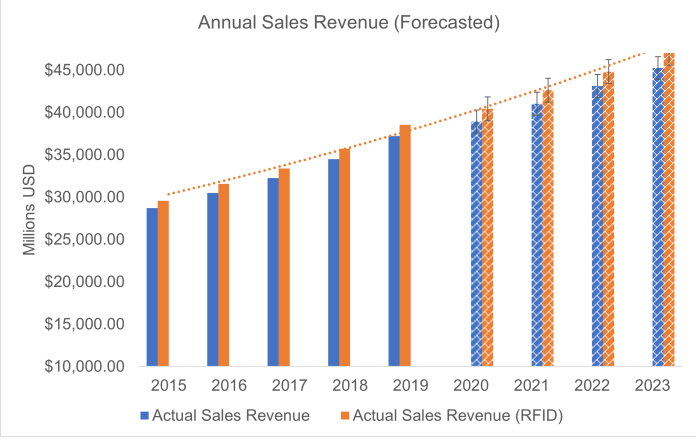

Figure 6.6: Adjusted sales revenue using RFID compared with no-RFID use for FY15-19

ysis, the consideration of what these other productive activities are, is not made. Instead, it is assumed that these labour units work on an hourly basis, and that any reduction in the worker hourly activity leads to cost savings. Thus, primary consideration is made to the number of hours saved as a result of RFID implementation leading to lower handling labour hours.

In order to calculate this effect of RFID implementation, it starts by defining the number of labour hours and costs associated with the manual process (without RFID) of inventory shipping and handling. The total labour cost of handling inventory is calculated annually as the product of the hourly wages (USD per hour), number of hours for handling activity (in hours per person) and the number of workers needed for the handling

tasks (number of persons). That is,

$$\text{Total Labour Costs of Handling (annual)} = 2 \times 150 \times w \times N_{\text{workers}} \tag{6.13}$$

The terms used in this formula reflect the current operational state, since Nike currently conducts two shifts of 150 hours each within its warehouses (for EMEA, this inventory audit takes place in Lakdaal, Belgium) in a one-year period (thus, 2×150). The number of workers required are calculated after making some assumptions. Firstly, it is assumed that no worker does inventory handling for more that one product type, that is the group of workers handling the inventory stockpiles of footwear are completely separate from those working on equipment and apparel. This is an assumption made to simplify analysis, and to strenghten another key assumption that all the stock audits and handling proceeds parallely for all the product types, that is all worker units work in parallel, executing handling tasks for footwear, apparel and equipment simultaneously.

Thus, the total number of workers in a given warehouse are:

$$N_{\text{workers}} = N_{\text{workers, footwear}} + N_{\text{workers, apparel}} + N_{\text{workers, equipment}}$$

this breakdown into the number of workers assigned to each product type now requires further assumptions. To begin with, it is assumed that this warehouse unit serves or supplies goods to s number of retail outlets in its region. Furthermore, it is assumed that there N number of workers for scanning footwear($N_{\text{(wroker,footwear)}}$), apparel($N_{\text{(worker,apparel)}}$), and equipment($N_{\text{(worker,equipment)}}$). Now, the number number of footwear, apparel, and equipment is written as ($N_{\text{(footwear)}}$), ($N_{\text{(apparel)}}$), and ($N_{\text{(equipment)}}$). Therefore, the total number of footwear in warehouse (Laakdal, Belgium) becomes number of products times the number of retail stores, which can be written as $s^*N_{(footwear)}$, $s^*N_{(apparel)}$, $s^*N_{(equipment)}$. Now, for footwear the assumption is that one worker can scan and handle p number of footwear. Therefore, to number of workers required to scan the total number of footwear becaomes,

$$N_{\text{workers, footwear}} = \frac{s \times N_{\text{footwear}}}{p_{\text{footwear}}}$$

Similarly, we can write for apparel and footwear

$$N_{\text{workers, apparel}} = \frac{s \times N_{\text{apparel}}}{p_{\text{apparel}}}$$

$$N_{\text{workers, equipment}} = \frac{s \times N_{\text{equipment}}}{p_{\text{equipment}}}$$

The number of items to be handled (N_{i}) of the type i (footwear, equipment, or apparel) are then computed based on the estimated sales revenue computed off of the demand planning reports. Thus, the sum of all the number of items to be handled across all the product types creates a portfolio describing the total order size.

$$N_{\text{i}} = N_{\text{footwear}} + N_{\text{apparel}} + N_{\text{equipment}} \tag{6.14}$$

