

Determining the human factors influencing RFID technology adoption in the South African wholesale distribution industry

C Botha

 orcid.org/0000-0002-8839-5945

Mini-dissertation accepted in partial fulfilment of the
requirements for the degree [Master of Business Administration](#)
at the North-West University

Supervisor: Prof WJH Roestenburg

Co-Supervisor: Dr JA Jordaan

Graduation: June 2023

Student number: 12129895

ACKNOWLEDGEMENTS

First and foremost, I want to thank God wholeheartedly for bestowing me with the ability, courage, and privilege to pursue and complete my MBA degree. He securely kept my hand in His hand to protect and guide me throughout this remarkable journey by steering truly phenomenal individuals on my path, to whom I would like to express my gratitude:

- To my loving and caring wife, Jolene Botha, God had a plan in meticulously selecting you as my life partner and friend. I am eternally grateful for your calmness, tolerance, and loving support throughout this demanding journey.
- My pride and joy, Mia and Lian Botha, thank you for understanding the necessity to sacrifice our family vacations and camping excursions. Your tender hugs, kisses, and creative artwork covering every wall in my study gave me the motivation and inspiration to complete each assignment to the best of my ability.
- My mother and pillar of strength, Marianne Botha, for always listening and standing tall in our darkest moments to lend a comforting shoulder of support.
- My father and friend, Dawie Botha, for guiding me throughout my life, constantly stating that life revolves around our decisions, beginning with the decision to get out of bed each day and give our all in whatever we set out to do.
- To my friends, family and syndicate group members for your encouragement and optimism when the path appeared bleak. Thank you for making this journey one of my life's most memorable and remarkable experiences.
- My supervisor, Prof Wim Roestenburg, for your exceptional guidance, rigorous evaluations, and valuable advice throughout this study. Your insightful remarks drove me to improve my thinking and elevate my work to a higher level.
- Dr Johan Jordaan, for your thorough review of my study, which was packed to the brim with practical and to-the-point recommendations.
- To my employer and manager, for your unwavering support in allowing me to undertake this study and for assisting me throughout this eye-opening experience. I look forward to the opportunity to add value by applying my knowledge.
- Dr Erika Fourie at the NWU Statistical Consultation Services for your expertise, guidance, and assistance in analysing the empirical data.

ABSTRACT

The South African wholesale distribution industry assumes a critical role in the supply chain network by forming the link that connects the manufacturing and retail industries. Warehouses globally have evolved significantly in recent years due to the adoption of advanced technologies such as Radio Frequency Identification (RFID), which has the potential to drive productivity and efficiency. However, RFID adoption in the country has been sluggish, and despite the importance of human factors in RFID adoption, research in this field has remained sparse. This research study addresses this gap by determining the human factors influencing RFID technology adoption in the South African wholesale distribution industry.

To achieve the study's objectives, widely used and previously validated measuring scales were used to gather the empirical data by uniquely integrating the TRI 2.0 and UTAUT models. A cross-sectional survey design and the statistical techniques of ANOVA, t-tests, and Linear Regression Analysis, amongst others, were used to measure and predict the readiness and behavioural intention to accept RFID technology from a sample of 117 potential users and implementors of the technology from an organisation in the industry.

This study empirically showed that, in general, workers and managers in the wholesale distribution industry regard themselves as ready and willing to accept and adopt RFID technology in that the study identified Performance Expectancy, Effort Expectancy, Social Influence, Attitude toward Using Technology, Self-Efficacy, Technology Readiness and RFID awareness as human factors influencing RFID technology adoption in the industry.

Conclusions were drawn based on the outcomes of this study of the human factors influencing RFID technology adoption in the South African wholesale distribution industry. In addition, this study contributed to the industry by formulating appropriate practical recommendations and an implementation plan for management to consider and prepare wholesale distribution organisations to adopt RFID technology successfully. Furthermore, this study is one of only a limited number of local studies known to have been conducted to determine the human factors influencing RFID technology adoption. The significance of the study could thus be instrumental in enabling greater adoption of the technology in South Africa.

LIST OF KEY CONCEPTS

This section provides brief descriptions of the key concepts applied in this study:

Behavioural Intention (BI): is the eagerness with which an individual considers the formal adoption of innovation once it becomes readily available (Plouffe *et al.*, 2001:212). BI represents the motivation to adopt new technology. It is the outcome variable in a complex set of variables called UTAUT, as defined below.

Human Factors: is defined as all physical, psychological, and social qualities of individuals that influence socio-technical system activity and is concerned with the knowledge of interactions among humans and other system elements, as well as a profession that uses theory, concepts, data, and methodologies design to enhance human well-being and overall system performance (Cimini *et al.*, 2021:101; Stern & Becker, 2019:4).

Radio frequency identification (RFID): is defined as an identification technology that employs radio frequencies to detect, locate, track, and identify tagged objects (Badru & Ajayi, 2017:8; Gladysz *et al.*, 2021:42; Maruthaveni & Kathiresan, 2018:62; Tan *et al.*, 2021:1755). The technology distinguishes objects using radio transponders, known as RFID tags (Khazetdinov *et al.*, 2020:265). RFID technology commonly consists of three key components: an RFID tag, an RFID reader, and middleware with a software database storing the unique identification of every tagged object (Akhtar *et al.*, 2020:271; Khazetdinov *et al.*, 2020:265; Tan *et al.*, 2021:1755).

Technology: Refers to devices and systems used to solve real-world problems (Andersson *et al.*, 2016:154). Furthermore, we define technology as the invention, design, or discovery of something that serves a particular purpose from a purely materialistic standpoint without needing humankind to be responsible for it (Carroll, 2017:18).

Technology Acceptance: Technology acceptance reflects the attitude and behaviour of individuals towards technology and its use (Donmez-Turan & Zehir, 2021:1718; Macedo, 2017:935). Identifying the technology acceptance of users is critical since it ultimately may result in the success or failure of the adopted technology (Pangriya & Singh, 2021:1). Technology acceptance is different to readiness in that it refers to the willingness to adopt technology by directing behaviour towards incorporating technology. Readiness

represents a general attitude towards technology that enables a person to direct behaviour towards adopting a technology.

Technology Adoption: We define technology adoption as the use and acceptance of new technology in society (Kundu, 2021:24). Technology adoption is also a decision that an individual or organisation makes to acquire, implement, or utilise a technology (Tatnall & Burgess, 2009:41).

Technology Readiness (TR): Society's propensity to accept and use new technologies at home and work to achieve goals (Parasuraman, 2000:308). The morale and productivity of employees may decline if they are uncomfortable or lack confidence in new technology (Parasuraman & Colby, 2015:2). TR, alongside BI, represents the potential for an organisation to adopt new technologies.

Technology Readiness Index 2.0 (TRI 2.0): This is a standardised scale developed by Parasuraman and Colby (2015:1) to measure and classify individuals by their propensity to adopt and embrace technology at work or home. Derived from literature and feedback from users of the earliest version of the Technology Readiness Index, this now widely used measure assesses the technology readiness of individuals and is a proven and robust predictor of technology-related behavioural intentions and actual behaviours.

UTAUT: Venkatesh, Morris, Davis, and Davis (2003:425) established a theoretical framework or model to assess and comprehend people's behavioural intention towards technology acceptance and adoption. The Unified Theory of Acceptance and Use of Technology (UTAUT) model was derived from multiple theoretical frameworks on technology use and adoption to analyse technology adoption and acceptance in various organisational situations. The theory contains several human attitude and behaviour factors reflecting acceptance and adoption of technology. It is a widely used theoretical perspective for studying technology adoption and acceptance in multiple business contexts. The concept is of special value in management sciences with interest in facilitating technological change in organisations.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	I
ABSTRACT	I
LIST OF KEY CONCEPTS	II
LIST OF ABBREVIATIONS	XI
LIST OF TABLES	XII
LIST OF FIGURES	XIV
CHAPTER 1: INTRODUCTION TO THE RESEARCH	1
1.1 INTRODUCTION	1
1.2 BACKGROUND TO THE STUDY	2
1.3 PROBLEM STATEMENT	3
1.4 RESEARCH OBJECTIVES	4
1.4.1 Primary objective	4
1.4.2 Secondary objectives	4
1.5 EXPECTED CONTRIBUTION OF THE STUDY	5
1.6 SCOPE OF THE STUDY	5
1.6.1 Field of the study	5
1.6.2 Industry investigated.....	5
1.6.3 Geographical demarcation	7
1.7 RESEARCH METHODOLOGY	8
1.7.1 Literature Study	8
1.7.2 Empirical Study	8

1.7.2.1	Research approach and design	9
1.7.2.2	Population and sample	9
1.7.2.3	Measuring instrument	9
1.7.2.4	Data collection.....	10
1.7.2.5	Statistical data analysis	11
1.7.2.6	Strategies used to ensure data integrity and quality	11
1.8	LAYOUT OF THE STUDY AND CHAPTER DIVISION	11
1.9	CHAPTER SUMMARY	13
CHAPTER 2: LITERATURE REVIEW		14
2.1	INTRODUCTION.....	14
2.2	DEFINING RFID TECHNOLOGY	14
2.3	THE EVOLUTION OF RFID TECHNOLOGY	15
2.4	RFID SYSTEM OVERVIEW	16
2.5	RFID COMPONENTS	18
2.5.1	RFID tags	18
2.5.2	RFID readers.....	19
2.5.3	RFID middleware.....	20
2.6	THE APPLICATION AND BENEFITS OF RFID IN THE INDUSTRY	20
2.7	DETERMINANTS AND BARRIERS TO RFID ADOPTION	22
2.8	RFID TECHNOLOGY AWARENESS.....	24
2.9	FUTURE OF RFID AND MODERN TECHNOLOGY COLLABORATION	24

2.10	HUMAN FACTORS INFLUENCING TECHNOLOGY ADOPTION	26
2.11	THEORETICAL BACKGROUND	27
2.11.1	Technology Readiness Index	28
2.11.2	Unified Theory of Acceptance and Use of Technology (UTAUT)	29
2.12	CONCEPTUAL FRAMEWORK.....	32
2.12.1	Performance Expectancy (PE)	33
2.12.2	Effort Expectancy (EE)	34
2.12.3	Social Influence (SI)	34
2.12.4	Self-Efficacy (SE)	34
2.12.5	Attitude toward using technology (ATUT)	34
2.12.6	Technology Readiness (TR)	35
2.12.7	Behavioural Intention (BI)	36
2.13	CHAPTER SUMMARY.....	36
 CHAPTER 3: RESEARCH METHODOLOGY.....		37
3.1	INTRODUCTION.....	37
3.2	RESEARCH DESIGN.....	37
3.3	THE RESEARCH UNION AS PARADIGM FOR DEVELOPING THE RESEARCH FRAMEWORK	38
3.3.1	Research paradigm	39
3.3.2	Research approach	40
3.3.3	Research strategy	40
3.3.4	Methodological choice	40

3.3.5	Time horizon	41
3.3.6	Study population.....	41
3.3.7	Sampling	44
3.3.8	The measurement tool used in this study	45
3.3.9	Collection of data.....	46
3.3.10	Reliability and validity	47
3.3.11	Statistical analysis	47
3.4	ETHICAL CONSIDERATIONS.....	48
3.4.1	Advertising and recruitment	49
3.4.2	Risk and benefit analysis	49
3.4.3	Voluntary participation and confidentiality	49
3.4.4	Informed consent.....	50
3.4.5	Incentives	50
3.4.6	Permissions.....	50
3.4.7	Preventing conflicts of interest	51
3.5	CHAPTER SUMMARY.....	51
CHAPTER 4: EMPIRICAL RESULTS AND FINDINGS		52
4.1	INTRODUCTION.....	52
4.2	REALISED SAMPLE	52
4.3	DEMOGRAPHIC AND RFID TECHNOLOGY AWARENESS INFORMATION.....	53
4.3.1	Age of respondents	53

4.3.2	Highest qualification	54
4.3.3	The geographical location of the respondents	54
4.3.4	Industry	55
4.3.5	Position	56
4.3.6	Work experience	56
4.3.7	RFID technology awareness.....	57
4.4	DESCRIPTIVE STATISTICS AND FREQUENCY ANALYSIS	58
4.4.1	Technology Readiness measurement	58
4.4.2	Technology acceptance based on UTAUT dimensions.....	61
4.5	RELIABILITY OF THE MEASUREMENT SCALE.....	65
4.6	DESCRIPTIVE STATISTICS SUMMARY.....	67
4.7	GROUP COMPARISONS	67
4.7.1	ANOVA: Age	68
4.7.2	ANOVA: Work experience	68
4.7.3	ANOVA: Qualification	69
4.7.4	ANOVA: Position	71
4.7.5	T-test: Industry	72
4.7.6	T-test: Geographical location.....	72
4.7.7	T-test: RFID technology Awareness	73
4.7.8	Cross tabulation: RFID Awareness.....	75
4.8	SPEARMAN'S RHO CORRELATIONS AMONG TRI 2.0 AND UTAUT DIMENSIONS.....	76

4.9	LINEAR REGRESSION ANALYSIS	78
4.10	KEY FINDINGS.....	80
4.11	CHAPTER SUMMARY.....	82
	CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS	83
5.1	INTRODUCTION.....	83
5.2	CONCLUSIONS.....	83
5.3	RECOMMENDATIONS TO MANagements OF WAREHOUSE DISTRIBUTION ORGANISATIONS.....	85
5.4	MANAGERIAL IMPLICATIONS.....	88
5.5	ACHIEVEMENT OF THE STUDY OBJECTIVES.....	90
5.5.1	Secondary research objective one.....	90
5.5.2	Secondary research objective two.....	90
5.5.3	Secondary research objective three.....	91
5.5.4	Secondary research objective four.....	91
5.5.5	Primary research objective.....	92
5.6	CONTRIBUTION OF THE STUDY.....	92
5.7	LIMITATIONS OF THE STUDY.....	93
5.8	RECOMMENDATIONS FOR FUTURE RESEARCH.....	93
5.9	CONCLUDING STUDY SUMMARY.....	94
	REFERENCE LIST	95
	APPENDICES.....	105
	APPENDIX 1: SURVEY QUESTIONNAIRE WITH INFORMED CONSENT.....	105

APPENDIX 2: PERMISSION LETTERS FROM THE ORGANISATION.....	118
APPENDIX 3: NWU ETHICS APPROVAL LETTER OF STUDY	120
APPENDIX 4: RESPONDENT RECRUITMENT ADVERT	122
APPENDIX 5: LICENCES AND PERMISSION TO USE UTAUT AND TRI 2.0.....	124
APPENDIX 6: ANOVA RESULTS REGARDING AGE	126
APPENDIX 7: ANOVA RESULTS REGARDING WORK EXPERIENCE	127
APPENDIX 8: T-TEST RESULTS REGARDING INDUSTRY	128

LIST OF ABBREVIATIONS

ABBREVIATION	DESCRIPTION
<i>ATUT</i>	Attitude toward Using Technology
<i>BI</i>	Behavioural Intention
<i>DIS</i>	Discomfort Statements
<i>EE</i>	Effort Expectancy
<i>FMCG</i>	Fast-Moving Consumer Goods
<i>FC</i>	Facilitating Conditions
<i>I4</i>	Industry 4.0
<i>INN</i>	Innovativeness Statements
<i>INS</i>	Insecurity Statements
<i>IoT</i>	Internet of Things
<i>PC</i>	Personal Computer
<i>PE</i>	Performance Expectancy
<i>OPT</i>	Optimism Statements
<i>RFID</i>	Radio Frequency Identification
<i>SE</i>	Self-Efficacy
<i>SI</i>	Social Influence
<i>TR</i>	Technology Readiness
<i>TRI 2.0</i>	Technology Readiness Index 2.0
<i>TRINH</i>	Technology Readiness Inhibitors
<i>TRM</i>	Technology Readiness Motivators
<i>UTAUT</i>	Unified Theory of Acceptance and Use of Technology

LIST OF TABLES

Table 2-1: RFID adoption benefits..... 22

Table 2-2: Barriers to RFID adoption..... 23

Table 2-3: TRI 2.0 dimensions 28

Table 3-1: Study population components and rationale 43

Table 4-1: Technology Readiness belief statements 59

Table 4-2: Technology Readiness toward technology adoption..... 60

Table 4-3: Performance Expectancy (PE) statements 61

Table 4-4: Effort Expectancy (EE) statements..... 62

Table 4-5: Social Influence (SI) statements 62

Table 4-6: Attitude toward Using Technology (ATUT) statements 63

Table 4-7: Self-Efficacy (SE) statements 64

Table 4-8: Behavioural Intention (BI) statements..... 64

Table 4-9: Scale reliability 66

Table 4-10: ANOVA results regarding respondent's qualifications..... 69

Table 4-11: ANOVA results regarding respondent's position 71

Table 4-12: T-test results of respondent's geographical location 73

Table 4-13: T-test results of respondent's RFID technology awareness 74

Table 4-14: Cross tabulation results of respondent's RFID technology awareness..... 75

Table 4-15: Spearman's Rho correlations with all scale dimensions 77

Table 4-16:	Regression model Coefficient data.....	78
Table 5-1:	RFID implementation plan.....	89

LIST OF FIGURES

Figure 1-1: The number of pharmaceutical wholesalers per province 6

Figure 1-2: Geographical demarcation of the research sites..... 7

Figure 1-3: Chapter division 12

Figure 2-1: A basic RFID system..... 17

Figure 2-2: RFID tag..... 18

Figure 2-3: RFID tag classification based on the operating frequency 19

Figure 2-4: TRI 2.0 scale 29

Figure 2-5: UTAUT model 30

Figure 2-6: Conceptual study framework 33

Figure 3-1: The research onion 38

Figure 4-1: Age of respondents 53

Figure 4-2: Highest qualification held by respondents 54

Figure 4-3: Geographical location of respondents 55

Figure 4-4: Industry wherein respondent’s work 55

Figure 4-5: Position held by respondents 56

Figure 4-6: Years of work experience..... 57

Figure 4-7: Respondents' RFID technology awareness 57

Figure 4-8: Scale dimension mean score summary 67

Figure 4-9: Summary of the key empirical results 80

CHAPTER 1: INTRODUCTION TO THE RESEARCH

1.1 INTRODUCTION

Technology has revolutionised our lives, and its impact is noticeable in every aspect of human life. Countless recent technological innovations have transformed how we live, work, and interact. Radio Frequency Identification (RFID) is one of these technological innovations, which has created new horizons for its users. The technology has increased productivity and convenience in human work, and the benefits of RFID technology are evident in most sectors, including supply chain and warehousing (Akhtar *et al.*, 2020:269; Seng & Yew, 2019:144). The focus of warehouses has evolved significantly over the last three decades in response to shifts in technology and the business environment (Kumar *et al.*, 2021:3472). As a result, warehouses play a vital role in supply chains and connect chain members by providing essential inbound, product storage, and outbound services (Seng & Yew, 2019:145). Since the 1990s, warehouses have gradually transformed from orthodox storerooms into sophisticated, automated, and advanced IT-enabled warehouses (Kumar *et al.*, 2021:3488). In addition, Richards (2014:2) stated that the influence of advanced technology adoption on logistics operations in warehouses might be as significant as the invention of the wheel ages ago.

Since the adoption of RFID by Wal-Mart and their suppliers in 2005, innovative technologies such as RFID have become a global trend, and several countries worldwide are actively trying to adopt the technology (Lee & Jung, 2016:68; Reddy *et al.*, 2018:596). This progressing trend of RFID technology applications and the growing external pressures on industries operating in the global market makes RFID adoption unavoidable (Liyanage & Gbededo, 2014:1). Despite this, several innovation-based technologies and organisations never reach their ultimate capacity because they fail to assess the readiness and acceptance of users for new technology (Pangriya & Singh, 2021:1). RFID-related research has recently escalated significantly, and the phenomenon signifies a high interest in RFID-associated activities, with particular emphasis on applications in supply chains (Casella *et al.*, 2022:1589). Furthermore, a revolution in information and research has been sparked by the adoption of RFID technology, which will reform conventional supply chains (Rafiquea *et al.*, 2022:1). In addition, Cimini *et al.* (2021:109) stated that the introduction of RFID has revolutionised warehouses. As a result, the

readiness to implement RFID affects the effectiveness of organisations and their related supply chain members in adopting this technology (Lyu *et al.*, 2014:112; Raza, 2021:639).

1.2 BACKGROUND TO THE STUDY

Wal-Mart and the US Department of Defence sparked tremendous interest in RFID technology in mid-2003 when they announced their intention to mandate suppliers to use RFID technology (Reddy *et al.*, 2018:296; Reyes *et al.*, 2016:801). Reyes *et al.* (2016:801) referred to this announcement as the *big bang* of RFID since numerous companies worldwide followed in their footsteps. According to Chanchaichujit *et al.* (2020:14), RFID technology hands organisations a competitive advantage by increasing customer loyalty and satisfaction. Lyu *et al.* (2014:118) stated that organisations could improve their strategic position by identifying areas where RFID technology can create business value. The initial step in this process is to ascertain the potential impacts of RFID and determine the benefits (Lyu *et al.*, 2014:118). In addition, Seng and Yew (2019:146) highlighted the need for further research on the factors influencing RFID technology adoption in supply chains to identify benefits, barriers, and criteria as sources of concern for RFID implementation decision-making. Chanchaichujit *et al.* (2020:17) further recommended that it would be practical for future researchers to study and understand the impact of various RFID barriers, such as the lack of awareness and knowledge.

Oni *et al.* (2011:357) emphasised the necessity to identify and resolve the RFID technology adoption barriers since it may promote the application and relevance of RFID in retail and other sectors in South Africa. Even though no known research has been conducted on this topic in the wholesale distribution industry in South Africa, several researchers identified various technological, organisational, and external factors influencing RFID adoption in the South African retail sector (Brown & Russell, 2007:250; Oni *et al.*, 2011:357; Upfold & Liu, 2010:16). However, human factors are considered the most significant factors influencing the transition towards the next logistics revolution and must thus be evaluated when the adoption of advanced technologies is considered (Cimini *et al.*, 2021:98,105). Hence, precisely in this context, the researcher aims to determine the human factors influencing RFID technology adoption. In particular, the study aims to determine individuals' readiness and acceptance of RFID technology in pharmaceutical and Fast-Moving Consumer Goods (FMCG) distribution wholesalers in

South Africa. The researcher argues that there is a need to determine the human factors influencing RFID technology adoption since knowing and understanding these factors will put practitioners in the best position to offer practical recommendations to address the problem of low RFID technology adoption. Indeed, only when we have performed a diagnosis can we provide practical solutions to the problem. In the case of the South African wholesale distribution industry that has been sluggish to adopt RFID technology, determining the human factors that influence the adoption of RFID technology is the very first step in addressing the problem of low adoption. Therefore, this study formulates appropriate practical recommendations that managers and practitioners can use to consider and prepare wholesale distribution organisations to adopt RFID technology successfully.

