# RFID *in* LOGISTICS

## *A Practical Introduction*


Erick C. Jones
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CRC Press
Taylor & Francis Group

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CRC Press
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Boca Raton London New York

CRC Press is an imprint of the
Taylor & Francis Group, an **informa** business

CRC Press
Taylor & Francis Group
6000 Broken Sound Parkway NW, Suite 300
Boca Raton, FL 33487-2742


Printed in the United States of America on acid-free paper
10 9 8 7 6 5 4 3 2 1

International Standard Book Number-13: 978-0-8493-8526-1 (Hardcover)



**Library of Congress Cataloging-in-Publication Data**

Jones, Erick C.
RFID in logistics : a practical introduction / Erick C. Jones and Christopher A. Chung.
p. cm.
Includes bibliographical references and index.
ISBN 978-0-8493-8526-1 (alk. paper)
1. Radio frequency identification systems. 2. Business logistics--Data processing. I. Chung, Christopher A. II. Title.

TK6553.J628 3007
658.5--dc22 2007025639

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# Preface

## ORIGINS OF RFID IN LOGISTICS

In 2003 while working as a newly hired assistant professor, I opened the Radio Frequency Identification (RFID) Supply Chain Logistics (RfSCL) lab in Lincoln, Nebraska, due to my current understanding of the importance of the development of this advance in automatic data capture technology. Previous experience as an industrial engineer for UPS had exposed me to the technology in 1993. Further experiences as a consultant with Tompkins Associates in the late 1990s implementing warehouse management, transportation management, and enterprise resource planning systems (WMS, TMS, and ERP, respectively) utilizing automatic data capture devices exposed me to the rigors of implementing these technologies. My goal for the lab was to allow industry and academia to work together for solutions that lead to research. The Auto-ID Research lab at MIT, which established EPC Global, provided leadership for developing passive RFID tags as possible replacements for bar codes in distribution supply chains. The RfSCL goal was to utilize the accepted industry Six Sigma methodologies to define industry problems and, in the process of solving problems, identify and pursue relevant research opportunities. The industry–university focus has led to our lab becoming one of the National Science Foundation's Industry University Cooperatives (NSF I/URC) in the Centers for Engineering Logistics and Distribution (CELDi).

As mandates for Wal-Mart and the Department of Defense (DOD) were given for the respective organizations' suppliers, many of these suppliers sought answers for integrating RFID into their supply chain. Many professors were not motivated to approach RFID due to the fact that it crossed many different fields of research, such as electrical engineering, computer science engineering, and industrial engineering, to name a few. The need to cross into different research fields made RFID more of a practical research area. Many suppliers set up their research labs and tested their products. These tests appeared to be self-serving, touting the high read rates and read accuracies of their products. When these products were tested by companies who bought these tags and readers, they did not perform as promised. This lack of confidence by organizations and suppliers, the public lawsuits for patent rights for RFID technologies, and mandates created the need for education about RFID.

During this time, because we were named as one of the first academic RFID labs, organizations approached us to test RFID technologies. They needed an unbiased opinion. As we began presenting the results of these first-generation tags (or GEN 1, or Class 0, 1 tags), industry partners suggested that we provide education seminars on RFID. During the process of presenting these seminars, the most common feedback from participants included questions regarding how the technology works, how it can be used in operations, and what other applications for this technology are. Other researchers, such as Satish Bukaputnam at Oklahoma State University (OSU),

described the need to introduce this knowledge into the engineering academic curriculum as a course. In fact, both OSU and the University of Nebraska — Lincoln (UNL) were, as I know it, the first to introduce RFID into the engineering curriculum. The knowledge of electrostatic theory, sensor technology, production planning and control, and logistics was best taught in engineering from our perspective. Currently, business case aspects are now being taught in some business schools.

We did our best to put together a structured description of the basics of RFID and how to use it in the supply chain. While doing this, we realized that certain fundamental relations exist — for example, the integration of testing the technology to the integration of the technology into operations. This became section 2 of our book. Though this material has been presented in short courses and in academic lectures, the process of converting this information into book form has proven challenging. Often the conversion of theoretical presentations into practical implementation practice remains difficult. Drawing from our implementations and other contributors we organize some of these principles in practice in section 3 of our book.