Now let us quantify these terms, $N_{\text{sold},i}$ that is the number of items to be sold of the type i, in aggregate terms the average number of goods (of type i) to be sold, can be obtained upon division with the average value of portfolio of goods of the type i (in USD). This average value of the portfolio for footwear products is calculated for example by catalouging the prices of all footwear products sold by Nike in a given market and taking their average. Note here that this average can be a weighted average with the relative distribution of the demand of each footwear type (for example Nike's Air Jordan and Nike Air Force) as normalized weights along with their unit prices. However, for simplicity and due to lack of data available, a simple average is considered here, without taking into account these demand-driven weights (as an indicator of the popularity of each category's product offering). In this analysis, this average value of footwear items is taken as USD 147.00 and for apparels it is taken as USD 89.00.

Then, the equation is written as,

$$N_{\text{sold, i}} = \frac{R_{\text{estimated,i}}}{2 \times s \times (\text{Avg. value for } i)}, \quad \text{for each 6 month period}$$

This gives us, the number of workers required to handle the number of goods of product type i, as:

$$N_{\text{workers, i}} = \frac{R_{\text{estimated,i}}}{2 \times p_i \times (\text{Avg. value for } i)} \tag{6.15}$$

Now by using the equation 6.14, and 6.15 the labour costs associated with the product type i, as:

$$\text{Total labour cost for } i = \frac{150 \times w \times R_{\text{estimated,i}}}{p_i \times (\text{Avg. value for } i)} \tag{6.16}$$

Finally, it is assumed that a single person can handle and execute tasks for 75 units of type footwear or 125 units of type apparel in 150 hours. The total labour costs associated with performing these tasks for footwear, apparel and equipments are computed as shown in Table 6.8.

Upon implementation of RFID, the process required for handling these inventory units reduces to 36 hours in a six month period. Thus for all the units marked with RFIDs, the labour costs of handling accounts for 36 hours instead of the 150 hour markup as seen up until now (in equation 6.16). This means, that for footwear, where all the items will be RFID enabled (100% RFID penetration), is written as,

$$\text{Total labour cost (footwear)} = \frac{36 \times w \times R_{\text{estimated,footwear}}}{p_i \times (\text{Avg. value for footwear})} \tag{6.17}$$

similarly, for apparels with 80% penetration of RFID, the labour costs for apparel becomes,

$$\text{Total labour cost (apparel)} = 0.2 \times \frac{150 \times w \times R_{\text{estimated,apparel}}}{p_i \times (\text{Avg. value for apparel})} + 0.8 \times \frac{36 \times w \times R_{\text{estimated,apparel}}}{p_i \times (\text{Avg. value for apparel})} \tag{6.18}$$

By using the equations 6.16, 6.17, and 6.18 the reduced labour costs are calculated,

Table 6.8: Comparision of labour costs for footwear and apparels with and without RFID

FY	Total Labour Costs (Footwear) p = 75 (in USD Millions)	Total Labour Costs (Footwear) With RFID (in USD Millions)	Total Labour Costs (Apparel) p=125 (in USD Millions)	Total Labour Costs (Apparel) With RFID (in USD Millions)
2019	2708.16	649.96	1316.53	516.08
2018	2546.23	611.09	1262.75	494.99
2017	2161.97	518.87	1003.28	393.29
2016	2079.93	499.18	885.56	347.14
2015	2016.95	484.07	871.27	341.54

The benefit of labour cost reduction as discussed in section 6.1 is shown in the below table 6.9 for footwear and table 6.10 for apparel. It should be noted that these reduced labour costs may vary but with no significant changes. The variation can be observed in real because this is a theoretical representation of RFID benefits and in the future any pandemic like crisis may affect the labour costs.

Now, to summarize the complete calculation, the following table shows the increase in sales revenue in % for both apparel and footwear (global and EMEA) and the decrease in labour costs in %. It should be noted here that for calculating the percent increase in sales revenue, the average of the improved sales revenue for all the three strategies is considered. This showed that on an average there is an increase of almost 4% to the sales revenue. Now, recall that labour hours were reduce from 150 hrs to 36hrs. The reduction

Table 6.9: Reduction labour costs for FY2015-2019 for footwear

FY	Total Labour Costs (Footwear) p = 75 (in USD Millions)	Total Labour Costs (Footwear) With RFID (in USD Millions)	Reduction in labour costs due to RFID
2019	2708.16	649.96	2058.2
2018	2546.23	611.09	1935.14
2017	2161.97	518.87	1643.1
2016	2079.93	499.18	1580.75
2015	2016.95	484.07	1532.88

Table 6.10: Reduction labour costs for FY2015-2019 for apparel

FY	Total Labour Costs (apparel) p = 125 (in USD Millions)	Total Labour Costs (apparel) With RFID (in USD Millions)	Reduction in labour costs due to RFID
2019	1316.53	516.08	800.45
2018	1262.75	494.99	767.76
2017	1003.28	393.29	609.99
2016	885.56	347.14	538.42
2015	871.27	341.54	529.73

of hours in percentage is 75% and can be seen in the table below both for footwear and apparel.