1.3 PROBLEM STATEMENT

The inception of the fourth industrial revolution is gaining impetus with the application of cutting-edge technologies, and the rapid rise in technological advances has transformed how customers buy, how businesses operate, and the speed at which these activities transpire (Mahroof, 2019:176; Zelbst *et al.*, 2019:441). Although RFID has been around for several years, it is still considered an emerging technology in supply chain management and one of the ten ground-breaking technologies to transform businesses across industries (Abugabah *et al.*, 2021:1335; Smith, 2021:122; Tan *et al.*, 2021:1754; Wamba *et al.*, 2016:1). However, the adoption and application of RFID in large-scale organisations have been lower than anticipated, and emerging countries such as South Africa are still exploring the advantages of RFID technology and have not yet fully adopted this technology (Badru & Ajayi, 2017:8; Brown & Russell, 2007:251; Wamba *et al.*, 2016:1). Furthermore, Abugabah *et al.* (2021:1336) noted that most previous RFID adoption studies focus primarily on environmental and organisational factors, while human and individual factors seemed to have received less research attention.

There are limited studies on the adoption of specifically RFID Technology in South Africa. For example, in a South African retail sector study, Brown and Russell (2007:250) identified several technological, organisational, and external factors influencing RFID adoption. Likewise, Upfold and Liu (2010:16) identified various technological, organisational, cost, privacy, security, and a limited number of people factors as barriers to RFID technology adoption. However, studies on the RFID adoption decisions of

individuals or users from a behavioural perspective remain sparse, and no known research study explicitly focused on the human factors influencing RFID technology adoption in the wholesale distribution industry in South Africa. This research intends to bridge this gap by identifying the role of human factors influencing the adoption of RFID technology. Addressing this problem will not only benefit the wholesale distribution industry and organisations in general with the implementation of RFID technology but also further the understanding of executive managers and management scientists on the strategic management of the workforce and all levels of management towards more effective adoption of technology in the workplace.

1.4 RESEARCH OBJECTIVES

The research objectives consist of a primary objective supported by four secondary objectives pertaining to RFID technology adoption. These objectives are defined in the subsections below.

1.4.1 Primary objective

The primary objective of this study is to identify the human factors influencing the adoption of RFID technology in the wholesale distribution industry in South Africa.

1.4.2 Secondary objectives

The following four secondary objectives support the primary objective:

- To perform a literature study to conceptualise the factors influencing RFID technology adoption.
- To empirically determine individuals' Technology Readiness (TR) and Behavioural Intention (BI) towards the acceptance and adoption of RFID technology based on the TRI 2.0 and UTAUT models.
- To determine the human drivers and barriers to RFID technology adoption by examining group differences in an empirical sample.
- To formulate appropriate practical recommendations that management can use to consider and prepare wholesale distribution organisations to adopt RFID technology successfully.

1.5 EXPECTED CONTRIBUTION OF THE STUDY

This study expects to contribute to the South African wholesale distribution industry and the Information Communication and Technology Management cluster at the NWU Business School by assisting local firms considering adopting RFID technology in making practical and informed decisions that facilitate the adoption and implementation of this technology.

1.6 SCOPE OF THE STUDY

1.6.1 Field of the study

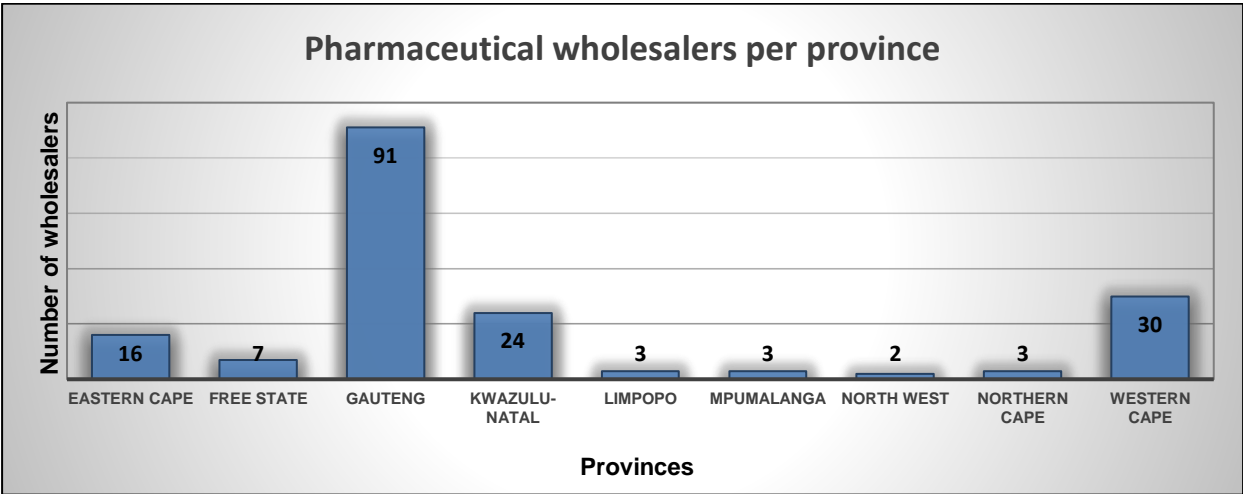
This study resorts under the Information Communication and Technology Management cluster of the NWU Business school.

1.6.2 Industry investigated

The industry investigated in this study is the wholesale distribution industry since the supply chains of Fast-Moving Consumer Goods (FMCG) and pharmaceutical companies rely heavily on wholesale and distribution to facilitate the supply of products to retail outlets countrywide (Bisschoff & Barnard, 2019:23; Mathu & Phetla, 2018:4). The terms "wholesaler" and "distributor" relate to similar operations and responsibilities in the functioning of supply chain channels and are thus frequently used interchangeably in the literature. However, a distributor is generally defined as an agent that acts on behalf of manufacturers to distribute their products to other warehouses and retailers, whereas wholesalers purchase products in bulk for their own account to sell to retailers in smaller quantities (Bisschoff & Barnard, 2019:26). Stats SA (2021:11) characterise wholesalers as corporations generating fifty per cent or more of their revenue from the sale of goods to other businesses and institutions. In 2021, the wholesale trade sales in South Africa totalled R2 601 259 million (Stats SA, 2021:5). The Helen Suzman Foundation (2018:31) found that while some firms specialise in wholesale and others in distribution, many larger firms operate as both wholesalers and distributors in this sector. In addition, most of the country's leading corporate retail pharmacy groups have backwards integrated with distributors and wholesalers to establish their own distribution networks (Helen Suzman Foundation, 2018:25).

Wholesale distribution is an important aspect of the South African medicine supply chain since wholesalers are responsible for the safe, effective, and efficient handling, storage, and distribution of pharmaceutical products to public and private healthcare facilities. Many pharmaceutical wholesalers distribute products all over South Africa, and they, like any other business, must strive to remain competitive (Bisschoff & Barnard, 2019:12; SAHPRA, 2016:874). According to a Helen Suzman Foundation (2018:31) report on pharmaceutical supply in South Africa, the fifteen largest pharmaceutical wholesalers in South Africa account for nearly ninety-five per cent of wholesale sales. There are one hundred and seventy-nine private pharmaceutical wholesalers registered in South Africa, according to the South African Pharmacy Council (2022). Most of these pharmaceutical wholesalers are located in Gauteng, numbering ninety-one, followed by thirty in the Western Cape and twenty-four in Kwazulu-Natal. The distribution of pharmaceutical wholesalers in South Africa is illustrated in Figure 1-1.

Figure 1-1: The number of pharmaceutical wholesalers per province



Source: South African Pharmacy Council (2022)

According to Bisschoff and Barnard (2019:23), customers of pharmaceutical wholesalers in the country expect a reliable delivery service of quality medication at a competitive price and consistently delivered on schedule. Furthermore, the researchers emphasised that any error made by wholesalers is unacceptable since they can directly influence the service quality offered by healthcare providers to their clients and the health and safety of their patients (Bisschoff & Barnard, 2019:23). Cimini *et al.* (2021:4) stated that warehouse operators could benefit from using technologies that complement

their existing competencies, allowing them to be more efficient, reduce errors, and enhance performance without requiring personnel to be replaced.

1.6.3 Geographical demarcation

The study respondents were individuals employed by a market-leading wholesale distribution organisation with eight warehouses strategically positioned in selected provinces in South Africa. The organisation distributes pharmaceutical, cosmetic and FMCG products to various pharmacies, hospitals, doctors, emergency medical services, clinics, and the FMCG retail market. The organisation and selected warehouses were deemed appropriate study sites for this research since it is one of the largest wholesale distribution organisations with a national footprint, distributing a wide variety of products to its stores and numerous independent customers countrywide. Therefore, the researcher believes that the organisation represents the broader wholesale distribution industry reasonably well. Furthermore, the organisation is expanding rapidly and is continuously seeking innovative solutions and technologies to improve operational efficiency and productivity. The name of the organisation is not disclosed for confidentiality reasons. The locations of the research sites are illustrated in Figure 1-2.

Figure 1-2: Geographical demarcation of the research sites



Source: Own Compilation

1.7 RESEARCH METHODOLOGY

To achieve the study objectives, the research methodology for conducting this study was undertaken in two phases: a literature review followed by an empirical study.

1.7.1 Literature Study

The first phase of this study employed the services of the North-West University's library to locate relevant literature, including university-supported databases such as Boloka, EDS search, Google Scholar, and others. Key search words included "RFID," "technology adoption," "technology acceptance," "technology readiness," "warehouse," "wholesaler," "supply chain," and "human factors". In addition, articles were scanned and read for relevance. The inclusion criteria were journals, peer-reviewed conference proceedings, articles, books, and dissertations published in English between 2017 and 2022.

The literature study assisted the researcher in understanding the contextual barriers and facilitators for the adoption of RFID technology in other and similar industries within the supply chain sector. The literature study further enhanced the basis for the empirical study that followed as it presented the theoretical framework against which the study results are interpreted. Furthermore, the literature review aimed to familiarise the reader with the fundamentals of RFID technology and conceptualise the factors influencing RFID technology adoption from previous literature studies.

1.7.2 Empirical Study

The second phase of this study consisted of an empirical study to collect the primary research data within a South African wholesale distribution organisation. In this phase, the quantitative research design was employed using previously empirically validated measurement scales to gather data from respondents through an online, self-administered, and structured questionnaire survey, followed by statistical analysis to achieve the set study objectives. The methodological choices followed in the empirical study are outlined in the subsections below. The reasons for the appropriateness of the selected research design and methodology choices, including the data collection methods and analysis strategy for this study, are comprehensively discussed and explained in chapter 3.

1.7.2.1 Research approach and design

The researcher selected a quantitative research design, which followed a deductive approach as the most appropriate method to achieve the study objectives, namely, to identify the human factors influencing the adoption of RFID technology in the wholesale distribution industry in South Africa. A quantitative research design was chosen since it is the preferred method to solve a research problem that requires the identification of factors that influence an outcome, in this case, RFID technology adoption (Creswell, 2014:50). Furthermore, the study adopted a cross-sectional research design to collect the primary research data from the target population in that the respondents completed a self-administered online questionnaire at a particular moment in time.

1.7.2.2 Population and sample

The target population for this study consisted of approximately 2000 warehouse workers, managers, and IT personnel, as indicated by the organisation. Even though the study was conducted on a single organisation, the study was not narrowly focused since the target population comprehensively included all users, management levels, implementors and decision-makers in a large wholesale distribution organisation with eight warehouses strategically positioned in four different provinces to gain the necessary stakeholder representation and valuable variation in opinions. Specified inclusion and exclusion criteria were applied during the sampling process, and the necessary steps were taken to ensure the respondents met the relevant criteria, which are further discussed in section 3.3.6 of chapter 3. The study utilised the non-probability sampling technique of convenience sampling since the organisation where the study was conducted was not permitted to provide the researcher with an employee list for sampling purposes due to the regulations pertaining to the Protection of Personal Information Act 4 of 2013.

1.7.2.3 Measuring instrument

Since limited studies explicitly focused on the human factors influencing RFID technology adoption, this study required an appropriate measurement tool to measure the Technology Readiness (TR) and Behavioural Intention (BI) of individuals employed in the South African wholesale distribution industry to adopt RFID technology (Abugabah *et al.*, 2021:1336). Thus, the *Technology Readiness Index* (TRI 2.0) was integrated into the *Unified Theory of Acceptance and Use of Technology* (UTAUT) model. Both these models

have been widely used, tested comprehensively and are broadly believed to be the most effective and latest methods to determine technology acceptance and readiness in different populations (Chang *et al.*, 2020:2; Hewavitharana *et al.*, 2021:7; Parasuraman & Colby, 2015:14; Tang *et al.*, 2019:202; Zainab *et al.*, 2018:18).

Since the adoption of RFID technology in South African wholesalers has been relatively low, this study was regarded as a pre-adoption study in that the respondents were asked questions regarding how they would feel about the use of RFID technology in their work context. To provide focus to the prospective respondents and prevent vague and inconsistent responses due to the misperception of RFID technology, the researcher aimed first to accustom the prospective respondents to the appropriate conceptualisation of RFID technology. Therefore, an overview of RFID was given by including a brief description and images in the introduction of the survey questionnaire to familiarise the respondents with the technology and visually demonstrate the application of RFID technology. An online survey with a Likert scale questionnaire consisting of three main sections: (1) demographical information, including age, experience and RFID awareness as variables related to the intention to adopt RFID technology, (2) Technology Readiness, and (3) UTAUT items were compiled using the SurveyMonkey® platform to collect the primary research data. Refer to Appendix 1 for the survey questionnaire.

1.7.2.4 Data collection

Meetings were held with the Director, Logistics Executive, and the Human Resources (HR) department manager of the organisation to request permission to conduct the research by administering a paper survey questionnaire since many prospective respondents did not have access to e-mails. Unfortunately, due to operational constraints, the organisation rejected the request to administer paper questionnaires to respondents. However, the organisation kindly agreed to distribute the survey link on behalf of the researcher. In light of the information mentioned above, the HR department manager distributed the SurveyMonkey® link via e-mail to the respondents with access to e-mails. In addition, the logistics managers in the relevant warehouses distributed the survey link via WhatsApp® to the respondents without e-mail access. Thus, the primary data required to meet the study objectives were collected through an online, self-administered, and structured questionnaire survey using the SurveyMonkey® platform. Refer to Appendix 2 for the permission letters from the organisation to conduct the study.

1.7.2.5 Statistical data analysis

The statistical analysis of the research data was undertaken with the professional support and guidance of Dr E Fourie from the Statistical Consultation Services of the North-West University. The primary research data recorded from the SurveyMonkey® questionnaire was transferred to a Microsoft Excel® spreadsheet, coded and imported into the Statistical Package for Social Sciences (SPSS) version 27.0. Subsequently, several statistical techniques were applied to analyse the research data, which are discussed in-depth in section 3.3.11 of chapter 3.

1.7.2.6 Strategies used to ensure data integrity and quality

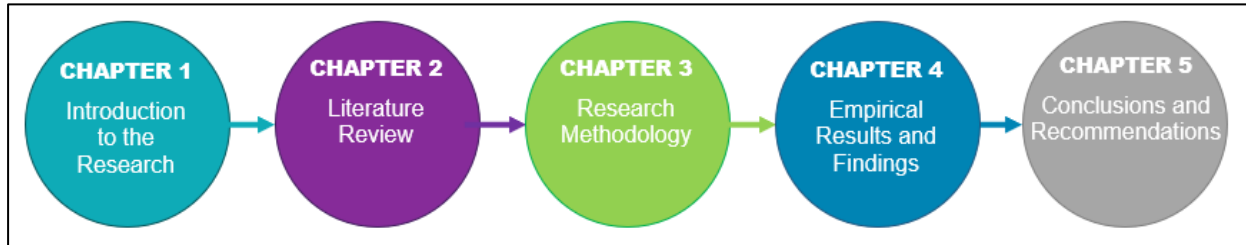
A thorough literature review covering the most recent studies and theoretical models for this research study was conducted to ensure the research data's integrity and relevance. The proposed research methodology was considered appropriate to achieve the study's objectives since the NWU Business School Scientific Committee approved the research design for this study. Data was collected from reliable sources under the appropriate circumstances, and the necessary authorisation was obtained from the organisation's director to conduct the study. The data collection process was well-defined, which resulted in the collection of integral and quality data. Primary data collection commenced after ethical approval was obtained from the Economic and Management Sciences Research Ethics Committee (EMS-REC) of the North-West University. In addition, the SurveyMonkey® platform permitted the respondents to complete the survey only once to prevent duplications or multiple participation in the study. Subsequently, the statistical analysis of the research data was undertaken with support and guidance from the Statistical Consultation Services of the North-West University to ensure the quality and correctness of the data analysis.

1.8 LAYOUT OF THE STUDY AND CHAPTER DIVISION

The layout of the research study followed the guidelines of the North-West University for master's degree mini-dissertations. The research report adhered to the technical and ethical principles of academic writing since the primary target audience is the examiners, research supervisors and relevant academic lecturers. This study has managerial implications for the management of wholesale distribution organisations and will thus be

shared with the management team of the research sites. The chapter division of this research report is represented graphically in Figure 1-3.

Figure 1-3: Chapter division



Source: Own compilation

The research study report consists of five chapters, namely:

- **Chapter 1: Introduction to the research**

This chapter introduces the research topic and provides the study's background. The problem statement then highlights the research gap to be filled. Whereafter, the chapter proceeds to set the objectives for resolving the problem, followed by a discussion of the study's expected contribution, scope and research methodology.

- **Chapter 2: Literature review**

The chapter aims to familiarise the reader with RFID technology fundamentals and conceptualise the factors influencing RFID technology adoption by conducting a comprehensive review of previous literature studies. Chapter 2 starts with a brief overview of the evolution of RFID technology, followed by a background discussion of RFID systems and the various components, benefits and application areas of the technology in warehousing and supply chain. Lastly, theoretical technology adoption models are discussed in-depth, and a conceptual framework is developed. Saunders *et al.* (2007:526) suggested that the literature review chapter is placed before the research methodology chapter in a research study report to set the study in its broader context.

- **Chapter 3: Research methodology**

Chapter 3 discuss and explain the reason for the appropriateness of the research design and methodology choices to achieve the study objectives. In particular, the study population, sampling, measurement scales, data analysis strategy and ethical considerations are comprehensively outlined in this chapter.

- **Chapter 4: Empirical results and findings**

The purpose of this chapter is to analyse the gathered data and provide a detailed report of the research results and findings. The chapter concludes with a summary of the study's key findings.

- **Chapter 5: Conclusions and recommendations**

The final chapter is devoted to drawing conclusions and making recommendations from the empirical results addressing the human factors influencing the adoption of RFID technology in the South African wholesale distribution industry. The chapter first draws conclusions and makes practical recommendations, followed by an appropriate RFID implementation plan that management can use to consider and prepare wholesale distribution organisations to successfully adopt RFID technology and thus enable greater adoption of the technology in South Africa. Subsequently, the chapter ascertains whether the study's research objectives were achieved. To conclude, the study's limitations are underscored, and recommendations for further research are tendered, followed by the study summary.

1.9 CHAPTER SUMMARY

This first chapter introduced the research topic, which is determining the human factors influencing the adoption of RFID technology in the South African wholesale distribution industry and provided the study's background. The formulated problem statement then highlighted the researched gap to be filled, whereafter, the chapter proceeded to set the objectives to resolve the research problem, followed by a discussion of the study's expected contribution, scope and research methodology. The next chapter, Chapter 2, entails a comprehensive literature review study aiming to familiarise the reader with the fundamentals of RFID technology and conceptualise the factors influencing the adoption of RFID technology from previous literature studies.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Automated warehouses known today are essentially defined by the use of automated storage and retrieval systems and RFID technology (Kumar *et al.*, 2021:3488). Most of the modern technology-related keywords in recent literature are linked to RFID, which signifies that the fundamental principles of automated devices are founded on RFID technology (Kumar *et al.*, 2021:3476; Zhou *et al.*, 2017:99). RFID is one of the modern technologies that has transformed and revolutionised human lives with applications of the technology used in vehicle theft prevention, employee access control, library book and animal tracking, seamless toll collection and supply chain automation systems (Akhtar *et al.*, 2020:269; Badru & Ajayi, 2017:1). RFID is ubiquitous and progressively seamless, with millions of individuals utilising RFID systems daily, without even realising it, as seen by access to regulated workspaces and the use of electronic car keys. In recent years RFID has nearly become inescapable in access control and logistics applications, where it is employed for its primary function: identification (Duroc & Tedjini, 2018:67).

This literature study aims to familiarise the reader with RFID technology fundamentals and conceptualise the factors influencing RFID technology adoption from previous literature studies. The first section of this study starts with a brief overview of the evolution of RFID technology, followed by a background discussion of RFID systems and the various components, benefits and application areas of the technology in warehousing and supply chain. Lastly, theoretical technology adoption models are discussed in-depth, and a conceptual framework is developed.

2.2 DEFINING RFID TECHNOLOGY

RFID technology is classified under the technology group known as Automatic Identification and Data Capture devices (Kgobe & Ozor, 2021:291; Reddy *et al.*, 2018:599). Researchers have defined RFID differently in literature: Maruthaveni and Kathiresan (2018:62) defined RFID as "Automatic identification technology which uses radio-frequency electromagnetic fields to identify objects carrying tags when they come close to a reader". In comparison, Tan *et al.* (2021:1755) described the technology as an automatic identification device that uses electromagnetic signals to detect, identify and

track an array of objects such as inventory, workforce, vehicles, and other assets. However, Gladysz *et al.* (2021:42) defined RFID as any technology employing radio frequencies to identify objects in a supply chain. Furthermore, according to Badru and Ajayi (2017:8), RFID is an identification technology that utilises radio waves to detect and locate objects efficiently and conveniently. The technology distinguishes objects using radio transponders, known as RFID tags (Khazetdinov *et al.*, 2020:265). RFID technology commonly consists of three key components: an RFID tag, an RFID reader and middleware with a software database storing the unique identification of every tagged object (Akhtar *et al.*, 2020:271; Khazetdinov *et al.*, 2020:265; Tan *et al.*, 2021:1755). For this study, RFID is defined as an identification technology that employs radio frequencies to detect, locate, track, and identify tagged objects.