## INTENDED AUDIENCE

RFID in logistics in intended for the three academic audiences:

1. BS and MS industrial engineering students in a production and planning course
2. MBA and MS students with a specialization in logistics as a core course on logistics
3. Logistics, manufacturing, and distribution engineering professionals

## HOW TO USE THIS BOOK

After a brief introductory chapter, the book is organized into several sections: Section 1, Understanding RFID; section 2, The RFID Integrated Logistics Model; and section 3, Principles in Practice. In our own teaching we cover all three sections in order. We believe that section 2 should be covered completely, as it represents the core of RFID in logistics. Because we refer to extensive use of passive RFID tags in logistics, it is recommended that you cover chapter 3 (RFID Passive System Components) and chapter 6 (RFID Standards) completely before starting section 2. Beyond this, the individual instructor can select historical topics from section 1 and apply topics from 2 to meet his specific audience's need.

The instructor is also faced with the choice of how much technical depth to use. To assist readers who want general concepts with minimal technical focus, we suggest reviewing the sections prior to creating a syllabus. Some sections can be skipped completely without losing continuity.

In teaching this material to both logistics professionals and engineering students, we have found that logistics professionals are less interested in the technical rigors than the engineering students. However, we have found that logistics professionals have returned to investigate the technical information as it became relevant to their operational testing.

# About the Authors

**Erick C. Jones, Ph.D.,** is an assistant professor at the University of Nebraska-Lincoln in the Industrial and Management Systems Engineering Department. His areas of specialization and teaching include Supply Chain Management, Engineering Management, and Total Quality Management.

Dr. Jones boasts a broad background that spans both industry and academia. Dr. Jones worked as an Industrial Engineering Supervisor for UPS, an Engineering Director for Academy Sports and Outdoors, a Project Manager for Tompkins Associates, and Executive Manager for Arthur Anderson, LLP, prior to his current position at the University of Nebraska-Lincoln.

His working experiences included consulting and implementing WMS, TMS, ERP, Retail systems, AS/RS, Work Measurement systems, facility designs, location modeling analysis, and organizational strategies. He has also been trained in and utilized common industry implementation techniques such as Six Sigma, Lean Techniques, 5S, along with other Quality Process Improvement Techniques for results

Dr. Jones currently chairs the University of Nebraska Certified Six Sigma Black Belt committee. This board consists of both academic and industry experts in Six Sigma. The committee awards UNL-backed Black Belts to qualified candidates. Jones is currently researching the best practices across industries for implementing Six Sigma and other Quality initiatives (Malcolm Baldridge, Deming, ISO) successfully.

Dr. Jones' research appointments include Nebraska site director of a National Science Foundation Industry University Cooperative that consists of a group of universities and which focuses on Logistics and Distribution Engineering called CELDI. He also is the director of the Radio Frequency Supply Chain Center at the University of Nebraska, which opened in 2003, prior to serious interest by most universities in the subject of RFID.

Dr. Jones' degrees are BSIE Texas A&M University, MSIE University of Houston, Central, and Ph.D. University of Houston, Central. His positions have included president of the IIE-Houston Chapter for more than three years, President of the BFSN at Texas A&M University, Alpha Phi Alpha Fraternitiy, Inc, Alpha Phi Mu, Sloan Foundation Fellow and Nebraska site director of the Minority Ph.D. program.

**Christopher Chung, Ph.D.,** is an associate professor in the Department of Industrial Engineering at the University of Houston. Dr. Chung's research areas include Engineering Management, Simulation, and Computer Applications.

Dr. Chung's research has been funded by the Department of Justice, the Department of Homeland Security, and a number of commercial corporations. His research has been published in *Simulation*, the *Journal of Transportation Engineering*, the *Journal of Air Transportation*, and *the International Journal of Industrial Engineering*. Dr. Chung is also the author of *Simulation Modeling Handbook: A Practical Approach*.

Dr. Chung has industrial experience as a manufacturing quality engineer for the Michelin Tire Corporation and military experience as a U.S. Army bomb disposal officer. Dr. Chung also holds a USCG 50 ton master's captains license.

Dr. Chung received his B.E.S. degree from the Johns Hopkins University and his M.S.I.E. and Ph.D. from the University of Pittsburgh.

# Contents