Table 6.11: Summary of changes in sales revenue and labour costs for apparel

FY	Sales revenue with RFID (apparel) for global (in %)	Sales revenue with RFID (apparel) for EMEA (in %)	Reduction in labour costs (in %) due to RFID (apparel)
2015	2.84%	2.84%	60.79%
2016	3%	3%	60.79%
2017	3.162%	3.162%	60.79%
2018	3.18%	3.18%	60.80%
2019	3.19%	3.19%	60.79%

6.7. CONCLUSIONS

This chapter answered the final sub research questions *How to model implementation of RFID technology for quantifying benefits?* and *How are these benefits calculated in terms*

Table 6.12: Summary of changes in sales revenue and labour costs for footwear in %

FY	Sales revenue with RFID (footwear) for global (in %)	Sales revenue with RFID (footwear) for EMEA (in %)	Reduction in labour costs (in %) due to RFID (footwear)
2015	3.41%	3.41%	75.99%
2016	3.80%	3.79%	76.00%
2017	3.93%	3.93%	76.00%
2018	3.97%	3.97%	76.00%
2019	3.99%	3.99%	75.99%

of increase in sales revenue and reduction in labour costs?. For answering the first question, the strategic profit model is adapted. Here quantification of benefits is shown in terms of profit. Recall that strategic profit model shows the increase in ROA and RONW. This research focuses on ROA becasue Nike can increase their Return on Assets (ROA) by increasing their sales and reducing the costs. This answers the question of how the modleing of RFID implementation is done. Now, for answering the last sub question, refer to the calculations shown in section 6.3 and 6.4. These calculations shows a linear increase in revenues and a decrease in costs. It should be noted that the values used for calculating these are estimated but validated, the figures are subject to change with no significant changes. By referring to the case studies and Nike's pilot study, the calculations were drawn for the five years (2015-2019). It is seen from table 6.11 and 6.12 that labour costs are reduced by almost 75% and sales revenue increase by almost 4%. These projections show that RFID will help in achieving the benefits Nike is focussed on. But, by referring to Macy's study it can be also seen that achieving these targets is not an easy task. After the proper study and integration of RFID, Macy took three years to realize the RFID benefits. Similarly, Nike may also take three or more/fewer years to unlock these achievements and serve their consumers. The next chapter will give the conclusion, recommendation and reflection on the research.

7

Conclusion, Recommendation, & Reflection

7.1. Conclusions

In this research, an overview of improving Nike's inventory management drawbacks is presented with an aim to explore the possibility of an RFID integrated supply chain system. As part of this exercise, the major impact due to inventory management drawback within Nike were identified and the local and global key performance indices were categorised. Through this, the research question of *"How RFID technology's integration to the current inventory management system at Nike increase the revenue through sales and reduce the labour costs?"* was identified, keeping in mind the possibility of Nike's multi-channel retail outreach and e-commerce portfolios.

The main research question was articulated in order to achieve the objectives of the research as discussed in chapter 1. Recalling the objectives of the research were, *Understanding the sales systems and inventory management, Understanding Nike's RFID technology vision*, and *Understanding RFID technology benefit at Nike*. Now, to achieve these objectives the research was then divided into sub research questions. Every chapter concluded by answering the respective sub research question.

To understand the need of integration of RFID technology within Nike's current process was shown in chapter three. The discussion on Nike's supply chain system showed the current inventory management and its impact on the overall sales of Nike products. The chapter also introduced RFID technology under Nike's digital evolution programme to eliminate the drawbacks through current inventory management. This chapter helped in achieving the first objective of understanding the sales system and inventory management at Nike. In order to build relevant benchmarks and understand the broader im-

pact of how RFID (as the first step towards a digital supply chain future for Nike) affects the business prospects of an industry reliant on efficient supply chain organizations, case studies were presented. These studies highlighted the application and evolution of a digital logistics system beginning with RFID integration for multiple global suppliers (conducted by Accenture) and the specific case of RFID integration to its store-front and back end processes helped drive better business for Macy's. These benefits are then viewed in a cross-industry perspective through the discussion of Nike's own pilot studies for the use of RFID systems at its many supply networks and stores and hence touching the second objective of the research.