2.3 THE EVOLUTION OF RFID TECHNOLOGY

RFID technology has significantly evolved in recent years from a technology that can only locate and identify an object to a highly sophisticated technology with the ability to sense environmental factors around an object, such as temperature activities, which has resulted in a worldwide adoption surge (Badru & Ajayi, 2017:8). However, the technology has been available for nearly a century, and Landt (2005:8) argued that the evolutionary development of RFID began as early as the 1600s. According to Rieback *et al.* (2006:62), the dawn of radio technology in 1901 acted as the primary prerequisite for RFID when Guglielmo Marconi transmitted radio signals across the Atlantic. This development was followed by the invention of the radar by Sir Alexander Watson-Watt in 1935, when he demonstrated how his device could locate physical objects using radio waves (Rieback *et al.*, 2006:62). The convergence of radar and radio broadcast technology followed shortly after the invention of the radar to conceptualise the idea of RFID (Landt, 2005:9). The first practical application of the technology dates back to World War II when the British utilised RFID principles in their Identification Friend or Foe (IFF) system to distinguish between friendly and enemy warplanes (Casella *et al.*, 2022:1583; Landt, 2005:9; Rieback *et al.*, 2006:62; Want, 2006:26). The development continued after the war, and the 1950s represented an area of RFID exploration (Landt, 2005:9).

RFID commercial endeavours commenced in the 1960s, and the theories developed in this period formed the foundation for the RFID explosion that followed in the 1970s. The 1970s signalled a revolutionary breakthrough in RFID development with several

academic institutions, government laboratories, inventors and developers actively working on RFID. The 1970s also witnessed the development of passive RFID tags with improved functionality and being smaller in size. The utilisation of low-power, low-voltage CMOS logic circuits was crucial in these developments (Landt, 2005:9). Between the 1980s and 1990s, worldwide RFID implementation occurred in numerous applications ranging from animal tracking to the first commercial toll collection in 1987 (Landt, 2005:10; Rieback *et al.*, 2006:64). The personal computer (PC) development that permitted cost-effective and convenient data management and collection from RFID systems played a significant role in the rapid expansion of RFID applications. The RFID functionality improvements and research continued during the 1990s, representing a profound decade for RFID that made RFID part of our daily lives, with several innovations such as gated community and campus access control implementation (Akhtar *et al.*, 2020:270; Landt, 2005:10).

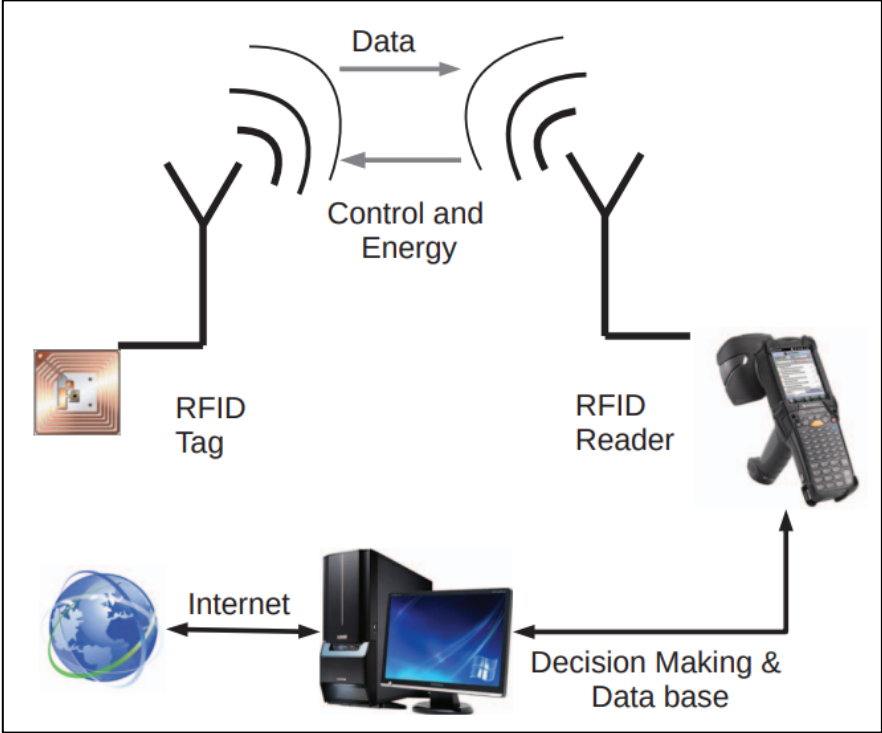
The evolution of RFID rapidly accelerated after the dawn of the twenty-first century to further induce RFID technology in our daily lives. The last two decades observed new applications of RFID technology in various aspects of our personal and working lives, such as the use of E-credit cards to pay for groceries, computerised vehicle identification, electronic licence cards, medical patient monitoring and history identification, supply chain tracking, stock identification and movement tracking (Akhtar *et al.*, 2020:270; Badru & Ajayi, 2017:1). Even though several RFID applications have been successfully adopted in various industries, the technology is continually evolving (Xu *et al.*, 2018:2946).

2.4 RFID SYSTEM OVERVIEW

RFID, according to its proponents, is a smart wireless technology for data gathering and real-time information visibility (Abugabah *et al.*, 2021:1335; Duroc & Tedjini, 2018:64). The technology has tremendous potential for use in a wide array of industries, including logistics, supply chain, engineering, healthcare, automotive and food safety management (Abugabah *et al.*, 2021:1335). RFID stands for Radio Frequency Identification and refers to non-contact systems that automatically employ radio waves to detect tags affixed to an object, thus identifying and locating the tagged objects. The beauty of the technology lies in the fact that the RFID reader does not require a clear line of sight of the RFID tag to get an accurate read, unlike barcode technology (Gladysz *et al.*, 2021:42; Soe & Aung, 2019:244; Tan *et al.*, 2021:1754; Zhou, 2019:1). A basic RFID system consists of a tag

with an integrated chip, an antenna, a reader, and a PC with middleware software (Khazetdinov *et al.*, 2020:265; Reddy *et al.*, 2018:594; Sharma & Hashmi, 2021:69841).

Figure 2-1: A basic RFID system



Source: Sanil *et al.* (2018:300)

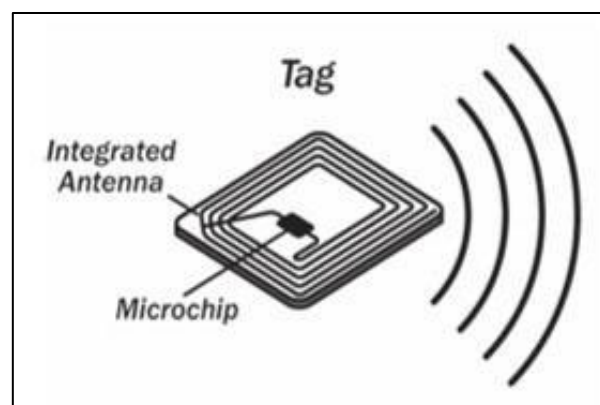
The primary information transmission occurs between the reader and the tag, as shown in the concept of a basic RFID system presented in Figure 2-1. An RFID reader can read data stored in an RFID tag from a distance within a specific range. The transceiver chip in the tags is activated when they come in proximity to an RFID reader's electromagnetic waves. The reader then uses the antenna to transfer the data stored on the tag to a middleware PC server for processing (Khazetdinov *et al.*, 2020:265; Sharma & Hashmi, 2021:69841; Soe & Aung, 2019:244). RFID middleware software can connect to the Internet of Things (IoT) to permit the system to detect, locate, track, and identify tagged objects for real-time information gathering and visibility. As a result, the technology is used in various warehouse applications to decrease shrinkage, improve material handling and tacking, and increase the accuracy of data collection (Seng & Yew, 2019:144; Tan *et al.*, 2021:1755).

2.5 RFID COMPONENTS

2.5.1 RFID tags

RFID tags, otherwise known as transponders, contain a microchip and an integrated antenna (Reddy *et al.*, 2018:594). A unique serial number with product information stored in the chip is transmitted to the reader when the tag is within range of the reader. Since RFID tags are considered a key component in RFID systems, the price of the tags is a significant contributor to the overall cost of RFID systems (Sharma & Hashmi, 2021:69841). RFID tags are generally characterised as passive or active tags (Tan *et al.*, 2021:1755). The passive tags are powered by the RFID reader's electromagnetic energy and do not require an internal power source. On the other hand, active tags have an internal battery and can hence connect with chips and readers. As a result, the transmission ranges of active tags are greater than those of passive tags (Akhtar *et al.*, 2020:271; Chanchaichujit *et al.*, 2020:4; Tan *et al.*, 2021:1755). Active tags are used to track items in real-time location by continuously delivering signals to the reader. The data density of tags plays a vital role in visualising data to provide valuable information to the user. Passive tags are less expensive and offer a similar data density as active tags. As a result, passive tags may be utilised to tag a vast number of items at a more economical deployment cost (Tan *et al.*, 2021:1755). The general design of an RFID tag is illustrated in Figure 2-2.

Figure 2-2: RFID tag

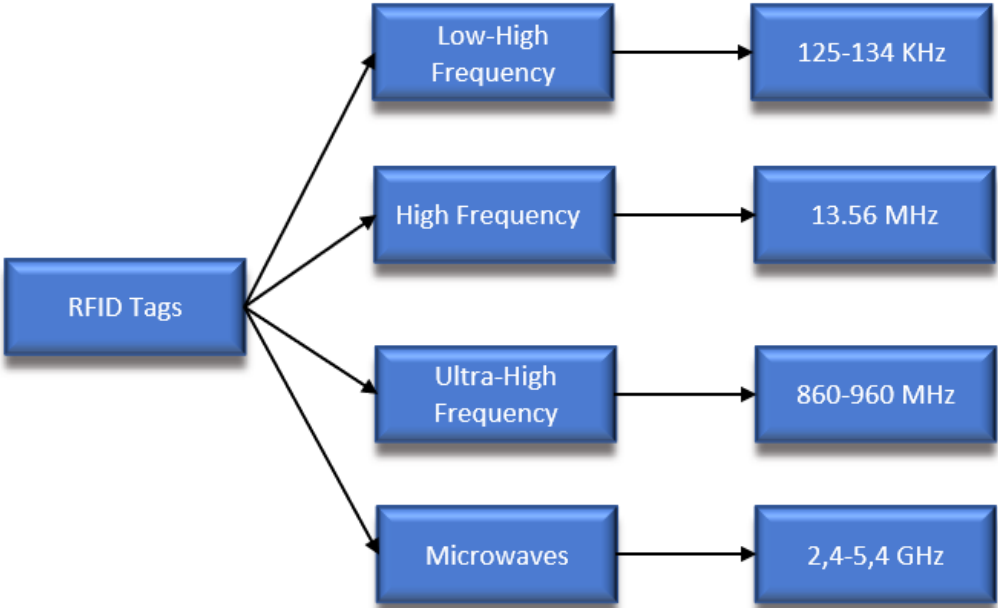


Source: Reddy *et al.* (2018:596)

RFID tags also operate at various frequencies, including low frequency, high frequency, ultra-high frequency, and microwave. These tag frequency ranges are selected based

on the specific application of use. For instance, RFID tags with high and ultra-high frequencies are commonly employed in supply chain applications (Agarwal & Ankolikar, 2022:3). The RFID tag classifications based on their operating frequency are illustrated in Figure 2-3.

Figure 2-3: RFID tag classification based on the operating frequency



Source: Adapted from Agarwal and Ankolikar (2022:3)

2.5.2 RFID readers

Using an RFID reader is comparable to using a barcode scanner. However, an RFID reader serves as both a transmitter and a receiver. The reader activates the tag, captures the signal from the tag, and delivers it to the middleware to be processed (Akhtar *et al.*, 2020:271; Sharma & Hashmi, 2021:69841). The reader's antenna determines the RFID system's decoding range, and tags must be inside the interrogation zone of the readers to be read. An RFID system configuration is based on a master-slave architecture, with the reader acting as the master since it controls the signal and the tag acting as the slave by responding to the signal. The reader is thus constantly connected to the middleware (Sharma & Hashmi, 2021:69841). The readers used in warehouses are commonly mobile handheld or stationary readers fitted to walls, doors, or fixed equipment. Stationary readers generally have a more extended tag reading range and are widely utilised in large businesses with high item flow traffic. Mobile readers have built-in antennas, and their reading range is substantially shorter than that of a stationary RFID reader. These readers

are battery-powered, lightweight devices utilised as portable handheld scanners (Khazetdinov *et al.*, 2020:265-266).

2.5.3 RFID middleware

Any RFID system revolves around the RFID middleware, which acts as the system's heart and is regarded as the tactile arrangement of RFID advancement since it provides vital features, such as the capable organisation of data generated by the RFID structure (Reddy *et al.*, 2018:597). The middleware consists of a PC with an RFID software application linking the reader and the data acquired from tags. The middleware includes features such as multiple synchronisations, hardware, scheduling, real-time data management, and application interfaces. It uses a variety of approaches to detect tags to gather and convey data. The middleware processes the data from the tags by taking the appropriate action and keeping the interface up to date for the encoding and decoding of information (Akhtar *et al.*, 2020:271; Sharma & Hashmi, 2021:69841). The middleware is in control of user monitoring, managing, isolating, preparing, and storing all the data gathered from the tags and directing the data to the appropriate information structures. Similarly, RFID middleware can be used to regulate and control the creation of RFID users (Reddy *et al.*, 2018:597).

2.6 THE APPLICATION AND BENEFITS OF RFID IN THE INDUSTRY

RFID technology has been around for decades and has a wide range of applications in healthcare, defence, security, the environment, agriculture, warehousing, and supply chain management (Seng & Yew, 2019:146; Tan *et al.*, 2021:1754). RFID technology enables the optimisation of various business processes by improving, automating, or even eliminating existing processes and the formation of new techniques known as intelligent processes or smart processes, which automatically trigger actions or occurrences (Soe & Aung, 2019:243). Unlike barcode scanners, which must align with the sight of the barcode to scan and retrieve information, RFID has automated sensing and recognition technology that does not require the line-of-sight of the tag to scan objects up to several meters away. When compared to barcode scanning systems, the removal of line-of-sight limits ensures improved information accuracy and thus hands RFID a distinct advantage over barcode technology (Chanchaichujit *et al.*, 2020:11; Gladysz *et al.*, 2021:42; Soe & Aung, 2019:244; Tan *et al.*, 2021:1754; Zhou, 2019:1).

Order picking systems to satisfy client orders, storage, and retrieval systems, checking items in and out of warehouses, and inventory management are just a few of the warehousing tasks where RFID technology applications are used (Custodio & Machado, 2020:542). In warehouses, RFID technology is used to track, sort, pick, route, and distribute tagged items from any location in the system (Custodio & Machado, 2020). In addition, mobile RFID readers can be attached to forklifts or other related equipment to increase the device's versatility of use in different warehouse activity areas (Reddy *et al.*, 2018:597). In the pharmaceutical supply chain, RFID applications are used to improve security and prevent losses due to counterfeit medication (Reddy *et al.*, 2018:599). According to Seng and Yew (2019:151), the use of RFID technology applications in warehouses has not yet reached its full potential.

Several researchers have documented the benefits of RFID technology adoption. Chanchaichujit *et al.* (2020:15) identified cost reduction, improved product quality and safety, reduced inventory discrepancies, enhanced real-time information sharing and integration, improved supply chain visibility, and large data capturing volumes for analytics as benefit drivers of RFID adoption in supply chains. In addition, Kgobe and Ozor (2021:296) stated that RFID technology has immense potential to generate value in an organisation and listed real-time information tracking, product visibility, reduction of out-of-stock products, and increasing capital as adoption benefits in supply chains. According to Kgobe and Ozor (2021:296), RFID technology has proven to be an effective method to track inventory and improve supply chain management in general. Furthermore, Seng and Yew (2019:151) documented enhanced inventory management, improved warehouse operations, and reduced warehouse operational expenses as RFID adoption benefits in warehouses. Zelbst *et al.* (2019:453) stated that RFID technology favourably impacts an organisation's performance and ability to synchronously communicate real-time information and data among supply chain members. Ultimately, RFID aids in improving inventory accuracy as well as reducing inventory cycle times. At the very least, effective tracking may prevent unjustified errors and reduce the frequency of out-of-stock situations for organisations. Essentially, RFID technology can increase sales and lower loss prevention costs, eventually leading to profitability. In addition, RFID systems increase supply chain management logistics efficiency and productivity by lowering labour costs and product cycle time (Kgobe & Ozor, 2021:296;

Seng & Yew, 2019:146). The benefits of RFID technology adoption are summarised in Table 2-1.

Table 2-1: RFID adoption benefits

Adoption benefit	Source
Automatic identification	Seng and Yew (2019:147)
Improved information sharing	Seng and Yew (2019:147)
Improved operation processes	Seng and Yew (2019:146)
Improved product quality and safety	Chanchaichujit <i>et al.</i> (2020:15)
Improved product visibility	Chanchaichujit <i>et al.</i> (2020:15); Kgobe and Ozor (2021:296)
Increased data accuracy	Seng and Yew (2019:147)
Increasing capital	Kgobe and Ozor (2021:296)
Real-time information tracking	Chanchaichujit <i>et al.</i> (2020:15); Kgobe and Ozor (2021:296); Zelbst <i>et al.</i> (2019:453)
Reduced inventory discrepancies	Chanchaichujit <i>et al.</i> (2020:15); Seng and Yew (2019:147)
Reduced material handling	Seng and Yew (2019:147)
Reduction of out-of-stock products	Kgobe and Ozor (2021:296)
Reduced operating costs	Chanchaichujit <i>et al.</i> (2020:15); Seng and Yew (2019:147)

2.7 DETERMINANTS AND BARRIERS TO RFID ADOPTION

Rafiquea *et al.* (2022:2) argued that the adoption of RFID technology by supply chain organisations depends on numerous factors, some of which drive its adoption while others act as barriers to it. Despite the abundance of benefits, RFID adoption comes with hurdles and concerns such as the cost of tags, lack of product features, the uncertainty of return on investment, shortage of skilled workers, lack of RFID technology awareness and the popularity of paper barcode labels (Kgobe & Ozor, 2021:296; Seng & Yew, 2019:151). Seng and Yew (2019:149) further identified technical expertise, cost of investment, staff competencies, products, and customer requirements as criteria for an organisation to consider when adopting RFID technology in warehouses. In contrast, Wamba *et al.* (2016:22) found that the RFID complexity, industry sector, competitive environment, and manager characteristics such as gender, education or age were not significant determinants of RFID adoption.

In a South African context, Upfold and Liu (2010:16) identified 16 barriers as stumbling blocks to RFID adoption in the South African retail sector. Among the barriers identified

by the respondents in the study, 75.7% identified the high cost of RFID hardware and infrastructure, 72.7% the high cost of RFID tags, 60.6% a lack of awareness in RFID technology and 63.6% identified a lack of skilled RFID personnel as barriers for RFID adoption in the South African retail sector. According to Badru and Ajayi (2017:8), customer privacy concerns, the cost of tags and the collision error of reading collocated tags are all stifling the extensive adoption of RFID technology in both developed and developing countries. Subsequently, RFID adoption drivers are being influenced by product features and the difficulty of monetising the technology's benefits and advantages in day-to-day business operations, which can derail the entire RFID adoption endeavour. Furthermore, the number of industry standards accessible for RFID use is limited around the world, which is a potential stumbling block to reaping the full benefits of RFID technology in supply chain management, particularly for businesses that import and export commodities (Kgobe & Ozor, 2021:296). Therefore, the adoption roadblocks must be overcome for RFID technology's potential benefits to be realised (Kgobe & Ozor, 2021:296). From this discussion, it is evident that previous researchers identified predominately barriers to RFID technology and only a limited number of determinates or drivers of the technology. The barriers to RFID adoption are summarised in Table 2-2.

Table 2-2: Barriers to RFID adoption

Adoption barrier	Source
Consumer privacy concern	Badru and Ajayi (2017:8); Upfold and Liu (2010:16)
Cost of tags	Badru and Ajayi (2017:8); Kgobe and Ozor (2021:296); Khayyam <i>et al.</i> (2022:35); Noor (2022:354)
Difficulty monetising the technology's benefits	Kgobe and Ozor (2021:296)
Implementation cost	Khayyam <i>et al.</i> (2022:35); Noor (2022:354); Seng and Yew (2019:151); Upfold and Liu (2010:16)
Insufficient market acceptance	Seng and Yew (2019:151)
Lack of awareness	Haibi <i>et al.</i> (2022:6363); Khayyam <i>et al.</i> (2022:35); Noor (2022:354); Seng and Yew (2019:151); Upfold and Liu (2010:16)
Lack of industry standards	Agarwal and Ankolikar (2022:13); Kgobe and Ozor (2021:296); Khayyam <i>et al.</i> (2022:35)
Lack of product features	Kgobe and Ozor (2021:296)
Lack of skilled workforce	Khayyam <i>et al.</i> (2022:35); Seng and Yew (2019:151)
Popularity of traditional bar code	Seng and Yew (2019:151); Upfold and Liu (2010:16)
Uncertainty of return on investment	Seng and Yew (2019:151); Tan <i>et al.</i> (2021:1754)
Uncertainty of technology	Noor (2022:355); (Seng & Yew, 2019:151)

As shown in Table 2-2 (p. 23), previous studies focused predominately on the organisational and technological factors influencing the adoption of RFID technology, except for lack of awareness, which is considered a human factor. Consequently, the following section further discusses RFID awareness's influence on the adoption of RFID technology.

2.8 RFID TECHNOLOGY AWARENESS

The adoption of new technologies is a process that begins with awareness and knowledge of a specific type of technology or device and progresses through stages, culminating in the rejection or full use of that technology (Gökalp *et al.*, 2022:2). Human behavioural interest in accepting and adopting innovative technologies has been found to be influenced by demographic factors such as awareness and staff knowledge (Ali *et al.*, 2022:10). In addition, Khayyam *et al.* (2022:27) argued that adopting advanced technologies is often difficult for businesses in developing countries due to a lack of awareness. Haibi *et al.* (2022:6363) noted that despite the pervasiveness of RFID technology, studies have continuously revealed a lack of awareness, understanding, and uncertainty regarding what the technology, its capabilities, and its limits entail. In comparison, several researchers cited a lack of knowledge and awareness of RFID technology as an adoption barrier in supply chains (Khayyam *et al.*, 2022:15; Noor, 2022:354; Seng & Yew, 2019:151).

