

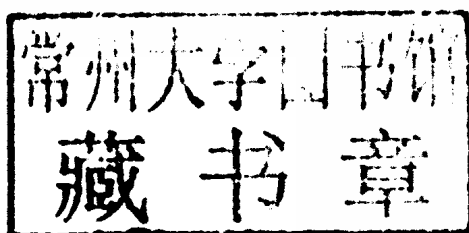
RFID

in the Supply Chain

Pedro M. Reyes

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RFID in the Supply Chain

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Foreword

Let me take this opportunity to express my highest regard for Dr. Pedro Reyes. I have known Dr. Reyes for the past 20 years, as a student in my classes, as a professional in industry, and as a knowledgeable and well-respected member of academia. He has made an enormous impact on the lives of those he has worked with and the students he has mentored.

Pedro Reyes has drawn from his industry and academic experience to write a practical guide to RFID in the supply chain. Dr. Reyes has over 20 years of industry experience and over 8 years in academia, working in the area of supply chain management. He has more than 25 publications in academic journals and numerous academic awards, has served on eight journal editorial boards, and is an active consultant in the field, all of which reflect the reputation and respect he enjoys in the field of supply chain management in both industry and academia.

For the past five years, Dr. Reyes has held an annual symposium on RFID at Baylor University. These continuing symposiums receive support from industry, Sloan Industry Studies, and Baylor University. Through these symposiums, academia and industry have partnered in expanding the knowledge and application of RFID.

Through his unique style of writing and teaching, Dr. Reyes conveys his knowledge on the subject of technology and the supply chain. His practical experience is instrumental in making this book a must-read for those responsible for the movement of goods and delivery of services in a global economy.

In the first part of the book, Dr. Reyes elaborates on RFID from historical and technical perspectives. He gives the advantages and limitations of the technology and examines the standards for RFID.

In the second part of the book, Dr. Reyes discusses the challenges faced in implementation of RFID. He gives an overview of system architecture, variables, and factors that go into RFID implementation. Applications, security, and privacy issues are included in this part of the book. He concludes this section with the return on investment (ROI) aspects of RFID for business.

In the third section of the book, he summarizes case study examples of how RFID has been and is being used to improve supply chain visibility, asset visibility, and tracking of work in progress as well as returnable asset tracking. Dr. Reyes concludes the book with a look to the future for RFID and supply chain management.

For supply chain managers and professionals looking to learn more about RFID and its applications, this book offers a great learning experience. For academic and industry professionals, this book provides a deeper understanding of how RFID can improve supply chain management.

PATRICK JASKA, PhD
Professor of Business Systems
Chair, Department of Business Computer Information Systems
College of Business
University of Mary Hardin-Baylor

Preface

In the decades before my current position as a college professor, I witnessed firsthand many technologies that changed how businesses managed their internal operations as well as how these technologies changed the supply chain landscape. During those years, I mostly worked with replenishment systems. So when I was working on my dissertation, it made sense to study replenishment systems. I focused on grocery supply chains.

During the last few months prior to my dissertation defense, I was continuing to read various papers on supply chain management technologies. I read a short article on RFID, but really did not see how the technology could work. And since I was studying “business,” I was not very interested in the engineering side of the technologies.

Well, it so happened that my replenishment system model was not getting the expected results. So I contacted the grocery retail store managers and asked for additional site visits to help me figure out what parameters (if any) might be incorrectly represented in my model. As I was entering one particular store in the Dallas area, the alarm went off (like someone had stolen something).

The funny thing was that the alarm went off as I was walking in (not out). As it turned out, the store was part of a pilot-study with Gillette on the use of RFID. Of course I did not have any of those products on me. So the questioning began. As it was discovered, I had an RFID tag in my shoe from a recent purchase. At this point, the wheels began to turn in my head, thinking, “How can this RFID tag be used to improve replenishment systems?” (This was in 2002, before Wal-Mart announced its mandate.)

Hence, my story is that I literally walked into the RFID field. The rest is history. I have enjoyed studying the various RFID applications and how this old/new technology has been reshaping the landscape of supply chain management processes.