Further, a quantitative assessment was provided as a means to characterize the possible outcomes of a Nike's investment in its digital supply chain structure. This is done through the simple model building over the increased sales revenue from Nike brand sales and digital e-commerce performance over the years and book-ended with an estimation of the reduction in inventories, and labour expenses. The applicability of these estimates however, would be limited to the exploratory setting of this research since there are multiple factors that were unaccounted for, alongside the very important consideration of the current global economic scenario that affects company performance worldwide.

Also, it emerged during the research that due to the very nascent stage of this research, not enough studies have been performed in order to measure indicators of success —the KPIs. A brief discussion of the possible choices of these indicators is presented based on available relevant literature and the results from Nike's pilot case studies.

For quantifying the benefits, the past sales data (Nike's annual reports) and Nike's pilot study were referred. However, the sales in FY2020 hit a new low, due to shops close globaly. Due to this, the sales data of FY2015- 2019 was used. From the pilot study it became clear that there was increase of 4% in sales revenue and reduction of 75% in labour hours for scanning the entire inventory. This was used to calculate the changes in sales revenue and labour costs. The final results in table 6.11 and 6.12 showed that the increase in sales revenue is almost around 4% and the reduction in labour costs is almost 75%. Therefore, understanding the third objective of the research. The case study of Macy helped understand that the entire adoption of RFID technology at Nike might take three or more years. This was used to draw different adoption strategies for and calculate the changes in sales revenue. The future projections might differ because of uncertainty of corona impacts and also because few values were assumed due to company's confidential data. Despite of these, the fig 6.5 - 6.6, shows the aanual sales revenue forecasted for all the three strategies and a leap in annual sales revenue respectively. This proves empirically Nike's increase in sales and revenue by RFID integration in its current process.

By conducting this research one thing became clear that the integration of RFID technology within current Nike systems will prove to be beneficial. The covid19 crisis slightly affected Nike's timeline of RFID technology integration. However, this will not bring a significant change in the estimated sales revenue and costs reduction.

7.2. RECOMMENDATIONS

Although there have been companies that have had the first mover advantage when it comes to implementing RFID within existent supply chain networks, it is still relevant and advantageous for Nike to invest (at least at an exploratory level) to understand the implementation steps required to achieve a cost-effective RFID integration network. Not only does this allow Nike to drive its operations more efficiently, but it also enables new modifications and innovations to be made as they move towards broader acceptance of digital disruptive technologies. In doing so, this integration must be seen as a force multiplier instead of an incremental change.

However, due to the limited amount of practical knowledge available in the public domain, the risks associated with RFID integration strategies become significant. A possible recommendation to identify these gaps in knowledge would be to further develop research into specific implementation scenarios for integration across supply value chains with a focus on building resilience and efficient logistics systems.

Another recommendation would be on the lines of covid19 pandemic. The unprecedented situation of covid19 situation posed few challenges on the RFID technology implementation in the current Nike systems. This situation could be retrospected in a way that could avoid such a hassle in the future. One of the recommendations would be of course to consider situations as such to plan the integration of new technology.

Along with RFID technology, technologies like IoT, and Blockchain are also making advancement and their adaptation in the retail industry will soon be realized. To gain the competitive advantage it will be very helpful if Nike will start the research on the use of these technologies to analyze the impact on their current process. This will make them ready for the unprecedented future demand.

7.3. REFLECTION

Finally a few reflections on the research. All the research comes with a few challenges. In this research, the major challenge was in the lack of information available on RFID technology at Nike. Since this was a new step towards becoming more consumer responsive, most of the teams were unaware of its impact on their current process.

The second surprise was on the lines of lack of real life benefits of RFID technology in a similar company. Eventhough the competitors like Adidas and Lululemon Athletica adopted RFID technology before Nike, the data available on the same was limited. Another challenge was conducting research in the covid19 pandemic crisis. This was majorly observed while collecting information for the background study of Nike and the RFID technology journey at Nike due to teams sitting in both the WHQ and EHQ. But, because of the timely response, the interviews were conducted to collect the relevant data. It was a great pleasure to connect with like minded minds and the contribution from Market Place Analysis, Demand and Supply, and RFID technology teams, has helped a

lot towards the completion of this thesis.

Last but not the least, constant and timely communication with the thesis committee helped in giving the right shape to this thesis. The feedback sessions and discussions helped a lot in achieving the expected outcome from this thesis.

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