According to Seng and Yew (2019:151), a lack of RFID awareness could lead to uncertainty about the technology and its return on investment. Furthermore, due to a lack of awareness, a company's top management may assume that RFID technology provides limited benefits to its business operations. This lack of awareness could make the top management hesitant to invest substantially in the implementation of the technology, including ensuring that the company is equipped with enough skilled workers to manage the use of the technology in the warehouse (Seng & Yew, 2019:151).

2.9 FUTURE OF RFID AND MODERN TECHNOLOGY COLLABORATION

According to Zelbst *et al.* (2019:453), RFID serves as the foundation for the adoption of various modern technologies, including the Internet of Things (IoT) and Blockchain. Gladysz *et al.* (2021:39) added that even though RFID technology was used before Industry 4.0 (I4) emerged, it has significantly benefited from the dawn of I4 and is now an

essential component of several I4 initiatives (Gladysz *et al.*, 2021:39). In addition, Gladysz *et al.* (2021:39) stated that RFID is a key technology in artificial intelligence, big data, autonomous and collaborative robots. Although RFID was originally designed for tracking and identification, increased interest in a wide range of other applications has led to the creation of a new generation of RFID-based wireless sensor systems (Xu *et al.*, 2018:2946). RFID is a cornerstone of the Internet of Things (IoT), a notion born out of RFID-enabled identification and tracking technology (Xu *et al.*, 2018:2946). The growth of IoT technology has been sparked by the combination of compact, conveniently accessible, and cost-effective embedded devices such as RFID (Tan *et al.*, 2021:1755).

The IoT is a network infrastructure that uses data gathering, data intake, and communication technology to connect physical and virtual objects, which has enabled users to access their devices remotely (Tan *et al.*, 2021:1755-1756). When RFID readers are connected to the internet, they can automatically and uniquely identify and monitor tagged objects in real time, which is the essence of the IoT. Subsequently, the IoT can be combined with other technologies such as sensors, actuators, the Global Positioning System (GPS), and mobile devices using Wi-Fi, Bluetooth, cellular networks, and near-field communication (Xu *et al.*, 2018:2944). Because of its remarkable capabilities, RFID-IoT in supply chain management has a wide range of possible applications worldwide. Furthermore, with the incorporation of RFID with IoT technology, data may be collected and shared over the Internet.

The IoT is critical to achieving a seamless, interoperable, and secure RFID-IoT system and has a wide range of possible applications in supply chain disciplines (Tan *et al.*, 2021:1756). Tan *et al.* (2021:1760) stated that factors such as firm size, product profit, middleware and hardware costs are likely to influence the benefits of RFID-IoT adoption. According to Tan *et al.* (2021:1754), the RFID-IoT collaboration is expected to be coupled with other technologies in the future to create a comprehensive supply chain management solution. One such technology is Blockchain technology, and the three technologies will likely form a system that improves end-to-end supply chain management (Zelbst *et al.*, 2019:444). Therefore, even though RFID technology is not new, it can profit from the digital innovation brought about by the fourth industrial revolution, and its use is projected to grow in the future. As a result, RFID is considered one of the future's key technologies (Gladysz *et al.*, 2021:39).

2.10 HUMAN FACTORS INFLUENCING TECHNOLOGY ADOPTION

The strongest anecdotal indication of a reluctance to embrace RFID was the failure of certain Wal-Mart merchants to accept RFID despite the retailing giant's RFID requirement. This suggests that, despite the technology's potential benefits, many businesses are hesitant to employ RFID and that other considerations may play a role in an organisation's choice to embrace RFID. Therefore, it highlights the need to integrate other components in prior research frameworks rather than simply relying on organisational aspects and perceived organisational advantages (Abugabah *et al.*, 2021:1337).

Human factors, which include all physical, psychological, and social characteristics of people, are considered by logisticians to be the most critical uncertainties and sources of complexity in industrial operations. Potentially, the complexity of logistics stems primarily from human behaviour, which influences logical decision-making, organisational structures, hierarchies, emotions, and personal characteristics (Cimini *et al.*, 2021:98). Abugabah *et al.* (2021:1343-1344) found in an empirical study that personal and human factors drive RFID adoption, and these factors should be considered ahead of the adoption and implementation of RFID applications instead of as a post-implementation issue. Abugabah *et al.* (2021:1335) identified staff readiness, IT awareness, experience and training as significant human factors influencing RFID technology adoption.

Abugabah *et al.* (2021:1338) argued that incorporating human "user" factors into technology adoption models would allow researchers to better understand how individual and organisational factors interact to influence RFID adoption decisions, both collectively and individually. In addition, Wanjari (2020:5) found that human factors have a significant positive or negative impact on warehouse productivity, and they outweigh the influence of technology factors on productivity. Furthermore, Abugabah *et al.* (2021:1343) found that human factors significantly influence the adoption of RFID technology and, hence are crucial factors to consider in RFID adoption. Therefore, it necessitates determining the human factors influencing RFID technology adoption in the wholesale distribution context.

2.11 THEORETICAL BACKGROUND

Technology adoption is a study topic that has caught the interest of technology academics for quite some time. Pangriya and Singh (2021:1) highlighted the importance of determining users' acceptance of new technologies since it ultimately may result in the success or failure of the technology. Furthermore, Venkatesh *et al.* (2003:426) argued that employees must accept and use technologies to positively impact an organisation's productivity. In the field of technology adoption, several theories and models have been developed to determine and predict the acceptance of innovations by both individuals and organisations by characterising the adoption drivers of technological innovations. Some of these models include the diffusion of technologies (DOT), the technology-organisation-environment system (TOE), the technology adoption model (TAM), the Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), Innovation Diffusion Theory (IDT), and the Unified Theory of Acceptance and Usage of Technology model (UTAUT) (Abugabah *et al.*, 2021:1337; Dube *et al.*, 2020:208; Venkatesh *et al.*, 2003:425).

Researchers have used TAM to determine the acceptance of RFID technology in various industries (Hewavitharana *et al.*, 2021:4). However, according to Hewavitharana *et al.* (2021:4), the TAM model does not consider the barriers that may obstruct the use of a given technology. Another limitation highlighted by researchers is that TAM measures perceived adoption of future behaviour rather than actual behaviour (Dube *et al.*, 2020:209). In response, Venkatesh, Morris, Davis, and Davis developed the UTAUT model in 2003 to address TAM's shortcomings and incorporated social factors and human behaviour in the model (Hewavitharana *et al.*, 2021:6). The UTAUT model offers a high degree of predictability and is one of the most widely used frameworks for predicting technology acceptance and adoption (Chang *et al.*, 2020:2; Dube *et al.*, 2020:210). In addition to these models, technology readiness (TR) measured by the TRI 2.0 scale has emerged as one of the most important indicators of new technology acceptance in recent years (Chang *et al.*, 2020:2).

A review of the TRI 2.0 and UTAUT models is undertaken in the subsequent sections to determine and select the appropriate model for this study.

2.11.1 Technology Readiness Index

The *Technology Readiness Index 2.0* (TRI 2.0) was developed by Parasuraman and Colby (2015:15) using feedback from users of the earliest version of the 36-item Technology Readiness index to update and produce a more condensed and modern scale. The researchers updated the scale on insights from an extensive exploratory research study followed by quantitative research that condensed the TR scale to produce the 16-item TRI 2.0 scale and then tested its validity and reliability on various criteria (Parasuraman & Colby, 2015:15). According to Parasuraman and Colby (2015:14), the TRI 2.0 scale can be employed to assess Technology Readiness (TR) levels within a particular population, such as a specific demographic group, a profession, or a market sector of interest. Chang *et al.* (2020:3) noted that some individuals have positive beliefs towards new technology services and products, while others hold negative beliefs. The TRI 2.0 framework consists of two positive motivators (i.e., *optimism & innovativeness*) and two negative inhibitors (i.e., *discomfort & insecurity*) (Chang *et al.*, 2020:3; Parasuraman & Colby, 2015:2). The definitions of the TRI 2.0 dimensions are summarised in Table 2-3.

Table 2-3: TRI 2.0 dimensions

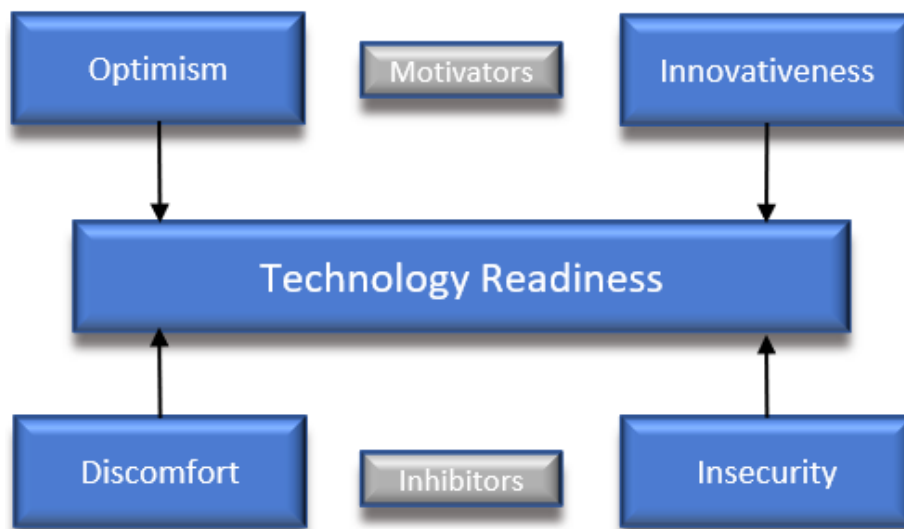
Dimension	Definition
Optimism:	An optimistic outlook toward technology and the notion that it affords people more control, flexibility, and efficiency in their daily lives.
Innovativeness:	Propensity to be a technological pioneer and intellectual leader.
Discomfort:	Sense of being overwhelmed by technology and a perceived lack of control over it.
Insecurity:	Distrust of technology based on doubts about its capacity to function effectively and fears about its potential for damaging outcomes.

Source: Adapted from Parasuraman and Colby (2015:2)

Parasuraman and Colby (2015:14) maintain that TRI 2.0 is a vigorous predictor of technology-related behavioural intentions (BI) and aids in identifying the dynamics behind the adoption of different technologies by providing measures of the four technology readiness dimensions and the overall technology readiness of users. However, many academics approaching the developers for permission to use the scale are solely interested in assessing overall TR as a single construct in multi-construct frameworks and, therefore, opt to use the concise 10-item scale (Parasuraman & Colby, 2015:3).

Researchers can use the 10-item scale to measure individuals' overall TR, whereby high motivator scores and low inhibitor scores suggest a high level of TR. In contrast, low motivator scores and high inhibitor scores imply the reverse (Matarirano *et al.*, 2021:140). The TRI 2.0 scale dimensions are illustrated in Figure 2-4.

Figure 2-4: TRI 2.0 scale



Source: Adapted from Parasuraman and Colby (2015:2)

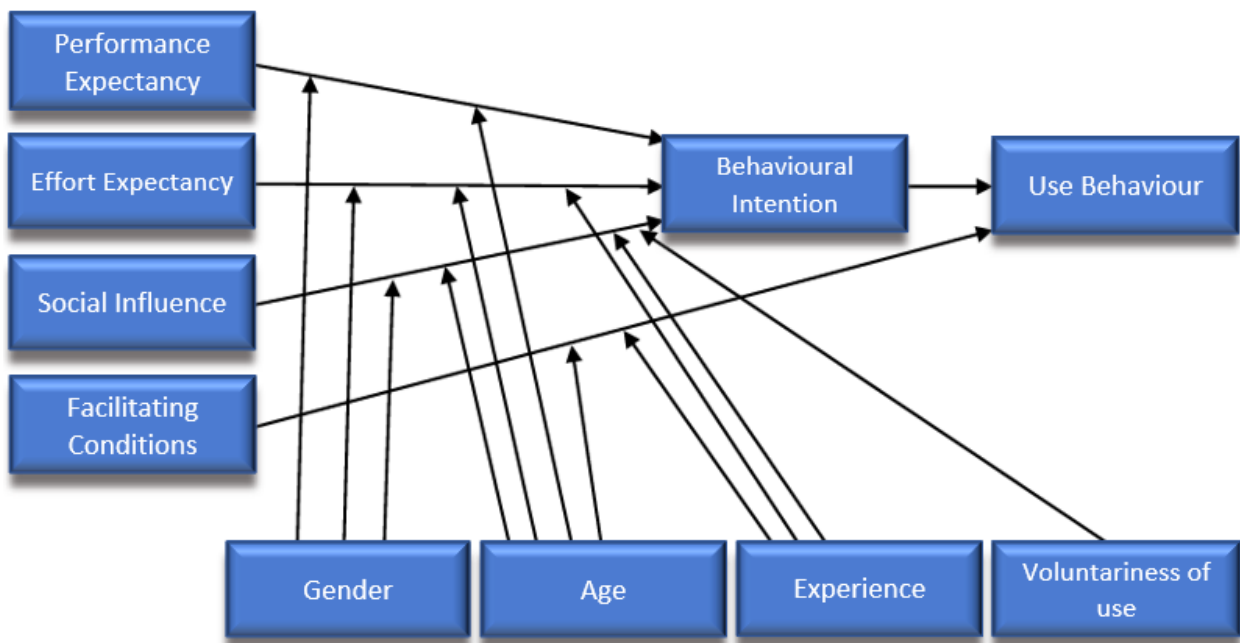
2.11.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

The *Unified Theory of Acceptance and Use of Technology* (UTAUT) model was developed to assist managers in determining how users accept new technology solutions and can also be used to predict and explain associated use behaviours (Chang *et al.*, 2020:3). The UTAUT model is broadly believed to be the most effective and latest method to determine technology acceptance in different populations and has been tested and validated extensively in numerous studies (Chang *et al.*, 2020:2; Hewavitharana *et al.*, 2021:7; Tang *et al.*, 2019:202; Zainab *et al.*, 2018:18). Venkatesh, Morris, Davis, & Davis (2003:425) conducted a comprehensive literature review to combine factors from eight of the most popular adoption theories to propose the UTAUT model, namely the Technology Acceptance Model (TAM), Theory of Reasoned Acceptance (TRA), Theory of Planned Behaviour (TPB), Social Cognitive Theory (SCT), combined Technology Acceptance Model and Theory of Planned Behaviour (C-TAM-TPB), Motivational Model (MM),

Innovation Diffusion Theory (IDT) and the Model of Personal-Computer Utilization (MPCU).

As illustrated in Figure 2-5, the original UTAUT model consists of four main determinants or dimensions of technology acceptance (i.e., *performance expectancy*, *effort expectancy*, *social influence*, and *facilitating conditions*) and four moderating factors (i.e., age, gender, experience, and voluntariness) (Venkatesh *et al.*, 2003:467).

Figure 2-5: UTAUT model



Source: Adapted from Venkatesh *et al.* (2003:447)

Venkatesh *et al.* (2003:467) revealed that the UTAUT model explains seventy per cent of the Behavioural Intention variance to use a particular technology. Furthermore, Venkatesh *et al.* (2003:426) stated that the UTAUT model is a valuable tool to assess the prospect of successful introductions of new technologies and assists managers in comprehending the drivers of acceptance for the adoption and use of new technologies. Dube *et al.* (2020:208) noted that UTAUT was developed with the intent to predict technology adoption at the individual level. The combination of the UTAUT model factors explains the perception of humans toward the acceptance of new technologies (Hewavitharana *et al.*, 2021:7). As a result, several researchers have used this model to describe human behaviour towards technology adoption in various industries (Hewavitharana *et al.*, 2021:7; Olasina, 2019:363). According to Venkatesh *et al.*

(2012:159), the Performance Expectancy (PE), Effort Expectancy (EE), and Social Influence (SE) variables influence Behavioural Intention (BI) to adopt a technology. On the other hand, the Behavioural Intention (BI) and Facilitating Conditions (FC) variables determine technology Use Behaviour (Venkatesh *et al.*, 2012:159).

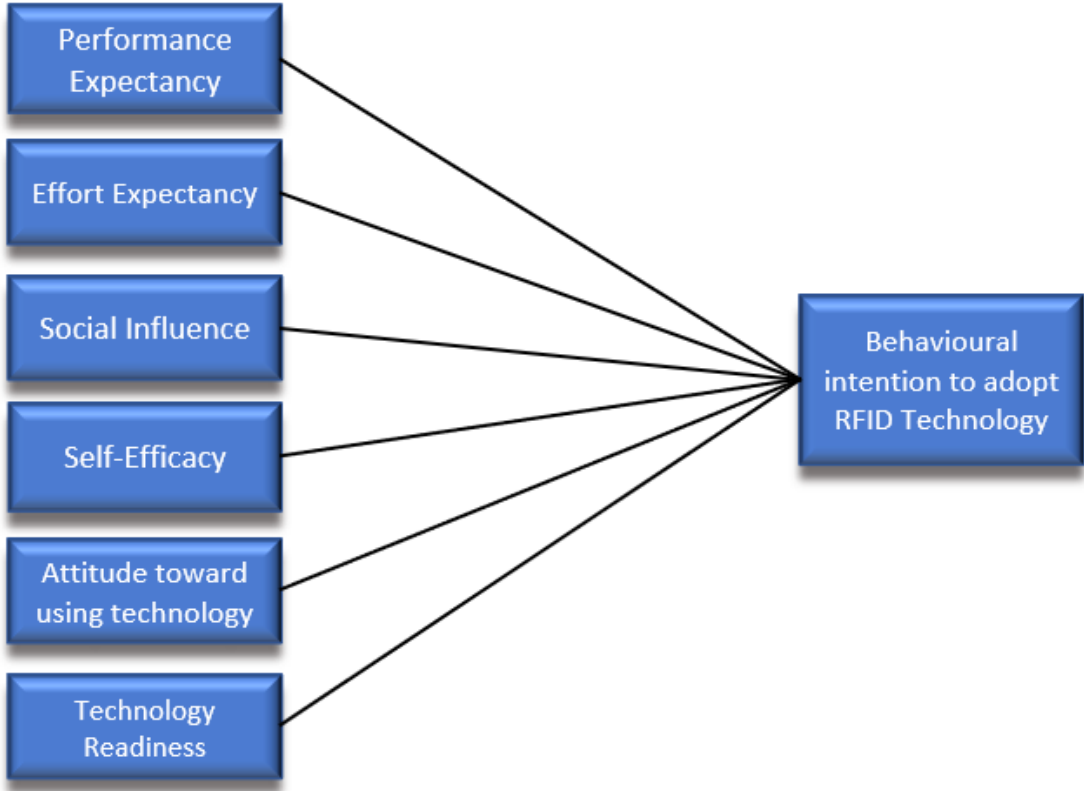
Since its development, the UTAUT model has been extensively adapted and adopted in several studies investigating the acceptance and use of technology in various environments or cultures. However, there are two drawbacks to the original UTAUT model: its poor parsimony, which is due to the complicated interactions among the attributes suggested by the moderating effects, and the lack of a meso-level formulation of the model (Venkatesh *et al.*, 2016:338). As a result, researchers have identified several other external factors in the adapted UTAUT models influencing the Behavioural Intention and use of new technologies, such as Anxiety, Trust, Self-efficacy (SE), and Attitude toward Using Technology (ATUT) (Tang *et al.*, 2019:202; Venkatesh *et al.*, 2016:331; Zainab *et al.*, 2018:18). In the original UTAUT model, Facilitating Conditions (FC) refer to the organisational and technical infrastructural factors influencing technology use, which are, in essence, unrelated to human and social elements (Olasina, 2019:365; Venkatesh *et al.*, 2003:453). In a new approach, Olasina (2019:365) removed FC from the UTAUT model to make the model more robust toward measuring human and social factors. In a study undertaken to determine the acceptance of RFID technology by librarians', Zainab *et al.* (2018:27) adapted the UTAUT model by replacing FC with ATUT and SE to highlight users' Behaviour Intention on the acceptance of RFID technology use. In their study, the researchers identified PE, EE, ATUT, SI and SE as the most important factors influencing the acceptance, adoption, and intention to use RFID technology (Zainab *et al.*, 2018:29-30). Similarly, Tang *et al.* (2019) found that PE, EE, SI and FC have a significant positive influence on users' BI to use RFID technology in the healthcare sector.

2.12 CONCEPTUAL FRAMEWORK

Zainab *et al.* (2018:29) argued that the UTAUT model could perform consistently in contexts other than its original intent with justifiable adaptations and the integration of other external variables. Wong *et al.* (2020:2107) added that numerous research studies that integrated TR with other technology adoption models have consistently shown a positive relationship with TR. Therefore, this study recognised the integration of the UTAUT model and TRI 2.0 scale as the optimal model to determine the human factors influencing RFID technology adoption.

Based on the discussion in section 2.11.2, six independent constructs derived from the original UTAUT (PE, EE, and SI), relevant literature (ATUT and SE) and TR (TRI 2.0) were integrated to form the study's conceptual framework. Two external human behavioural variables (ATUT and SE) and TR were integrated into the adapted model to replace the FC construct. SE and ATUT were adapted from the questionnaire items used by Venkatesh *et al.* (2003:460) to estimate the original UTAUT model. In a comprehensive longitudinal literature review of the UTAUT model, Venkatesh *et al.* (2016:332) identified that most researchers test only the main UTAUT variables by omitting the moderating effects of age, gender, experience, and voluntariness. Subsequently, Venkatesh *et al.* (2016:346) omitted moderators from their proposed model to evaluate future technology acceptance. Dwivedi *et al.* (2019:729) argued that the moderators in the original UTAUT model are not universally applicable to all contexts. Zainab *et al.* (2018:29) suggested that with justifiable modifications and the addition of additional external variables, the UTAUT model could consistently perform in situations outside of those for which it was designed. Therefore, the moderating factors were removed in this study to focus on five main determinants of the UTAUT model; Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Attitude toward Using Technology (ATUT), Self-Efficacy (SE) and the integrated effect of Technology Readiness (TR) measured by the TRI 2.0 scale. Another alteration to the original model is that this study only investigated behavioural intention and excluded actual use behaviour since this study is regarded as a pre-adoption study. As proposed above, the conceptual framework for this study is illustrated in Figure 2-6 (p. 33).

Figure 2-6: Conceptual study framework



Source: Own Compilation

The following subsections will further conceptualise the human constructs that constitute the study's conceptual model, as represented in Figure 2-6.