I begin most of my professional talks by saying, “RFID has, for the most part, been flying below the business innovation radar.” This has been my opening tag line dating back to my early work in 2002. Of course in those first few years of my studies I was questioned about return on investment (ROI), where’s the business case, and

standards. Hence, the real challenge during my academic or professional presentations has been to get others to look beyond the present cost. I explain that RFID is a proven technology with its roots in access control, and in theory there is clearly a great potential to revolutionize business. With the assumption that the engineering side of the RFID field can make it cost effective, how can we in business adopt the technology, reduce operating costs, and ultimately make more money?

With the publication of this book, I would like to acknowledge a number of colleagues and coresearchers who contributed to this work. The nature of my academic career depends heavily on collaboration. And over the years, my collaborators have also become my friends.

Patrick Jaska, professor at the University of Mary Hardin-Baylor, is a long-time colleague, coauthor, mentor, and friend. He has been a big supporter of my work and always willing to help.

For his encouragement when I was just starting to research RFID, Frank Giarratani, director at the University of Pittsburgh's Center for Industry Studies (<http://www.industrystudies.pitt.edu>), deserves a lot of credit. His support of my research based on an understanding of the RFID industry and the annual RFID Integrated Supply Chain Seminar Series/Symposium was instrumental in advancing my career toward tenure. And most recently, with his guidance and the Industry Studies Association (<http://www.industrystudies.org>) support, I coordinate an RFID Research Network. The network members are professional colleagues and friends who have generously shared ideas and questions over the past six years. They include Kevin Berisso, director for the Automatic Identification and Data Capture (AIDC) Laboratory at Ohio University (<http://www.ohio.edu/industrialtech/aidc>); Qiannong Gu, assistant professor of operations management at Sam Houston State University; Gregory Heim, assistant professor at Texas A&M University; Diego Klabjan, associate professor at Northwestern University; John Visich, associate professor at Bryant University; and Pamela Zelbest, assistant professor of operations management and director of the Sower Business Technology Laboratory at Sam Houston State University (<http://www.shsu.edu/~coba/sower/>).

I would also like to recognize Greg Frazier, professor of operations management (my dissertation chairman), and Edmund Prater, associate professor (also on my dissertation committee), both at the University of Texas at Arlington, who through their insights continue to ask challenging questions as they pertain to my research.

In addition, Nicole DeHoratius, assistant professor at the University of Portland, always had some interesting questions that pushed my research for a better understanding of RFID's potential.

Ertunga Ozelkan, assistant professor at the University of North Carolina at Charlotte, not only participated in the annual RFID Integrated Supply Chain Management Symposium but also helped

organize special topics on RFID in supply chains at the Decision Sciences Institute (DSI), the Production and Operations Management (POMS), and the Institute for Operations Research and Management Sciences (INFORMS) annual meetings.

I also express my gratitude to those who participated and/or attended those special topics on RFID in supply chains. Without your feedback and questions, parts of this book would not have been possible.

I would also like to acknowledge three postgraduate assistants who took an interest in my RFID research and helped in data collection for various projects, including this book. These students include Sushmi Chakraborty (MBA/MSIS 2011), Christopher Zane (MBA 2008), and Manuja Baral (MS 2006).

In addition to my professional colleagues, my family and friends played an important role in encouragement and support. Friends kept asking for updates on the writing and would state: "You are the book." And finally a special thanks to my best friend and wife, Cherylle, who truly made a difference and continues to provide encouragement and inspiration.

PEDRO M. REYES

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PART I

Introduction and Overview

CHAPTER 1

Introduction

CHAPTER 2

RFID 101

CHAPTER 3

EPCglobal Overview and
Standards

The first part consists of three chapters and provides an overview for RFID.

Chapter 1: *Introduction* first introduces the reader to RFID and why this old technology is receiving so much attention. Chapter 2: *RFID 101* provides a technical overview of the basics of RFID technology written in non-engineering speak. Chapter 3: *EPCglobal Overview and Standards* describes the three-layer architecture of the EPCglobal standards (identify, capture, and exchange), and is perhaps the most technical chapter of this book.

CHAPTER 1

Introduction

This chapter begins with a brief history of past business technologies, followed by an introduction to RFID and an explanation of why it is getting so much hype. Finally, the chapter ends with the motivation and organization of this book.