2.12.1 Performance Expectancy (PE)

This construct is defined as “the degree to which an individual believes that using the system will help him or her to attain gains in job performance.” (Venkatesh *et al.*, 2003:447). According to Venkatesh *et al.* (2003:467,469), PE is a determinant of BI in most situations, and the strength of this relationship varies with age in that it appears to be more significant for younger workers and is also more relevant in contexts where usage is mandatory. In this study, PE refers to the belief of employees in the wholesale distribution industry that using RFID technology will improve their work performance.

2.12.2 Effort Expectancy (EE)

Effort Expectancy is the degree of ease with which users expect to use a chosen technology (Venkatesh *et al.*, 2012:159; Venkatesh *et al.*, 2003:450). According to van Tonder *et al.* (2018:94), Effort Expectancy is similar to the Technology Acceptance model's "ease of use" construct in that it refers to how easily users expect to operate a particular technology. A technology perceived as easy to use requires less effort than interaction with complex systems, and users are more likely to adopt a technology that is deemed easy to use and has a short learning curve (Wong *et al.*, 2020:2105). EE is a prominent determinant of BI, and the effect seems to be more significant for older workers and those with limited experience (Venkatesh *et al.*, 2003:467).

2.12.3 Social Influence (SI)

Social Influence measures the extent to which a person perceives that important others believe they should use a particular new technology (Venkatesh *et al.*, 2012:159; Venkatesh *et al.*, 2003:451). Social factors are described as specific cultural and interpersonal impacts on a person by influential individuals that the person feels might influence their adoption of new technology (Zainab *et al.*, 2018:22). Venkatesh *et al.* (2003:468-469) found that the effect of SI on BI is more significant for older workers and is more likely to be important in contexts where usage is mandated. In this study, SI examines whether warehouse workers and managers are influenced by important others, such as high-ranking individuals in the organisation when deciding on accepting and using RFID technology.

2.12.4 Self-Efficacy (SE)

Self-Efficacy is individuals' self-confidence in their ability to accomplish a job or specific task using a particular technology (Venkatesh, 2000:347). Users with a high level of self-efficacy are more inclined to adopt a technology (Chong *et al.*, 2022:6).

2.12.5 Attitude toward using technology (ATUT)

This dimension is defined as a person's overall affective response towards using a chosen technology (Venkatesh *et al.*, 2003:455). Furthermore, attitude is the degree to which positive and negative sentiments regarding the desired behaviour are perceived (Zainab

et al., 2018:21). Dwivedi *et al.* (2019:727) identified attitude as a critical factor in individuals' acceptance and use of information technology innovations. In this study, ATUT refers to the positive feelings related to the Behavioural Intention to adopt RFID technology. The explicit attitude modelling significantly improves the explanatory power of theoretical models measuring BI (Dwivedi *et al.*, 2019:728). Thus, the current study incorporated ATUT in the conceptual framework.

2.12.6 Technology Readiness (TR)

Technology Readiness (TR) refers to a combination of mental incentives and inhibitors that largely determine humans' willingness to use new technology (Pangriya & Singh, 2021:3). Parasuraman (2000:308) defined technology readiness as "people's propensity to embrace and use new technologies for accomplishing goals in home life and at work." Furthermore, TR is related to individuals' beliefs, feelings, and perceptions toward hi-tech products and services (Pangriya & Singh, 2021:3). Chang *et al.* (2020:3) argued that instead of measuring an individual's competence to utilise a given technology, TR assesses the beliefs and attitudes of individuals toward the technology. In addition, Kim and Chiu (2018:112) stated that the TR variable is a critical influencer of Behavioural Intention. TR has long been recognised as a key factor influencing people's acceptance and use of new technology (Kim & Chiu, 2018:112).

According to Parasuraman and Colby (2015:2), the morale and productivity of employees may decline if they are uncomfortable or lack confidence in a new technology, which makes it critical to understand employees' reactions to cutting-edge technologies. As a result, the practical relevance of the TR construct will continue to grow, proportionate with rapidly evolving technologies (Parasuraman & Colby, 2015:2). The adoption of cutting-edge technology, the intensity with which it is used, and the degree of perceived ease with which it is used are all associated with higher TR levels (Parasuraman & Colby, 2015:3). Additionally, higher TR levels are also associated with greater technology adoption rates and has a strong correlation with BI (Chang *et al.*, 2020:11; Matarirano *et al.*, 2021:141). Therefore, this study argues that there is a potential link between TR and BI to adopt RFID technology.

2.12.7 Behavioural Intention (BI)

In the original UTAUT model, Behavioural Intention (BI) is identified as the dependent variable, whereas PE, EE, SI and FC are independent variables of BI (Venkatesh *et al.*, 2012:467). BI is commonly used in theoretical models to predict user acceptance and adoption of new technologies (Chang *et al.*, 2020:2; Zainab *et al.*, 2018:18). Phalitnonkiat *et al.* (2020:32) argued that BI should be considered a factor that influences the use of technology since technology use is reliant on management decisions and operators' acceptance of the technology. In this study, Behavioural Intention (BI) is defined as the degree to which a person intends to adopt RFID technology in the future.

2.13 CHAPTER SUMMARY

Based on existing literature, the researcher first defined RFID technology before introducing the reader to the evolution and fundamentals of the technology. The literature study revealed several benefits of RFID technology and a wide range of applications for use in the industry. Despite the importance of considering human factors ahead of the adoption and implementation of RFID applications, literature revealed that most adoption studies focused predominately on organisational and technological factors, while human factors received less research attention. Importantly, grounded on the review of the theoretical technology adoption models, TRI 2.0 and UTAUT models were identified as the optimal models to form the foundation of the conceptual study framework.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

Saunders *et al.* (2007:602) defined research methodology as the notion of how research should be conducted, including the philosophical and theoretical presuppositions that support the study and the implications of those assumptions for the technique or methods adopted. Therefore, this chapter introduces the reader to the Research Onion, which is dissected to develop the research framework for the empirical study. The chapter will further discuss and explain the reasons for the appropriateness of this study's research design and methodology choices to achieve the study's objectives. The chapter will conclude with deliberations on the study population, sampling, measurement scales, data analysis and ethical considerations.

3.2 RESEARCH DESIGN

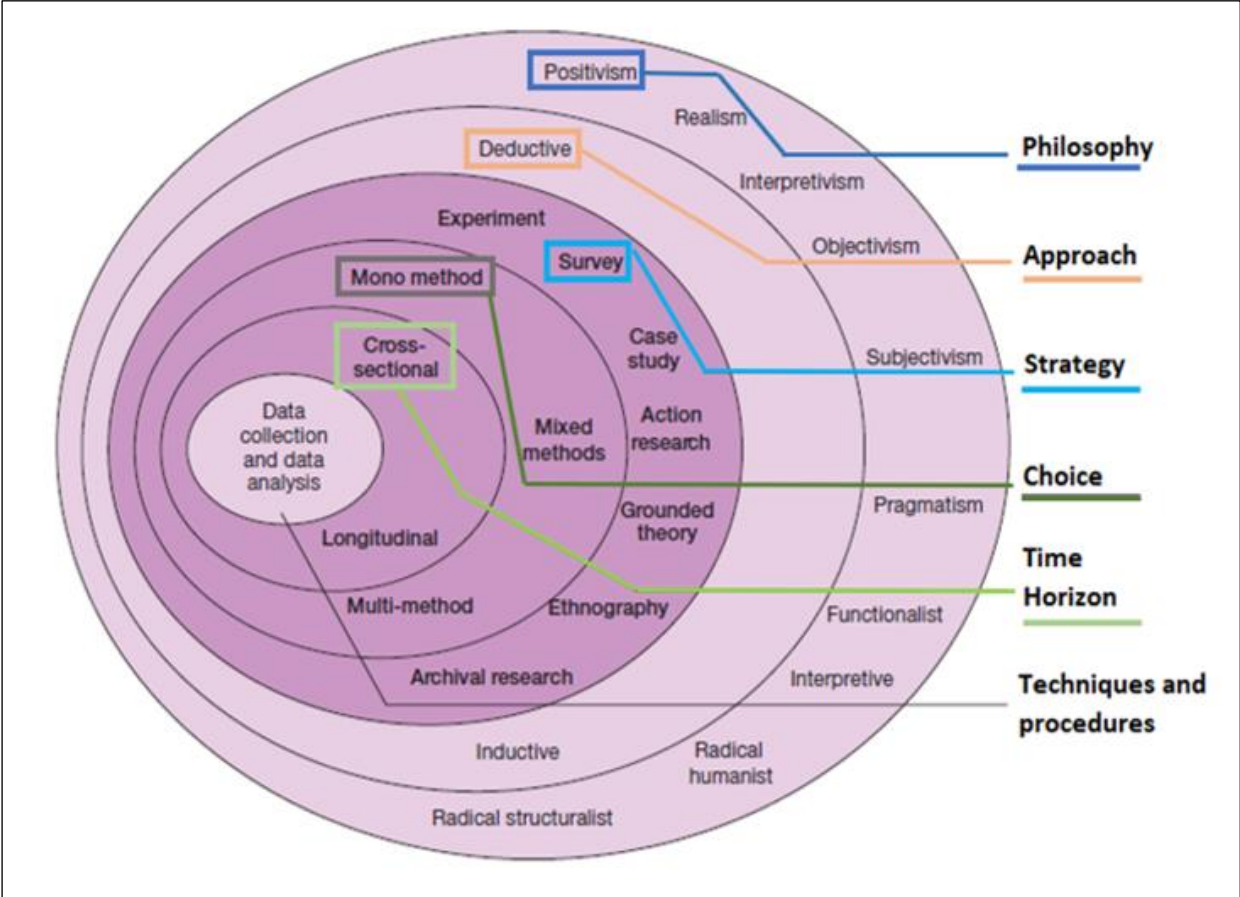
A research design stipulates the blueprint that leads to the use of the research method for data collection and analysis to solve a research problem (Bryman *et al.*, 2014:100; Malhotra, 2010:70). The empirical investigation was conducted through an online, self-administered, and structured questionnaire survey using the SurveyMonkey® platform. This study adopted a cross-sectional research design since respondents completed a self-administered questionnaire at a particular moment in time.

The quantitative research approach highlights the quantification in data collection and analysis and tends to adopt a deductive approach to the correlation between research and theory by accentuating hypothesis testing, which is sculpted by positivists philosophies (Bryman *et al.*, 2014:31). In addition, Saunders *et al.* (2007:75) also noted that quantitative research follows the deductive model of fixed research objectives. This study followed a positivist research paradigm with a deductive approach since quantitative research was conducted.

3.3 THE RESEARCH ONION AS PARADIGM FOR DEVELOPING THE RESEARCH FRAMEWORK

Saunders *et al.* (2007:100) stated that collecting data and answering research questions form the core of a research study. However, according to Saunders *et al.* (2007:100), a researcher must first peel away several layers before deciding on data collection techniques and analysis procedures for a study. This proposed research framework is known as the research onion and can be used to portray the issues underlying a researcher's choice of data collection method or methods (Saunders *et al.*, 2007:130). The research onion presented in Figure 3-1 consists of six layers: (1) research philosophy; (2) research approach; (3) research strategy; (4) research choices; (5) time horizons, and the final layer, (6) data collection techniques and analysis procedures (Saunders *et al.*, 2007:101).

Figure 3-1: The research onion



Source: Adapted from Saunders *et al.* (2007:132)

In this framework, the research strategy, research choices, and time horizon layers are grouped to focus on the research design to convert the research question into a research project (Saunders *et al.*, 2007:130). Saunders *et al.* (2007:131) further stated that the research question influences the research philosophy and approach. Therefore, since the onion layers are interconnected, the choices made in the outer layers will influence the methodological decisions made in the subsequent layers (Saunders *et al.*, 2007:131). This study applied the research onion principles to design the study framework and to facilitate seamless progression through the different stages of research methodology design. The methodological choices for this study are highlighted in an illustration of the research onion in Figure 3-1 (p. 38) and are further discussed in the subsequent sections.

3.3.1 Research paradigm

According to Saunders *et al.* (2007:121), research philosophy or paradigm concerns knowledge development and contains essential assumptions about a researcher's view of the realm. Saunders *et al.* (2007:121) highlighted three distinct rationalising research philosophies: epistemology, ontology, and axiology. These assumptions contain distinct differences that influence how a researcher thinks about the research process (Saunders *et al.*, 2007:121). In addition, Saunders *et al.* (2007:100) identified five major research philosophies for business research: positivism, realism, pragmatism, interpretivism, objectivism, and constructionism. Furthermore, Saunders *et al.* (2007:116) stated that business and management research is frequently a mixture between positivist and interpretivist philosophies. According to Creswell (2014:200), positivist philosophical assumptions are reflected in studies adopting a quantitative research method with a survey or experimental design. Positivism is an epistemological position that correlates to the philosophical viewpoint of the natural scientist. This philosophy necessitates working with an observable social reality that emphasises a highly structured methodology to enable replication (Saunders *et al.*, 2007:121,606). This study follows a positivist, epistemological research paradigm by adopting a quantitative research approach.

3.3.2 Research approach

According to Creswell (2014:31), a research approach is a plan and method for research to bridge decisions from broad assumptions to more comprehensive data collection and analysis methods. Saunders *et al.* (2007:596) noted that the deductive research approach involves theoretical proposition testing by employing an explicitly designed research strategy. In contrast, the inductive approach consists of a theory deployment due to empirical data observation (Saunders *et al.*, 2007:599). The quantitative research approach highlights the quantification in data collection and analysis and tends to adopt a deductive approach to the correlation between research and theory by accentuating hypothesis testing, sculpted by positivists philosophies (Bryman *et al.*, 2014:31). In addition, Saunders *et al.* (2007:75) also noted that quantitative research follows the deductive model of fixed research objectives. Thus, this study followed a deductive approach in that the quantitative approach enables the deductive interpretation of data.

3.3.3 Research strategy

Saunders *et al.* (2007:135) stated that research questions, objectives, timeframe, available resources, level of present knowledge, and the researcher's philosophical foundations guide the choice of research strategy. Several research strategies exist, such as experiment, survey, case study, action research, grounded theory, ethnography, and archival research (Saunders *et al.*, 2007:136). In addition, Saunders *et al.* (2007:138) noted that the survey strategy is typically linked to the deductive approach and is often used in business and management research studies to answer the “who”, “what”, “where”, “how much” and “how many” questions. As a result, researchers follow this strategy for exploratory and descriptive research purposes. Furthermore, the survey strategy allows a researcher to collect quantitative data, which can be analysed using inferential and descriptive statistics to propose potential causes for particular relationships between variables (Saunders *et al.*, 2007:138). Therefore, the survey strategy was adopted as this study's research strategy.

3.3.4 Methodological choice

A researcher will select a mono, mixed or multi-method when selecting a research method. A mono method is a single data collection technique and matching analysis procedure, either quantitative or qualitative. In contrast, mixed or multi-methods are

combinations of quantitative or qualitative techniques (Saunders *et al.*, 2007:147). Creswell (2014:32) suggests that qualitative research helps understand and explore the meaning individuals or groups attribute to a human or social problem. In contrast, quantitative research is an ideal approach to resolving a research problem that requires the identification of factors that influence an outcome, in this instance, technology adoption (Creswell, 2014:50). Therefore, this approach is consistent with the aim of this study to identify factors, specifically human factors influencing an outcome, the adoption of RFID technology in the wholesale distribution industry context. The approach is also the most appropriate to test theories by assessing the correlation among variables (Creswell, 2014:50). With the quantitative approach, these variables can be measured on instruments to analyse the numbered data using statistical methods (Creswell, 2014:32). This study thus followed a mono method by adopting quantitative data collection techniques and analysis procedures to identify the human factors influencing the adoption of RFID technology.

3.3.5 Time horizon

According to Saunders *et al.* (2007:148), a researcher should decide during the planning phase of a research study whether data collection should be undertaken as a snapshot at a particular time or represent events over a given period. Longitudinal studies involve data collection over a long period while collecting data from the target population at a particular time is known as a cross-sectional study (Malhotra, 2010:76; Saunders *et al.*, 2007:148). This study adopted a cross-sectional research design since respondents completed a self-administered questionnaire at a particular moment in time. A cross-section of the industry served as the sample for this study. The cross-sectional design was thus considered appropriate for this study.

3.3.6 Study population

Malhotra (2010:340) defines the target population as the compilation of elements or objects that hold the data required by the researcher and about which conclusions are drawn. Malhotra (2010:340) added that an inaccurate description of the target population would result in ineffective and misleading research. The population identified for this study consisted of warehouse workers, managers, and IT personnel of different ages, genders, and work experience currently working for a large wholesale distribution organisation with

eight warehouses in selected provinces in South Africa. The organisation distributes pharmaceutical, cosmetic, and fast-moving consumer goods (FMCG) to various pharmacies, hospitals, doctors, emergency medical services, clinics, veterinary services and the FMCG market countrywide. The holding company of the organisation is one of the leading retail pharmacy groups in South Africa, with many pharmacies and baby stores all over the country. Since it is one of the leading wholesale distribution organisations with a national footprint distributing a wide variety of products to its stores and numerous independent customers across the country, the organisation and chosen warehouses were regarded as appropriate study sites for this research. Furthermore, the organisation is expanding rapidly and is continuously seeking innovative solutions and technologies to improve operational efficiency and productivity. RFID technology is one of the innovations that the organisation is considering deploying to improve inventory accuracy and enable product tracking. In addition, the technology has numerous advantages, such as cost reduction, improved supply chain visibility, reduction of out-of-stock products and increased logistics efficiency and productivity by lowering labour costs and product cycle time (Chanchaichujit *et al.*, 2020:15).

The technology has several warehouse applications, such as order-picking systems or inventory drones. The cost of tags, once considered a barrier to RFID adoption, has dropped dramatically in recent years (Rafiquea *et al.*, 2022:3). As a result, the organisation views the technology as a viable solution to improve inventory accuracy and enhance efficiency in the dispatch departments. Many of the operational challenges in the organisation are due to human errors, such as incorrect counts, picks, or failure to scan and bill parcels before they are loaded on the vehicles. Inventory and dispatch accuracy are of utmost importance to avoid severe financial losses since the organisation distributes a wide variety of exceptionally high-value products, such as oncology medicines. Therefore, this study may provide valuable insight to the organisation to aid with the successful implementation of RFID technology.

The total population consisted of approximately 2000 warehouse workers, managers, and IT personnel, as indicated by the organisation. To define the target population, Malhotra (2010:340) stated that a problem definition must be converted into an exact statement of who should either be omitted from or included in the sample.

The sample inclusion and exclusion criteria were thus defined as follows:

Inclusion criteria:

- Respondents were included in the study if they were warehouse workers, managers, or IT personnel employed by a wholesale distribution organisation.
- Respondents of different ages and various levels of work experience.
- Only respondents with internet access were included in the sample since the data was collected exclusively through an online questionnaire survey using the SurveyMonkey® platform.

Exclusion criteria:

- To ensure voluntary study participation, respondents who reported to the researcher at the time of the study were excluded from the sample.

According to Malhotra (2010:340), the target population should also be specified in terms of the different sampling units, extent, and time. This study thus followed the recommendations stipulated by Malhotra (2010:340) to define the study population. The study population components and rationale for the decisions are presented in Table 3-1.

Table 3-1: Study population components and rationale

Component	Description	Rationale
Element	Warehouse workers, managers, or IT personnel employed by a wholesale distribution organisation.	To get an all-inclusive representation of technology users, management and implementors.
Sampling unit	A leading wholesale distribution organisation with eight warehouses in selected provinces distributing a variety of products countrywide.	The organisation represents the broader wholesale distribution industry reasonably well.
Extent	Gauteng, Mpumalanga, KwaZulu-Natal & Western Cape provinces in South Africa.	The vast majority of registered pharmaceutical warehouses are located in these provinces (South African Pharmacy council, 2022).
Time	11 th May until 20 th June 2022.	A cross-sectional study was undertaken.

Source: Own compilation

3.3.7 Sampling

According to Malhotra (2010:342), deciding whether to employ probability or non-probability sampling is the most critical decision to be made by a researcher regarding the sampling technique. With probability sampling, every element in the population has a fixed probabilistic chance of being selected for the sample (Malhotra, 2010:344). However, this technique necessitates an exact definition of the target population and sampling frame specification (Malhotra, 2010:345). In contrast, non-probability sampling counts on the individual judgment of a researcher instead of probability to select the elements of a sample, and the researcher can subjectively decide which elements the sample should include. However, the probability of choosing any specific element in a sample seems indeterminable with this technique, and selected estimates are not statistically projectable to the population. Nevertheless, non-probability samples may produce proper estimations of the population characteristics (Malhotra, 2010:344). Malhotra (2010:345) further describes convenience sampling as a technique a researcher uses to obtain a sample in the easiest conceivable way, where the selection is made at the researcher's discretion. Convenience sampling has several benefits over other sampling techniques. For example, it is the least costly and time-consuming sampling technique, and the sampling units are collaborative, straightforward to measure, and easily accessible (Malhotra, 2010:345).

In terms of the regulations pertaining to the Protection of Personal Information Act 4 of 2013, the organisation where the study was conducted was not permitted to provide the researcher with an employee list for probability sampling purposes. Therefore, this study utilised the non-probability sampling technique of convenience sampling to ensure that the study complies with the Protection of Personal Information Act 4 of 2013 and since the sample was reasonably accessible to the researcher.

Malhotra (2010:342) defines sample size as the number of elements required for a study. When the sample size is determined, the researcher should consider several factors, such as the size of samples in related studies, type of research, number of variables, type of analysis, incidence rates, completion rates, and resource constraints (Malhotra, 2010:375). For example, a previous research study that used the TRI 2.0 and UTAUT scales conducted by Chen *et al.* (2021:7) gathered primary data from 260 respondents. In addition, Field (2009:222,647) recommends a sample size of 300 or more to deliver a

stable factor solution, or preferably 10-15 respondents per variable. Therefore, after consultation with the NWU Statistical Consultation Services, the minimum sample size required for this study was determined to be 100-150 respondents. However, considering the objectives and nature of this study, the researcher aimed to recruit 300 respondents.

3.3.8 The measurement tool used in this study

This study employed two previously empirically validated and widely used research measurement scales to collect the empirical research data in this study. Malhotra (2010:266) argued that ethical considerations necessitate the utilisation of appropriate measurement scales to obtain the required data to answer research questions and test the hypotheses. Therefore, the 10-item Technology Readiness Index (TRI 2.0) model by Parasuraman and Colby (2015:1) was used in combination with the Unified Theory of Acceptance and Use of Technology (UTAUT) model by Venkatesh *et al.* (2003:425) as the measurement tool in this study. The models were adapted and modified from the literature and subjected to reliability tests during analysis to confirm the properties of the instruments. Parasuraman and Colby (2015:15) used feedback from users of the earliest version of the 36-item Technology Readiness (TR) index to update and produce a more condensed and modern scale. The researchers updated the scale on insights from an extensive exploratory research study followed by quantitative research that condensed the TR scale to produce the 16-item and 10-item TRI 2.0 scales and then tested its validity and reliability on various criteria (Parasuraman & Colby, 2015:15). According to Parasuraman and Colby (2015:14), the TRI 2.0 scale can be employed to assess technology readiness levels within a particular population, such as a specific demographic group, a profession, or a market sector of interest. In addition, the 10-item scale is helpful in studies where TR is one of the variables for the analysis and not the primary construct of the research and allows researchers to measure the overall TR. Therefore, the 10-item TRI 2.0 scale was adapted and used in this study since TR was measured as a variable and not the primary construct.

The UTAUT model was adapted from literature to determine the behavioural intention of individuals towards the acceptance and adoption of RFID technology and to determine the human drivers and barriers to RFID technology adoption. The UTAUT model is broadly believed to be the most effective and latest method to determine technology acceptance in different populations. The model has been tested extensively in numerous

studies since the development of the model by Venkatesh *et al.* (2003). Venkatesh *et al.* (2003:425) combined factors from eight of the most popular adoption theories to develop the UTAUT model, which consists of four main determinants or dimensions of technology acceptance (i.e., *performance expectancy*, *effort expectancy*, *social influence*, and *facilitating conditions*) and four moderating factors (i.e., age, gender, experience, and voluntariness). Venkatesh *et al.* (2003:426) stated that the UTAUT model is a valuable tool to assess the prospect of successful introductions of new technologies and assists managers in comprehending the drivers of acceptance for the adoption and use of new technologies. According to Venkatesh *et al.* (2012:157), UTAUT explains nearly 70 per cent of the Behavioural Intention variance to use a technology and nearly 50 per cent of the actual technology use variance. In addition, the TRI compliments UTAUT by offering an insightful way to measure the factors influencing the drive or hindering technology usage. Therefore, the UTAUT and TRI 2.0 models were well suited to be used as measuring instruments in the context of this study.

3.3.9 Collection of data

This cross-sectional study employed a self-administered online questionnaire survey with a five-point Likert measurement scale (strongly disagree = 1 to strongly agree = 5) to gather primary data regarding the Behavioural Intention (BI) to adopt RFID technology and the Technology Readiness (TR) of respondents in the survey context. Saunders *et al.* (2007:389) stated that nearly all data collected for management or business research through questionnaires are used for descriptive or explanatory purposes. The quantitative research method was adopted for this study as the data collection method. The primary data required to meet the study objectives were collected through an online, self-administered, and structured questionnaire survey using the SurveyMonkey® platform.

Since many prospective respondents did not have access to e-mails, the researcher requested permission from the organisation to distribute paper questionnaire surveys. Unfortunately, the request was rejected by the organisation. However, the organisation agreed to distribute the survey link on behalf of the researcher. In light of the information mentioned above, a Human Resources (HR) department manager distributed the survey link via e-mail to the respondents with access to e-mails. In addition, the researcher asked the logistics managers in the relevant warehouses to forward the survey link via WhatsApp® to the respondents who did not have e-mail access. The data was transferred

to a Microsoft Excel® spreadsheet for analysis after the survey was closed and was coded by Dr E Fourie from the Statistical Consultation Services of the North-West University before importation into the IBM SPSS platform for analysis.

3.3.10 Reliability and validity

Kelley-Quon (2018:363) stated that researchers could be confident that a survey instrument is measuring what it is supposed to be measuring and that differences measured between groups can be assumed to be valid and reproducible when using a previously validated instrument. Field (2009: 647) recommends a sample size of 300 or more to deliver a stable factor solution. Field (2009:646) further stated that correlation coefficients vary from sample to sample, which is significantly more noticeable in small samples than in large samples.

Based on the discussion mentioned above, the researchers considered validating the measures used in the study before calculating the technology use scores for respondents. However, the sample size of 117 respondents was found to be inadequate for a procedure such as Factor Analysis. Since the researchers consciously decided to employ reliable and previously empirically validated, tested, and widely used TRI 2.0 and UTAUT measurement scales to collect the empirical research data in this study, no further attempts were made to perform Factor Analysis.

Subsequently, Cronbach's Alpha was used to measure the reliability of the scale dimensions and by using the scale factors as determined in other studies. The reliability measurement is further discussed in section 4.5 of Chapter 4.

3.3.11 Statistical analysis

The data gathered on the SurveyMonkey® platform was transferred to Microsoft Excel® after the survey questionnaire was closed. Since all the data was collected electronically, there was no need to clean the data before statistical analysis. Dr E Fourie from the North-West University Statistical Consultation Services coded the data before importation into IBM SPSS Statistics Version 27 for statistical analysis. First and foremost, descriptive analysis was undertaken on the demographical variables in Section A to profile the respondents and determine their RFID technology awareness level. Whereafter Cronbach's Alpha was used to measure the reliability of the scale dimensions.

ANOVA and t-tests were conducted to test for differences in the scale dimensions between the demographic variables in Section A's groups to determine the human drivers and barriers to RFID technology adoption. The ANOVA technique was used to make group comparisons between variables with more than two categories (age, qualification, position, and work experience). In addition, t-tests were used to measure the differences between groups with only two categories (location, industry, and RFID awareness level). A cross tabulation was used to determine the association between the variables, Position and RFID technology awareness. Furthermore, Spearman's Rho correlation was used to investigate whether TRI 2.0 and UTAUT's various dimensions correlate with the Behaviour Intention (BI) to adopt RFID technology. Behaviour intention (BI) was the output variable as, theoretically, the dimensions of technology adoption in the UTAUT model all contribute to the intention to behave in an adoptive manner. Finally, Linear Regression analysis was conducted to measure the importance of the influences of Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Attitude toward using technology (ATUT), Self-Efficacy (SE) and Technology Readiness (TR) on the dependent variable, Behavioural Intention (BI) to adopt RFID technology.

3.4 ETHICAL CONSIDERATIONS

According to Malhotra (2010:128), a researcher has an ethical obligation to provide accurate and representative data to the best of the researcher's ability. Furthermore, data collected in a manner that harms respondents or violates their privacy may be deemed unethical (Malhotra, 2010:128). Therefore, the researcher ensured that this study complied with the ethical standards of academic research by submitting a comprehensive research proposal to the North-West University Ethics Committee for ethical clearance and following the data collection processes stipulated in the proposal after ethics approval was obtained (NWU-00638-22-A4). Refer to Appendix 3 for the study ethics approval letter. In addition, the study adhered to the regulations of the Protection of Personal Information Act 4 of 2013. The ethical considerations addressed by the researcher during the study are described in detail in the following subsections:

3.4.1 Advertising and recruitment

The researcher obtained permission from the organisation to continuously show an advert on the internal TV screens in the canteens of the relevant warehouses where the study was conducted to recruit respondents without access to e-mails to participate in the study. Unfortunately, the advert could not be shown on the TV screens as planned due to technical reasons. Therefore, to recruit respondents, the survey link was only distributed via email and WhatsApp®, as discussed in section 3.3.9. An overview of RFID was given by including a brief description and images in the introduction of the survey questionnaire to familiarise the respondents with the technology and visually demonstrate the application of RFID technology to focus the prospective respondents and prevent vague and inconsistent responses due to the misperception of RFID technology. Refer to Appendix 4 for the proposed respondent recruitment advert.

3.4.2 Risk and benefit analysis

This study contained limited risks for human respondents as the questions only related to their readiness to utilise technology such as RFID in their respective work contexts and did not contain any personal or sensitive types of questions that could in any manner have a negative psychological impact on them or cause them harm. The respondents were able to complete the online questionnaire in their own time and at their own pace, thereby limiting any possible risks. Furthermore, the respondents did not stand to directly benefit from the study, although the survey may have increased their level of awareness regarding RFID technology. This effect was not intended or considered a planned effect. The hosting company, as well as the scientific community, benefitted from the study as important information about the potential of RFID technology in a warehousing context was obtained.

3.4.3 Voluntary participation and confidentiality

Participation in the study was entirely voluntary, anonymous, and dependent on the person's willingness to take the survey since all prospective respondents received the online questionnaire electronically. Respondents had the right to withdraw at any stage during the questionnaire completion process without any penalty or future disadvantage whatsoever. The HR manager and warehouse managers distributing the survey link were thoroughly briefed by the researcher on the procedural and ethical requirements of the

research study. These managers were informed that participation in the study is entirely voluntary and that the identity and responses of the respondents must remain anonymous and confidential. The SurveyMonkey® questionnaire was set not to record any contact numbers, e-mail, or IP addresses to ensure complete anonymity of the collected data. The demographic information was only gathered for statistical purposes to make comparisons among the various demographic groups. All other information collected was not personal, and in this way, the researcher could not identify the respondents in any way.

3.4.4 Informed consent

The prospective respondents were asked for their permission to participate in the study by using a clickable button on the electronic survey, and the purpose of the study was truthfully stated. The respondents were informed that the gathered information would exclusively be used for purposes of this project only, and the estimated survey completion time of 15-20 minutes was indicated in the consent. In the first question of the online survey, the respondents were asked to consent to participate in the study. Access to the survey questionnaire was not allowed unless the respondents selected the "agree to participate" option. The survey automatically closed if the "disagree to participate" option was selected. Refer to Appendix 1 for the informed consent.

3.4.5 Incentives

The respondents were not rewarded or incentivised to participate in the study since it was anticipated that they would not incur any costs from participating in the study.

3.4.6 Permissions

This study complied with the ethical standards of academic research in that a permission letter for the study was obtained from the logistics director in the organisation where the study was conducted. Refer to Appendix 2 for the permission letters from the organisation to conduct the research. Furthermore, the researcher acquired a license from the Copyright Clearance Centre, and the developer, Professor Viswanath Venkatesh, granted the researcher permission to use the Unified Theory of Acceptance and Use of Technology (UTAUT) model. Subsequently, permission was also granted by Dr Charles Colby from Rockbridge Associates to use the 10-item TRI 2.0 scale to measure the

technology readiness of the respondents. Refer to Appendix 5 for the licences and permission to use UTAUT and TRI 2.0.

3.4.7 Preventing conflicts of interest

The researcher is a manager in one of the eight facilities where the research was conducted. Therefore, employees reporting to the researcher at the time of the study were excluded from the study to prevent potential conflicts of interest.

3.5 CHAPTER SUMMARY

This chapter dissected the research onion into its distinctive layers to develop a robust research framework for this study and facilitate seamless progression through the different stages of the research methodology design to achieve the study's objectives. Emphasis was placed on the measuring scales, data collection methods, statistical analysis, and ethical considerations. The analysis and interpretation of the research data gathered during the empirical study and the findings are covered in depth in the proceeding chapter, Chapter 4.

CHAPTER 4: EMPIRICAL RESULTS AND FINDINGS

4.1 INTRODUCTION

This study combined and applied the UTAUT and TRI 2.0 models to determine the influence of PE, EE, SI, SE, ATUT and TR on the BI of warehouse workers and managers toward the adoption of RFID technology. This chapter is thus devoted to analysing and interpreting the research data gathered during the empirical study to identify the human factors influencing the adoption of RFID technology in the South African wholesale distribution industry. Previously empirically validated, tested, and widely used measurement scales were utilised as the measuring instrument to collect the empirical research data in this study. In addition, the reliability of the measurement instrument was determined using Cronbach's Alpha coefficients. The purpose of this chapter is to analyse the gathered data and provide a detailed report of the research results and findings. The chapter concludes with a summary of the study's key findings.

4.2 REALISED SAMPLE

The data was gathered over five weeks, during which 117 respondents completed the survey questionnaire on the SurveyMonkey® platform. The realised sample of 117 responses is smaller than what the researcher aimed to gather (N = 300). Nevertheless, it is worth noting that the researcher made several attempts to increase the number of responses by submitting requests to the organisation for permission to distribute paper questionnaires, advertise the study and obtain a complete employee list with contact details to conduct probability sampling. Even though the organisation was immensely supportive of the researcher, the above-mentioned permission could understandably not be granted due to the regulations stipulated in the Protection of Personal Information Act 4 of 2013. Furthermore, as discussed in section 3.3.9, the organisation distributed the survey questionnaire link on behalf of the researcher. In light of this, the researcher is satisfied that every effort was made within the ethical standards of academic research to reach the target population and gather the maximum number of responses.

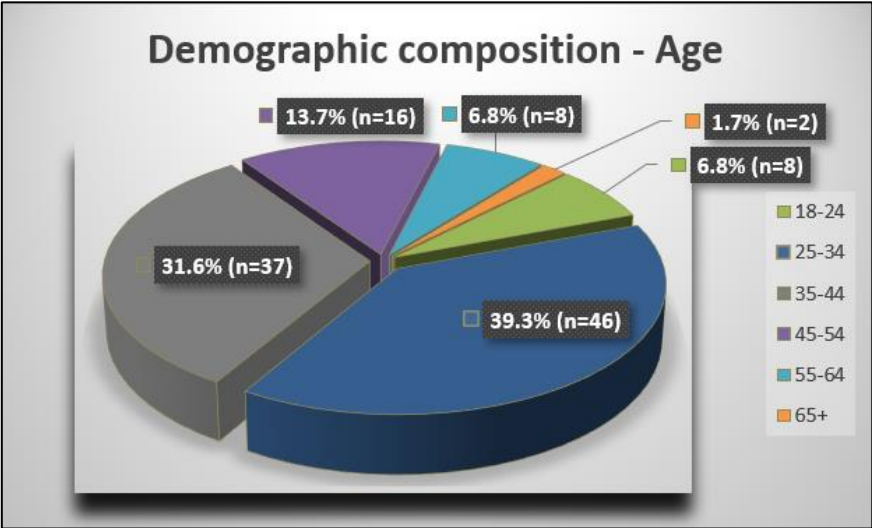
4.3 DEMOGRAPHIC AND RFID TECHNOLOGY AWARENESS INFORMATION

The respondents' demographic composition and information related to their RFID awareness were collected in Section A of the questionnaire. The data was gathered to profile the respondents who participated in this study and perform statistical comparisons among the various demographic groups to comprehend the research results fully. In this section, the respondents had to indicate their age, highest qualification, industry, position, work experience and the province where they work. On recommendation from the NWU Business School Scientific Committee, the respondents were not asked to reveal their gender. In the last question of this section, the respondents were asked to indicate how familiar they were with RFID technology to comprehend their RFID technology awareness level. The subsequent sections present a comprehensive analysis of Section A.

4.3.1 Age of respondents

Slightly less than half of the respondents were 34 years or younger (46.2% in total, with 6.8% being 18-24 years and 39.3% being 25-34), while the remainder were 35-44 years (31.6%), 45-64 years (13.7%), 55-64 years (6.8%) and 65+ (1.7%). The count (n) and percentages (%) per respondent age group are graphically illustrated in Figure 4-1.

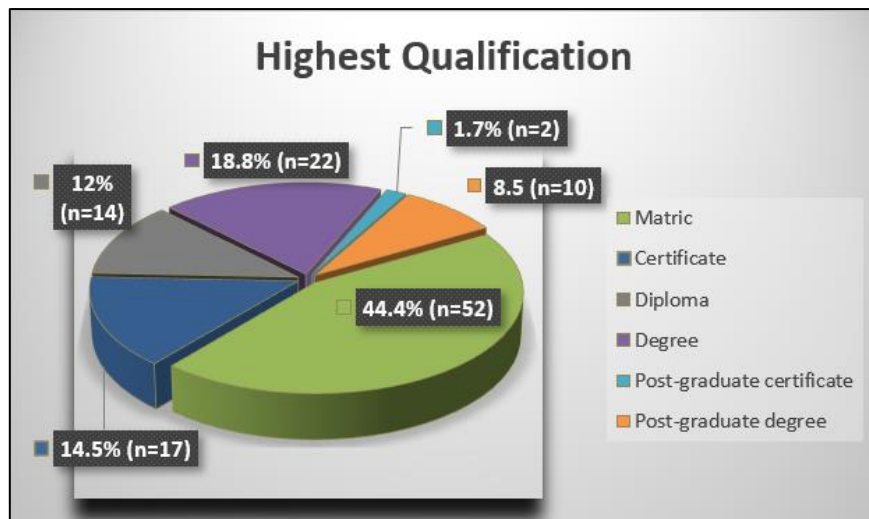
Figure 4-1: Age of respondents



4.3.2 Highest qualification

The sample represented a broad spectrum of qualifications held by the respondents, as shown in Figure 4-2. The organisation's minimum educational requirement for employment is matric, and little under half of the respondents selected this qualification on the questionnaire as their highest level of education (44.4%). Respondents with a certificate (14.5%) or diploma (12%) represented 26.5% of the sample, and 18.8% held a degree. Slightly more than 10% of the respondents obtained a post-graduate certificate (1.7%) or post-graduate degree (8.5%). The workforce appears to have a respectable level of education. However, the organisation should consider assisting those with mere matriculation to advance their education.

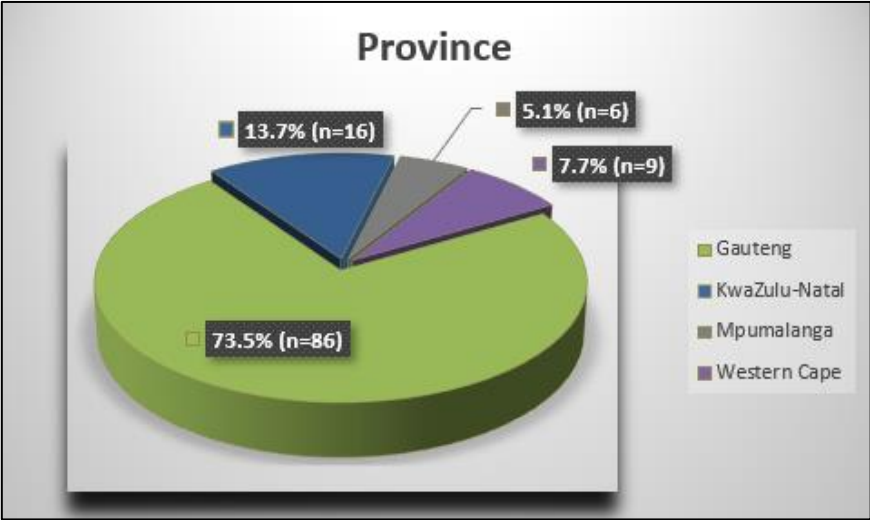
Figure 4-2: Highest qualification held by respondents



4.3.3 The geographical location of the respondents

The largest proportion of the respondents indicated that they are currently working in Gauteng (73.5%), with the second largest proportion working in KwaZulu-Natal (13.7%). The rest of the respondents indicated that they work either in Mpumalanga (5.1%) or Western Cape (7.7%). Although representation was not aimed for, to some extent, this distribution assimilates the distribution of employees in the population, Gauteng (69%), Cape (10%), KZN (7%) and Delmas (14%), as indicated by the organisation. The geographical location where the respondents that participated in the study work are shown in Figure 4-3 (p. 55).

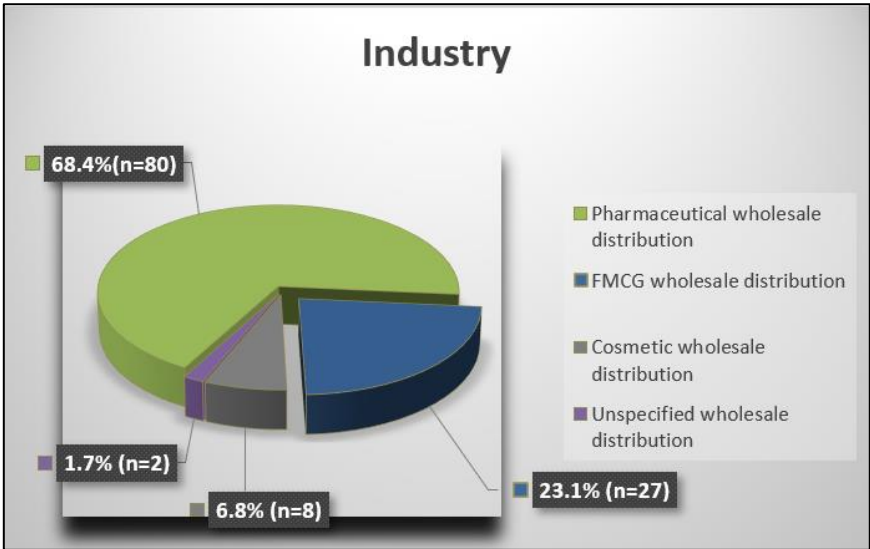
Figure 4-3: Geographical location of respondents



4.3.4 Industry

The respondents were asked to specify the industry in which they were employed. The results indicated that most of the respondents were employed in the pharmaceutical wholesale distribution industry (68.4%), followed by the FMCG (23.1%) and cosmetic wholesale distribution industry (6.8%), as indicated in Figure 4-4. Two respondents indicated in the open question that they were employed in the wholesale distribution industry but did not specify the relevant field.

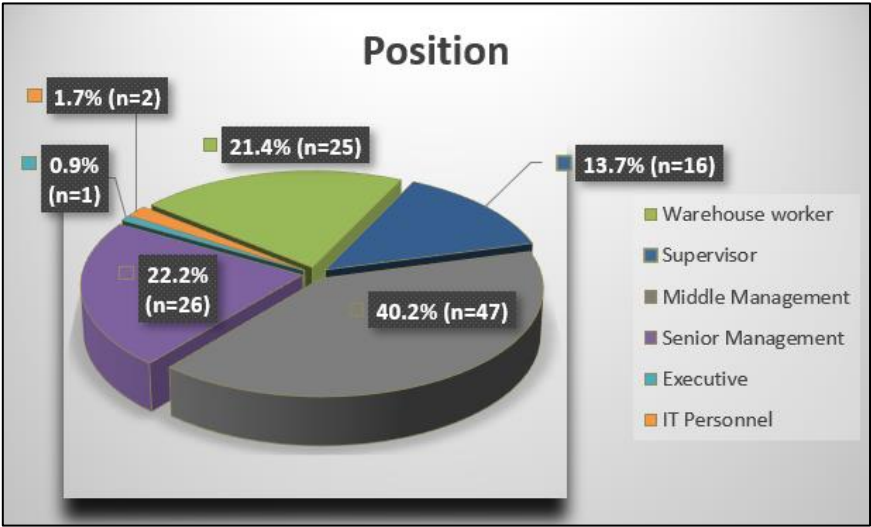
Figure 4-4: Industry wherein respondent's work



4.3.5 Position

Lower-level workers made up slightly more than one-third of the sample (35.1% in total, with 21.4% being warehouse workers and 13.7% being supervisor level), while respondents in middle management level positions (40.2%) accounted for a marginally larger proportion of the sample as illustrated in Figure 4-5. In contrast, senior management (22.2%), executives (0.9%) and IT personnel (1.7%) accounted for the smallest proportion, with 24.8% in total.