Brief History of Past Business Technologies

Throughout history, business technologies have revolutionized the way firms design (and often redesign) their supply chains and management control systems. Historical examples include (1) the telegraph once used for railroad transportation scheduling, (2) the telephone (and facsimile) for faster business communication, and (3) electronic data interchange (EDI) for more efficient and paperless business transactions. While these technologies have enhanced the business practices of those eras, the actual benefits were limited to the specific supply chain process. The Internet has helped to address those limitations and the trade-offs between cost, rich content of data, real-time information sharing, and the up- and downstream integration between the business partners.

Today, RFID (radio frequency identification) is quickly catching on as an intriguing supply chain technology with flexibility for numerous applications. Despite its increasing popularity, the lack of understanding of RFID technology has slowed its acceptance. Yet, even with a limited and fragmented understanding, there is still a strong interest in RFID technology as a viable solution for improving supply chain operations.

What Is This Thing Called RFID?

RFID is an auto-ID technology that uses radio frequencies to identify, track, and trace an object or product. Like many modern technologies, RFID technology has its origin in military applications during World War II (Fig. 1.1), when British planes were equipped with radio frequency transmitters to identify them as friendly aircraft to British forces on the ground. Commercial applications began during the early 1980s. Today, these applications span several industries.



FIGURE 1.1 Origin in military applications. (Source: http://d2eosjbgw49cu5.cloudfront.net/rfid-weblog.com/imgname-rfid_and_its_history-50226711-36935578.jpg)

While there are arguments both pro and con, RFID has the potential to offer considerable benefits. A variety of applications already exist for RFID with over 100 reported cases in the fields of security, process control, hospital, consumer goods, retailing, document management, perishable logistics, warehousing, distribution, and construction sites. As more companies consider the potential applications of RFID, a good understanding is needed of what RFID is, the current and future states of RFID technology, and the current and future applications of RFID, as well as the technology's advantages and limitations.

Why All the Hype?

RFID has, for the most part, been flying below the business-innovation and best practice radar. Most of the propaganda and press given to RFID have been since the mandates announced by Wal-Mart* in 2004 and the U.S. Department of Defense (DoD) in 2003 for suppliers' use of RFID. January 2005 is considered by researchers as the "big bang" for RFID. Yet, whether RFID represents a new direction in supply chain management theory and practice is a question

*Branded as Walmart since 2008.

of no small consequence. Equally important, it is not reasonable to believe that all firms will adopt RFID, yet many managers are in a dilemma as to whether RFID is right for their organization or application. In some ways, RFID is like many other past technological implementations, but in some ways it is not. The actual benefits and risks of RFID coupled with managers' evolving perceptions about these benefits and risks will decide the speed at which RFID moves from introduction and developmental stage to the maturity stage. Many RFID white papers published during the past few years describe RFID and its advantages, primarily to aid managers in their effort to determine whether RFID is appropriate for their particular needs and give them some guidelines for implementing an RFID solution. Although RFID has been around for more than 60 years, it took the recent mandates by Wal-Mart and the DoD to spark the massive interest in its potential for improving supply chain performance. Also, contributing to this interest is the rapid acceleration and availability of computer science and Internet technologies that have been evolving and reshaping supply chain management processes and practice. As part of the considerations for RFID implementation, managers must filter out the hype and understand what the technology can do—and equally important what it cannot do. As with many technologies, the excitement and the misunderstanding can be damaging to expectations.

Motivation and Organization of this Book

This book is targeted to the business community and aims to enlighten and inform managers about RFID issues and the design principles behind software applications, and ultimately to help them decide whether, when, and how to use RFID technology for improving supply chain operations.

Basics of RFID

The basics of RFID are presented in Chap. 2: *RFID 101*. The chapter begins with a history of RFID followed by an overview of RFID system components. The technology's advantages and limitations are also provided. Typically, the basic RFID system consists of tags, antennas, readers, and communication infrastructure (Figs. 1.2 and 1.3). Naturally an RFID tag is attached to an object. The RFID tag can be either active (battery powered and proactively emitting a radio frequency signal) or passive (unpowered and reactively emitting a radio frequency signal). An RFID reader communicates with the tag to identify the object to which the transponder or tag is attached. The tag has information about the object for identification purposes depending upon the need. The serial number, model number, or other characteristics of the object could be stored within the tag to identify