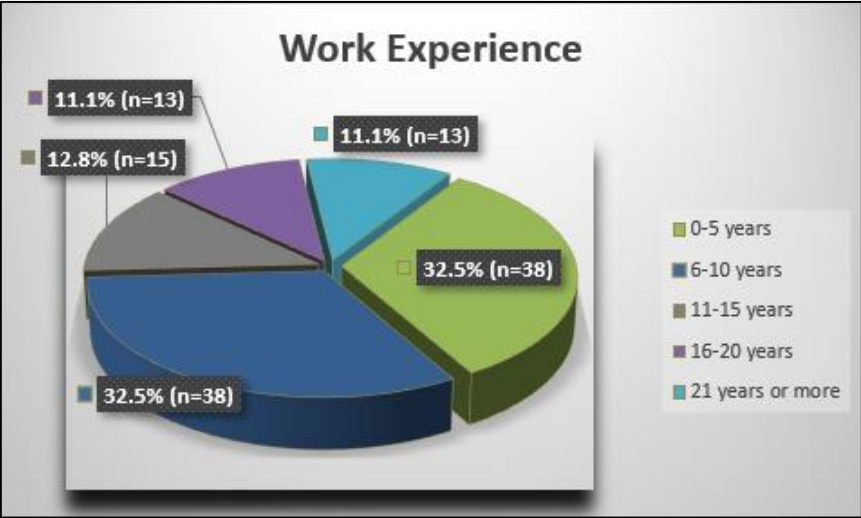
Figure 4-5: Position held by respondents



4.3.6 Work experience

Respondents with less than five years (32.5%) and those with six to ten years (32.5%) of work experience were represented equally and accounted for the largest proportion of the sample. The remainder of the respondents had eleven or more years of work experience. Figure 4-6 (p .57) illustrates that 65% of the respondents have less than ten years of work experience. This result indicates that the workforce appears relatively inexperienced, early career and likely less experienced.

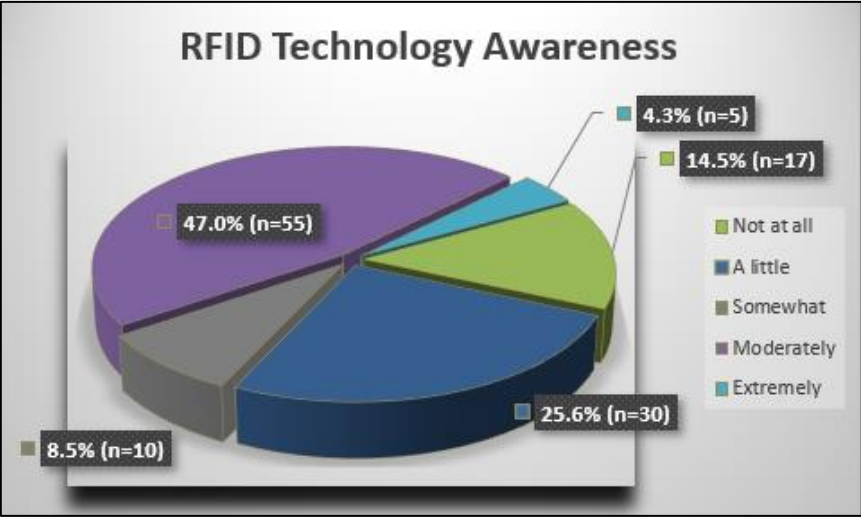
Figure 4-6: Years of work experience



4.3.7 RFID technology awareness

The respondents were asked to answer the question, "How familiar are you with RFID technology". The respondents who indicated that they are moderate to extremely familiar with RFID technology are deemed to have a high awareness of RFID technology. Figure 4-7 illustrates that slightly more than half of the respondents (51.3%) were moderate (47%) to extremely (4.3%) familiar with RFID technology. The remainder of the respondents were less familiar with RFID technology, and a noteworthy 14.5% of the respondents indicated that they were not at all familiar with RFID technology. These results suggested that the groups of respondents with a high level of RFID technology awareness and those with low awareness are equally well represented.

Figure 4-7: Respondents' RFID technology awareness



4.4 DESCRIPTIVE STATISTICS AND FREQUENCY ANALYSIS

Malhotra (2010:545) noted that it is practical for researchers to examine several values of a variable using frequency distribution. A frequency table is simple to read and gives basic information, but occasionally the researcher may simplify it using descriptive statistics since the information may be too complex (Malhotra, 2010:545). In addition, Field (2009:141) stated that descriptive statistics is a valuable method to obtain an instant snapshot of the research data distribution and assists in comparing or describing variables numerically. The mean is the average value determined by adding together all components and dividing by the total number of components. The statistic known as standard deviation is used to describe how much data values deviate from the mean for a variable that contains measurable data (Saunders *et al.*, 2007:612). The frequencies expressed in percentages, mean scores and standard deviations of the scale items and dimensions are presented and discussed in the subsequent subsections.

4.4.1 Technology Readiness measurement

Section B aimed to measure the Technology Readiness level of the respondents. For this purpose, the 10-item TRI 2.0 scale was used. The 10-item scale is a condensed version of the 16-item TRI 2.0 scale, which consists of ten belief statements ranging from 1.0 (strongly disagree) to 5.0 (strongly agree), with 3.0 serving as the scale's midpoint (neutral). The scale's Technology Readiness Motivators (TRM) include two Optimism (OPT) and three Innovativeness (INN) statements, while two Discomfort (DIS) and three Insecurity (INS) statements from the 16-item scale make up the Technology Readiness Inhibitors (TRINH). The original 10-item TRI 2.0 belief statements were used in the questionnaire with only one minor wording change to the belief statement in Q9 to suit the South African setting. The relevant belief categories and numbers representing the original 16-item TRI 2.0 version statement are indicated next to the belief statements used in this scale in Table 4-1 (p. 59).

The TR belief statements in Table 4-1 (p. 59) were evaluated using mean, standard deviation, and frequencies. The mean indicated the degree to which the respondents agreed with the statements (1 = strongly disagree – 5 = strongly agree). The highest mean was reported for Q10, stating that "Technology makes me more productive in my personal life" ($M = 4.42$; $SD = 0.98$), and the second highest mean was reported for Q9,

stating that "Technology gives freedom to move/travel between places easily" ($M = 4.33$; $SD = 1.15$). Both these items are Optimism (OPT) belief statements indicating that the respondents demonstrated an optimistic outlook toward technology and the notion that it affords people more control, flexibility, and efficiency in their daily lives. The lowest mean scores were reported for Q15, stating, "Sometimes, I think that technology systems are not designed for use by ordinary people." ($M = 2.45$; $SD = 1.26$), and Q14 stating, "Technical support lines are not helpful because they don't explain things in terms I understand" ($M = 2.76$; $SD = 1.05$). These two statements are both Discomfort (DIS) statements. Therefore, the low scores for the Discomfort (DIS) statements indicate that the respondents did not demonstrate a sense of being overwhelmed by technology or a perceived lack of control over it.

Table 4-1: Technology Readiness belief statements

		% Strongly Disagree (1)	% Somewhat Disagree (2)	% Neutral (3)	% Somewhat Agree (4)	% Strongly Agree (5)	Mean	SD
TECHNOLOGY READINESS MOTIVATORS (TRM)								
Q 9	Technology gives freedom to move/travel between places easily (OPT1).	7.69	0.85	5.98	21.37	64.10	4.33	1.15
Q 10	Technology makes me more productive in my personal life (OPT4).	4.27	1.71	5.13	25.64	63.25	4.42	0.98
Q 11	Other people come to me for advice on new technologies (INN1).	5.13	5.98	38.46	35.90	14.53	3.49	0.99
Q 12	In general, I am among the first in my circle of friends to acquire new technology when it appears (INN2).	9.40	11.11	44.44	24.79	10.26	3.15	1.06
Q 13	I keep up with the latest technological developments in my areas of interest (INN4).	5.13	12.82	21.37	33.33	27.35	3.65	1.16
TECHNOLOGY READINESS INHIBITORS (TRINH)								
Q 14	Technical support lines are not helpful because they don't explain things in terms I understand (DIS2).	14.53	22.22	39.32	20.51	3.42	2.76	1.05
Q 15	Sometimes, I think that technology systems are not designed for use by ordinary people (DIS3).	29.91	25.64	19.66	18.80	5.98	2.45	1.26
Q 16	People are too dependent on technology to do things for them (INS1).	6.84	5.98	21.37	38.46	27.35	3.74	1.13
Q 17	Too much technology distracts people to a point that is harmful (INS2).	14.53	10.26	22.22	34.19	18.80	3.32	1.30
Q 18	Technology lowers the quality of relationships by reducing personal interaction (INS3).	11.97	7.69	18.80	38.46	23.08	3.53	1.26

The respondents' Technology Readiness (TR) was measured by calculating the Technology Readiness Index (TRI 2.0). The following instructions for the use of the 10-item TRI 2.0 were followed to calculate TR:

1. The averages of the five positive statements (TRM) and five negative statements (TRINH) were calculated.
2. Afterwards, the mean of the negative Technology Readiness Inhibitor (TRINH) items was reversed by subtracting the scores from six.
3. Finally, the average of the two dimensions was calculated as follows to determine TR:

$$\text{TRI 2.0} = (\text{TRM} + (6 - \text{TRINH})) / 2$$

Table 4-2: Technology Readiness toward technology adoption

Dimension	Questions	N	Min	Max	Mean	SD
Technology Readiness Motivators (TRM)	Q9-Q13	117	1.60	5.00	3.81	0.76
Technology Readiness Inhibitors (TRINH)	Q14-Q18	117	1.00	5.00	3.16	0.79
Technology Readiness Index (TRI 2.0)	Q9-Q18	117	2.20	4.90	3.32	0.58

Parasuraman and Colby (2015:11) divided and characterised TR into three groups based on the respondents' TRI 2.0 scores, namely:

- Low Technology Readiness (TR) tier: ≤ 2.82
- Middle Technology Readiness (TR) tier: $2.83 - 3.24$
- High Technology Readiness (TR) tier: ≥ 3.25

The Technology Readiness Index score of 3.32 (SD = 0.58) presented in Table 4-2 is positioned in the highest TR tier, indicating that the respondents possess a high level of Technology Readiness toward adopting new technologies. Therefore, this result implies that, on average, the respondents demonstrate strong positive beliefs and attitudes toward adopting new cutting-edge technologies such as RFID to accomplish their work goals.

However, studying the inhibitor items in the above table (Table 4.2) indicates that respondents felt relatively strongly about the inhibiting social aspects of technology, namely, reducing social contact, being overly dependent on technology, and technology distracting a person from their work. As discussed in section 2.12, TR was incorporated

as an independent variable of the UTAUT model. Therefore, only TR was used and further discussed in the subsequent sections, not its TRIM and TRINH variables.

4.4.2 Technology acceptance based on UTAUT dimensions

Section C of the questionnaire aimed to determine the technology acceptance of respondents toward the Behavioural Intention (BI) to adopt RFID technology and thus utilised the UTAUT scale for this purpose. This scale measured the dependent variable (BI) and five independent UTAUT variables (PE, EE, SI, ATUT, and SI) using a 5-point Likert scale ranging from 1.0 (strongly disagree) to 5.0 (strongly agree), with 3.0 serving as the scale's midpoint (neutral). The descriptive statistics and frequency analysis results of each UTAUT dimension are presented in the subsequent tables and discussed in-depth.

Table 4-3: Performance Expectancy (PE) statements

		% Strongly Disagree (1)	% Somewhat Disagree (2)	% Neutral (3)	% Somewhat Agree (4)	% Strongly Agree (5)	Mean	SD
PERFORMANCE EXPECTANCY (PE)								
Q 19	I would find the technology useful in my job.	2.56	0.00	6.84	19.66	70.94	4.56	0.83
Q 20	Using the technology would enable me to accomplish tasks more quickly.	0.85	0.00	6.84	20.51	71.79	4.62	0.69
Q 21	Using the technology would increase my productivity.	0.85	0.00	9.40	19.66	70.09	4.58	0.73
Q 22	If I use the technology, I will increase my chances of career advancement.	1.71	0.00	14.53	25.64	58.12	4.38	0.86

The highest mean in Table 4-3 was reported for Q20, stating that "Using the technology would enable me to accomplish tasks more quickly." ($M = 4.62$; $SD = 0.69$), with 71.79% of the respondents strongly agreeing with this statement. The lowest mean score was reported for Q22, stating, "If I use the technology, I will increase my chances of career advancement." ($M = 4.38$; $SD = 0.86$), with 58.12% of the respondents strongly agreeing with this statement. The mean scores for the statements in this dimension range from 4.38 to 4.56, indicating that the respondents, on average, somewhat to strongly agreed with the statements in the Performance Expectancy (PE) dimension. These results

suggest that respondents strongly believe using RFID technology will improve their work performance.

Table 4-4: Effort Expectancy (EE) statements

		% Strongly Disagree (1)	% Somewhat Disagree (2)	% Neutral (3)	% Somewhat Agree (4)	% Strongly Agree (5)	Mean	SD
EFFORT EXPECTANCY (EE)								
Q 23	My interaction with the technology would be clear and understandable.	0.85	0.85	16.24	40.17	41.88	4.21	0.81
Q 24	I think it would be easy for me to become skilful at using the technology.	0.85	1.71	5.13	26.50	65.81	4.55	0.75
Q 25	I think that I would find the technology easy to use.	0.85	0.00	7.69	31.62	59.83	4.50	0.71
Q 26	I think it will be easy to learn how to use the technology.	0.85	0.85	6.84	27.35	64.10	4.53	0.74

With regards to the Effort Expectancy (EE) dimension, the respondents agreed most with the statement in Q24, stating that "I think it would be easy for me to become skilful at using the technology." ($M = 4.55$; $SD = 0.75$). This result indicates that the respondents believed it would be relatively easy to become skilful at using RFID technology. The respondents agreed the least with the statement in Q23, stating that "My interaction with the technology would be clear and understandable." ($M = 4.21$; $SD = 0.81$). As indicated in Table 4-4, 65.81% of respondents strongly agreed with the statement in Q24, compared to only 41.88% who strongly agreed with the statement in Q23.

Table 4-5: Social Influence (SI) statements

		% Strongly Disagree (1)	% Somewhat Disagree (2)	% Neutral (3)	% Somewhat Agree (4)	% Strongly Agree (5)	Mean	SD
SOCIAL INFLUENCE (SI)								
Q 27	People who influence my behaviour think that I should use the technology.	8.55	1.71	37.61	28.21	23.93	3.57	1.13
Q 28	People who are important to me think that I should use the technology.	4.27	1.71	35.90	27.35	30.77	3.79	1.04
Q 29	In general, the organisation will support the use of the technology.	1.71	0.00	11.11	31.62	55.56	4.39	0.82
Q 30	The senior management of this business will be helpful in the use of the technology.	1.71	1.71	11.11	26.50	58.97	4.39	0.88

As indicated in Table 4-5 (p. 62), the statements in Q29, "In general, the organisation will support the use of the technology." (SD = 0.82), and Q30 stating that "The senior management of this business will be helpful in the use of the technology." (SD = 0.88), received the most support from the respondents with the same mean score of 4.39. These results indicate that the respondents, on average, somewhat agree and believe that the organisation will support the use of RFID technology and that the senior management in the organisation would assist respondents in using RFID technology. As shown in Table 4-6, the respondents least supported the statement in Q27, stating, "People who influence my behaviour think that I should use the technology." ($M = 3.57$; $SD = 1.13$). Furthermore, more than half of the respondents strongly agreed with the statements in Q29 (55.56%) and Q30 (58.97%). In contrast, only 23.93% of the respondents strongly agreed with the statement in Q27.

Table 4-6: Attitude toward Using Technology (ATUT) statements

		% Strongly Disagree (1)	% Somewhat Disagree (2)	% Neutral (3)	% Somewhat Agree (4)	% Strongly Agree (5)	Mean	SD
ATTITUDE TOWARD USING TECHNOLOGY (ATUT)								
Q 34	Using the technology is a good idea.	0.85	0.85	6.84	22.22	69.23	4.58	0.73
Q 35	I think the technology will make my work more interesting.	0.85	0.85	9.40	25.64	63.25	4.50	0.77
Q 36	I think working with the technology will be fun.	1.71	0.00	11.97	32.48	53.85	4.37	0.83
Q 37	I think I will enjoy working with the technology.	0.85	0.00	9.40	27.35	62.39	4.50	0.74

The respondents consistently agreed with the statements in Table 4-6 related to the Attitude toward using Technology (ATUT) dimension, with the mean scores ranging between 4.37 and 4.58. The highest mean score of 4.58 ($SD = 0.73$) was reported for the statement in Q34, stating, "Using the technology is a good idea." While the lowest reported mean score was for the statement in Q36 that stated, "I think working with the technology will be fun." ($M = 4.37$; $SD = 0.83$). These results indicate that the respondents generally hold positive attitudes toward RFID technology.

Table 4-7: Self-Efficacy (SE) statements

		% Strongly Disagree (1)	% Somewhat Disagree (2)	% Neutral (3)	% Somewhat Agree (4)	% Strongly Agree (5)	Mean	SD
SELF-EFFICACY (SE)								
I could complete a job or task using RFID technology...								
Q 38	if there was no one around to tell me what to do	2.56	7.69	24.79	32.48	32.48	3.85	1.05
Q 39	if I could call someone for help if I got stuck.	0.85	0.00	24.79	41.03	33.33	4.06	0.81
Q 40	if I only had the system manuals for reference.	2.56	3.42	28.21	39.32	26.50	3.84	0.95
Q 41	if I had a lot of time to complete the job for which the technology was provided.	0.85	8.55	24.79	32.48	33.33	3.89	1.00

The highest mean score in the Self-Efficacy (SE) dimension was reported for the statement in Q39, which stated, "I could complete a job or task using RFID technology if I could call someone for help if I got stuck." ($M = 4.06$; $SD = 0.81$). While the lowest mean score reported was for the statement in Q40, which stated, "I could complete a job or task using RFID technology if I only had the system manuals for reference." ($M = 3.84$; $SD = 0.95$), as indicated in Table 4-7.

Table 4-8: Behavioural Intention (BI) statements

		% Strongly Disagree (1)	% Somewhat Disagree (2)	% Neutral (3)	% Somewhat Agree (4)	% Strongly Agree (5)	Mean	SD
BEHAVIOURAL INTENTION (BI)								
Q 31	I intend to use the technology in the future.	0.85	0.85	11.11	22.22	64.96	4.50	0.79
Q 32	I predict that I will use the technology in the future.	0.85	0.00	10.26	18.80	70.09	4.57	0.75
Q 33	I plan to use the technology in the future.	0.85	0.00	14.53	19.66	64.96	4.48	0.81

The respondent's views on the statements in the Behavioural Intention (BI) dimension are all closely related, with mean scores ranging between 4.48 and 4.57, as shown in Table 4-8. The statement in Q32, stating that "I predict that I will use the technology in the future." reported the highest mean score of 4.57 ($SD = 0.75$), while the statement in Q33,

stating "I plan to use the technology in the future." reported the lowest score ($M = 4.48$; $SD = 0.81$). On average, 70.09% of the respondents strongly agreed with the statement in Q32, whereas 64.96% strongly agreed with the statements in Q31 and Q33. These results signify that the respondents demonstrated strong behavioural intent toward adopting RFID technology.

4.5 RELIABILITY OF THE MEASUREMENT SCALE

Based on the discussion in section 3.3.10, the researchers regard the results as valid since previously empirically validated and tested measurement scales were used to collect the empirical research data in this study. Therefore, the scale factors, as determined in other studies, were used to measure the reliability of the measuring scale.

Reliability is the consistency of a measure, and a measurement scale is considered reliable when it consistently yields the same findings as measurements are retaken (Field, 2009:674; Malhotra, 2010:286). Field (2009:674) acknowledged Cronbach's Alpha as the preferred method to measure scale reliability. Therefore, Cronbach's Alpha was calculated to assess the reliability of the measuring scales utilised in this study, and the reliability coefficients for each dimension are listed in Table 4-9 (p. 66). According to Field (2009:675), Cronbach Alpha values above 0.7 are considered good values, but also quotes Kline regarding acceptable Cronbach's alpha levels: "Kline (1999) notes that although the generally accepted value of .8 is appropriate for cognitive tests such as intelligence tests, for ability tests a cut-off point of .7 is more suitable. He goes on to say that when dealing with psychological constructs, values below even .7 can, realistically, be expected because of the diversity of the constructs being measured." Therefore, Field (2009:675) noted that Cronbach's alpha values above 0.5 might also be used, specifically for psychological constructs. However, interpretation should be approached with caution. Therefore, in this study, Cronbach's Alpha coefficients of 0.5 and above were considered sufficient for inclusion.

All responses from the 117 respondents were used to determine the reliability of the measuring scale dimensions presented in Table 4-9 (p. 66). Cronbach Alpha values above 0.7 were reported for five dimensions, namely, PE, EE, SI, BI and ATUT, with the highest values reported for BI (0.942) and ATUT (0.931). In comparison, Cronbach Alpha's of slightly below 0.7 were calculated for the TR (0.687) dimension and its TRINH

(0.676) variable and above 0.7 for the TRM (0.754) variable. Even though the lowest Cronbach Alpha value of 0.524 was reported for the SE, the value is still above the minimum specified threshold of 0.5. Therefore, the reported Cronbach Alpha values of the scale dimensions were found to be above the guideline value of 0.7 or at least 0.5 (Field, 2009:675), which signifies that the resulting scale dimensions are reliable.

Table 4-9: Scale reliability

Dimension	Questions	N	Mean	SD	Cronbach's Alpha
Technology Readiness Motivators (TRM)	Q9-Q13	117	3.81	0.76	0.754
Technology Readiness Inhibitors (TRINH)	Q14-Q18	117	3.16	0.79	0.676
Technology Readiness (TR)	Q9-Q18	117	3.32	0.58	0.687
Performance Expectancy (PE)	Q19-Q22	117	4.54	0.64	0.842
Effort Expectancy (EE)	Q23-Q26	117	4.45	0.63	0.864
Social Influence (SI)	Q27-Q30	117	4.04	0.77	0.796
Behavioural Intention (BI)	Q31-Q33	117	4.52	0.74	0.942
Attitude toward using Technology (ATUT)	Q34-Q37	117	4.49	0.70	0.931
Self-Efficacy (SE)	Q38-Q41	117	3.91	0.61	0.524

None of the scale items contributed negatively towards the overall reliability. All the scale items were thus retained without requiring adjustments or further analysis. In light of the discussion above, the questionnaire's mean results are considered reliable for further analysis in this study to draw conclusions on the influence of the selected human factors on RFID technology adoption, represented by dimensions shown in Table 4-9.

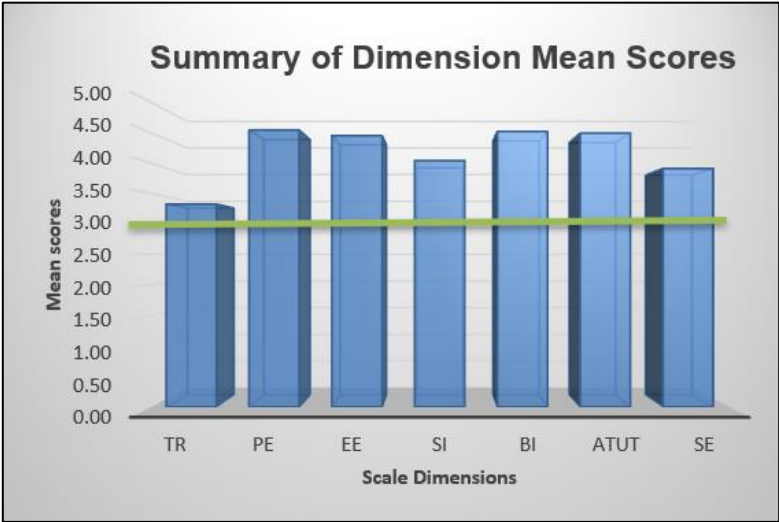
The mean value of 3.32 (SD = 0.58) for the TR dimension presented in Table 4-9 indicates that respondents, on average, felt Neutral regarding the statements within this dimension. Whereas the mean values ranging from 3.91 to 4.49 for the EE ($M = 4.45$; $SD = 0.63$), SI ($M = 4.04$; $SD = 0.77$), ATUT ($M = 4.49$; $SD = 0.70$) and SE ($M = 3.91$; $SD = 0.61$) dimensions indicates that respondents on average somewhat agreed with the statements within these dimensions. Whereas the mean values for PE ($M = 4.54$; $SD = 0.64$) indicate that the respondents strongly agreed with the statements within this dimension on average. The same goes for the BI score, with a mean value of 4.52 ($SD = 0.74$), indicating that the respondents, on average, strongly agreed, which signifies that the individuals working in the wholesale distribution industry have a strong behavioural intent to adopt RFID technology in their workplace. The standard deviations ranging between 0.58 and 0.77 indicate that the respondent's responses (SD) did not vary considerably.

These findings suggest that the respondents, to a high degree, expressed their acceptance of RFID technology by directing behaviour towards the adoption of the technology.

4.6 DESCRIPTIVE STATISTICS SUMMARY

The reported mean scores of all the scale dimensions are above the scale's midpoint of 3.0, of which five out of seven dimensions have mean scores above 4.0. These results, summarised and illustrated in Figure 4-8, indicate that, on average, the respondents expressed positive beliefs toward the readiness and acceptance of RFID technology.

Figure 4-8: Scale dimension mean score summary



4.7 GROUP COMPARISONS

ANOVA and t-tests were conducted to test for differences in the scale dimensions between the demographic variables in Section A's groups with the aim of determining the human drivers and barriers to RFID technology adoption. The ANOVA technique was used to make group comparisons between variables with more than two categories (age, qualification, position, and work experience). In addition, t-tests were used to measure the differences between groups with only two categories (location, industry, and RFID awareness level). A cross tabulation analysis was used to determine the association between the position and RFID technology awareness variables.

According to Steyn and Ellis (2003:51), convenience-sampled data should be regarded as small populations for which statistical inference and p-values are irrelevant and should

not be analysed as if gathered by random sampling. Therefore, p-values were reported for completeness's sake but not interpreted since a convenience sample instead of a random sample was used to gather data in this study. Field (2009:56) stated that the fact that a test statistic is significant does not imply that the effect it measures is meaningful or important, hence the importance of measuring the effect size. According to Field (2009:785), an effect size is a standardised and objective measure of the magnitude of an observed effect. In addition, Steyn and Ellis (2003:51) highlighted that effect size is a measure of practical significance and is independent of sample size. A large enough effect size is considered significant in practice to describe variances in means, the relationship in two-way frequency tables, and a multiple regression fit (Steyn & Ellis, 2003:51).

In light of the above discussion, effect sizes instead of p-values were used to interpret the ANOVA and t-test results based on the following guidelines (Steyn & Ellis, 2003:52):

- Small, no practically significant difference: $d \sim 0.2$
- Medium, practically visible difference: $d \sim 0.5$
- Large, practically significant difference: $d \sim 0.8$

4.7.1 ANOVA: Age

The One-way ANOVA for multiple groups was used in the analyses, which were supplemented with effect sizes seeing that p-values are only reported for completeness' sake. The reported effect sizes ($d = 0.02 - 0.34$) did not indicate any practically visible or practically significant differences between age groups. Refer to Appendix 6 for the table presenting the effect sizes with regard to the various age groups. These results indicate that age does not influence employees' readiness or acceptance of RFID technology and further highlight that age differences among employees would not be considered a barrier for a wholesale distribution organisation to adopt RFID technology.

4.7.2 ANOVA: Work experience

In this instance, the influence of work experience on the TRI 2.0 and UTAUT scale dimensions was considered by investigating the significance of the effect sizes with regard to the various work experience groups. Based on the effect sizes ($d = 0.00 - 0.26$), there are only practically insignificant differences with regard to years of work experience.

Refer to Appendix 7 for the table presenting the effect sizes with regard to work experience. The results, therefore, indicate that years of work experience do not influence employees' readiness or acceptance of RFID technology. Work experience, like age, is not regarded as a barrier to the wholesale distribution industry's adoption of RFID technology.

4.7.3 ANOVA: Qualification

The respondents were grouped based on their highest qualification to determine whether practical differences in the responses of the various groups exist, thus possibly indicating that qualification could drive or hinder the Behavioural Intention (BI) to adopt RFID technology. The qualifications were segmented into three groups: 1) respondents with only a matric qualification, 2) those with a diploma or certificate, and 3) respondents that obtained a degree, post-graduate certificate or post-graduate degree. The results of the analysis are presented in Table 4-10.

Table 4-10: ANOVA results regarding respondent's qualifications

	Qualification	N	Mean	SD	Anova Sig.	Welsch Sig.	Effect sizes	
							Matric with	Certificate & Diploma with
TR	Matric	52	3.39	0.67	0.363	0.340		
	Certificate & diploma	31	3.35	0.49			0.06	
	Degree, Post-Cert, Post-Deg	34	3.21	0.53			0.27	0.27
PE	Matric	52	4.55	0.57	0.637	0.695		
	Certificate & diploma	31	4.60	0.62			0.08	
	Degree, Post-Cert, Post-Deg	34	4.46	0.78			0.12	0.19
EE	Matric	52	4.47	0.56	0.893	0.910		
	Certificate & diploma	31	4.45	0.60			0.03	
	Degree, Post-Cert, Post-Deg	34	4.40	0.77			0.09	0.06
SI	Matric	52	4.18	0.79	0.078	0.089		
	Certificate & diploma	31	4.05	0.71			0.17	
	Degree, Post-Cert, Post-Deg	34	3.80	0.76			0.48	0.33
BI	Matric	52	4.56	0.70				

	Qualification	N	Mean	SD	Anova Sig.	Welsch Sig.	Effect sizes	
							Matric with	Certificate & Diploma with
	Certificate & diploma	31	4.54	0.66	0.675	0.675	0.04	
	Degree, Post-Cert, Post-Deg	34	4.42	0.87			0.16	0.13
ATUT	Matric	52	4.59	0.62	0.204	0.282		
	Certificate & diploma	31	4.50	0.61			0.15	
	Degree, Post-Cert, Post-Deg	34	4.32	0.86			0.32	0.21
SE	Matric	52	3.92	0.57	0.074	0.086		
	Certificate & diploma	31	4.08	0.53			0.28	
	Degree, Post-Cert, Post-Deg	34	3.74	0.71			0.26	0.49

Based on the reported effect size ($d = 0.48$) in Table 4-10 (p. 69), there is a practically visible difference between the respondents with matric and those with a degree or higher qualification when considering the Social Influence (SI) dimension. The group with matric ($M = 4.18$, $SD = 0.79$) on average somewhat agree and lean towards strongly agree with the statements within this dimension, whereas the group of respondents with a degree, post-graduate diploma or post-graduate degree ($M = 3.80$, $SD = 0.90$) also somewhat agree but are leaning towards feeling neutral. This result reflects that employees with only a matric qualification could be easier influenced by individuals perceived to be important, such as senior management, to adopt RFID technology, compared to employees with a degree, post-graduate diploma or post-graduate degree qualification.

In addition, when considering the Self-Efficacy (SE) dimension, a practically visible difference ($d = 0.49$) between the respondents with a certificate or diploma and those with a degree or higher exists. On average, the group with a degree or higher qualification ($M = 3.74$, $SD = 0.71$) somewhat agree but leans toward feeling neutral. While the group with a certificate or diploma ($M = 4.08$, $SD = 0.53$), on average, somewhat agree and leans toward strongly agree to indicate that the respondents in this group have higher self-confidence in their ability to accomplish a task using RFID technology compared to the group with a degree or higher qualification. All other effect sizes regarding qualification were practically insignificant ($d = 0.03 - 0.32$). These results show that a lack of qualified tertiary personnel is not regarded as a barrier to adopting RFID technology by an organisation in the wholesale distribution industry.

4.7.4 ANOVA: Position

The respondents were grouped based on their position in the organisation to determine whether practical differences in the various groups' responses exist that could indicate that employees' positions in an organisation could drive or hinder their Behavioural Intention (BI) to adopt RFID technology. The respondents were grouped according to their position in the organisation: lower-level workers (warehouse workers & supervisors), middle management and senior management (senior managers, executives, and IT personnel). The results of the analysis are presented in Table 4-11.

Table 4-11: ANOVA results regarding respondent's position

	Position	N	Mean	SD	Anova Sig.	Welsch Sig.	Effect sizes	
							Lower-level workers with	Middle Management with
TR	Lower-level workers	41	3.54	0.64	0.012	0.020		
	Middle Management	47	3.20	0.61			0.53	
	Senior Management	29	3.22	0.33			0.49	0.04
PE	Lower-level workers	41	4.68	0.53	0.200	0.186		
	Middle Management	47	4.43	0.79			0.31	
	Senior Management	29	4.52	0.51			0.30	0.11
EE	Lower-level workers	41	4.60	0.50	0.051	0.018		
	Middle Management	47	4.45	0.75			0.19	
	Senior Management	29	4.22	0.54			0.69	0.30
SI	Lower-level workers	41	4.28	0.74	0.040	0.036		
	Middle Management	47	3.91	0.82			0.44	
	Senior Management	29	3.89	0.65			0.53	0.03
BI	Lower-level workers	41	4.75	0.56	0.035	0.012		
	Middle Management	47	4.43	0.88			0.36	
	Senior Management	29	4.32	0.65			0.65	0.13
ATUT	Lower-level workers	41	4.67	0.62	0.090	0.042		
	Middle Management	47	4.43	0.82			0.29	
	Senior Management	29	4.32	0.53			0.57	0.14
SE	Lower-level workers	41	4.03	0.63	0.151	0.142		
	Middle Management	47	3.90	0.61			0.20	
	Senior Management	29	3.74	0.56			0.46	0.27

Regarding the TR dimension, practically visible differences based on the reported effect sizes ($d = 0.49 - 0.53$) were identified between the responses of the lower-level workers

($M = 3.54$; $SD = 0.64$) and those of middle management ($M = 3.20$; $SD = 0.61$; $d = 0.53$) and also with senior management ($M = 3.22$; $SD = 0.33$; $d = 0.49$). These results indicate that the TR level of lower-level workers is higher than that of Middle and senior management. In fact, lower-level workers are positioned in the High TR tier ($TR \geq 3.25$) compared to the Middle TR tier ($TR = 2.83 - 3.24$) for middle and senior managers. Practically visible differences based on the effect sizes ($d = 0.46 - 0.69$) with regard to the EE, SI, BI, ATUT and SE dimensions were also reported between the lower-level workers and senior management as presented in Table 4-11 (p. 71). The most significant practically visible difference based on the effect size ($d = 0.69$) was reported in regard to the EE dimension, where senior management ($M = 4.22$; $SD = 0.54$), on average, somewhat agreed with the statements in this dimension. In comparison, the lower-level workers ($M = 4.60$; $SD = 0.50$), on average, strongly agreed with the statements in the EE dimension. The same goes for the BI dimension, where based on the effect size ($d = 0.65$), a practically visible difference between the lower-level workers and senior managers were reported. Similar to the EE dimension, the senior managers ($M = 4.32$; $SD = 0.65$), on average, somewhat agreed, while the lower-level workers ($M = 4.75$; $SD = 0.56$), on average, strongly agreed with the statements in the BI dimension. These results indicate that, on average, the lower-level workers demonstrated a higher level of Technology Readiness and more strongly expressed their acceptance of RFID technology compared to the other groups.

4.7.5 T-test: Industry

T-tests were conducted to calculate the various effect sizes between the respondents working in pharmaceutical warehouses and those working in FMCG warehouses. The reported effect sizes ($d = 0.07 - 0.33$) did not indicate any practically visible or practically significant differences between warehouse industry groups. The results indicate that the subindustry within the South African wholesale distribution industry does not influence employees' readiness or acceptance of RFID technology. Refer to Appendix 8 for the table presenting the effect sizes.

4.7.6 T-test: Geographical location

The respondent's work location was grouped based on whether the respondents worked in an inland or coastal province. Consequently, responses from Gauteng and

Mpumalanga were grouped as the inland group, whereas the responses from the Western Cape and KwaZulu-Natal were grouped as the coastal group.

Table 4-12: T-test results of respondent's geographical location

Dimension	Location	N	Mean	SD	Sig. (2-tailed)	Effect size
Technology Readiness (TR)	Inland	95	3.37	0.55	0.122	0.37
	Coastal	22	3.12	0.68		
Performance Expectancy (PE)	Inland	95	4.60	0.62	0.052	0.47
	Coastal	22	4.27	0.70		
Effort Expectancy (EE)	Inland	95	4.49	0.62	0.180	0.32
	Coastal	22	4.27	0.67		
Social Influence (SI)	Inland	95	4.07	0.76	0.303	0.24
	Coastal	22	3.88	0.81		
Behavioural Intention (BI)	Inland	95	4.56	0.75	0.189	0.30
	Coastal	22	4.33	0.70		
Attitude toward using technology (ATUT)	Inland	95	4.52	0.69	0.379	0.21
	Coastal	22	4.36	0.73		
Self-Efficacy (SE)	Inland	95	3.88	0.62	0.242	0.27
	Coastal	22	4.05	0.60		

Based on the reported effect sizes presented in Table 4-12, there are mostly practically insignificant differences between the various mean dimension scores of the respondents working in Inland vs Coastal provinces. Except for the PE dimension, where a practically visible difference between the means of the two groups has been reported ($d = 0.47$). On average, the inland group ($M = 4.60$, $SD = 0.62$) strongly agreed with the statements within this dimension and the coastal group ($M = 4.27$, $SD = 0.70$) somewhat agreed. This result reflects that, on average, the respondents in the inland provinces expressed a stronger belief in RFID technology to improve their work performance than those working in Coastal provinces.

4.7.7 T-test: RFID technology Awareness

T-tests were performed to measure the significance of the effect sizes between the low RFID technology awareness (< 50% awareness) and the high RFID technology awareness group (> 50% awareness) among the various scale dimensions.

Table 4-13: T-test results of respondent's RFID technology awareness

Dimension	Awareness	N	Mean	SD	Sig. (2-tailed)	Effect size
Technology Readiness (TR)	Low	57	3.18	0.60	0.008	0.47
	High	60	3.46	0.54		
Performance Expectancy (PE)	Low	57	4.39	0.77	0.013	0.39
	High	60	4.68	0.46		
Effort Expectancy (EE)	Low	57	4.27	0.76	0.003	0.46
	High	60	4.62	0.42		
Social Influence (SI)	Low	57	3.85	0.84	0.009	0.44
	High	60	4.22	0.65		
Behavioural Intention (BI)	Low	57	4.31	0.87	0.004	0.46
	High	60	4.71	0.53		
Attitude toward using technology (ATUT)	Low	57	4.34	0.76	0.029	0.37
	High	60	4.63	0.61		
Self-Efficacy (SE)	Low	57	3.88	0.62	0.650	0.08
	High	60	3.93	0.61		

Based on the reported effect sizes presented in Table 4-13, practically visible differences were noted between the Technology Readiness ($d = 0.47$), Effort Expectancy ($d = 0.46$), Behavioural Intention ($d = 0.46$) dimensions and the mean scores of the respondents with high RFID technology awareness vs those with low RFID technology awareness. The respondents with high RFID technology awareness ($M = 3.46$, $SD = 0.54$) are segmented in the high TR tier vs respondents with low RFID awareness ($M = 3.18$, $SD = 0.60$), who are segmented in the middle TR tier. This result signifies that respondents with high RFID awareness have a higher Technology Readiness (TR) and thus hold stronger positive beliefs and attitudes toward adopting cutting-edge technologies, such as RFID, to accomplish their work goals. Furthermore, the high RFID technology awareness group ($M = 4.62$, $SD = 0.42$), on average, strongly agreed with the statements within the Effort Expectancy dimension, and the low RFID awareness group ($M = 4.27$, $SD = 0.76$), on average, somewhat agreed. This result signifies that wholesale distribution employees with high RFID technology awareness perceive RFID technology as easier to use with a shorter learning curve than those with low RFID awareness. In comparison, the high RFID technology awareness group ($M = 4.71$, $SD = 0.53$), on average, strongly agreed with the statements within the Behavioural Intention (BI) dimension. While the low RFID awareness group ($M = 4.31$, $SD = 0.87$), on average, somewhat agreed. Consequently, the results discussed above indicate that wholesale distribution employees with high

RFID technology awareness are likelier to adopt RFID technology than employees with low RFID technology awareness. Therefore, these results suggest that high RFID technology awareness is a driver for RFID technology adoption.

4.7.8 Cross tabulation: RFID Awareness

A cross tabulation was used to determine the association between the variables' Position and RFID technology awareness. Cross-tabulation is a statistical method that simultaneously explains multiple variables and generates tables showing the combined distribution of variables with a small number of categories or values (Malhotra, 2010:461). Effect sizes instead of p-values were used as guidelines to indicate the practical significance of the associations based on the following guideline values (Steyn & Ellis, 2003:53):

- Small, no practical significant correlation: $\phi \sim 0.1$
- Medium, practical visible correlation: $\phi \sim 0.3$
- Large, practical significant correlation: $\phi \sim 0.5$

Table 4-14: Cross tabulation results of respondent's RFID technology awareness

		Not at all	A little	Somewhat	Moderately	Extremely	Total
Lower-level workers	Count (n)	10	10	1	17	3	41
	% within Position (grouped)	24.4%	24.4%	2.4%	41.5%	7.3%	100.0%
Middle Management	Count (n)	4	15	5	22	1	47
	% within Position (grouped)	8.5%	31.9%	10.6%	46.8%	2.1%	100.0%
Senior Management	Count (n)	3	5	4	16	1	29
	% within Position (grouped)	10.3%	17.2%	13.8%	55.2%	3.4%	100.0%

The analysis results presented in Table 4-14 indicate that the association between the respondents' position and the question "How familiar are you with RFID technology" is leaning toward a practically visible effect size ($\phi = 0.21, p = 0.21$). A smaller proportion of senior management indicated that they are not at all or a little familiar with RFID technology (27.5%) compared to lower-level workers (48.4%) and middle management (40.4%). Naturally, the opposite is true for the groups moderately and extremely familiar with RFID technology resulting in a more significant proportion of senior management

selecting these options (58.6%) compared to lower-level workers (48.8%) and middle management (48.9%). Since the question "How familiar are you with RFID technology" was asked to determine the RFID technology awareness level of the respondents, the results presented in Table 4-14 (p. 75) indicate that lower-level workers exhibited a lack of RFID technology awareness, compared to senior management. This finding has a significant impact since senior management would be more likely to drive and push RFID technology use, whereas lower-level workers may resist technology adoption since they are less aware of what it exactly entails. This means that more effort must be exerted in selling the RFID technology concept to lower-level workers through training and advertising RFID technology before lower-level workers, who would be those who work with the technology, will be expected to use it.

4.8 SPEARMAN'S RHO CORRELATIONS AMONG TRI 2.0 AND UTAUT DIMENSIONS

This study aimed to ascertain whether and to what extent the various UTAUT and TR dimensions correlate. According to Field (2009:794), Spearman's correlation coefficient or Spearman's rho is a standardised evaluation of the strength between two variables independent of the assumptions of an analytical test and added that Spearman's rho is Pearson's correlation coefficient applied to data which has been converted into ranked scores. Thus, Spearman's correlation coefficient, abbreviated as r_s , is a non-parametric statistic that requires merely ordinal data for both variables (Field, 2009:186). A correlation coefficient quantifies the strength of a linear relationship between two ranked or quantified variables (Saunders *et al.*, 2007:450).

In this analysis, p-values were reported for completeness' sake but not be interpreted since a convenience sample instead of a random sample was used to gather the data. Therefore, effect sizes based on the correlation coefficients are instead used as guidelines to indicate the practical significance of the relationship or effect sizes based on the following guideline values (Steyn & Ellis, 2003:53):

- Small, no practical significant correlation: $r_s \sim 0.1$
- Medium, practical visible correlation: $r_s \sim 0.3$
- Large, practical significant correlation: $r_s \sim 0.5$

The effect sizes and the practical significance of these correlations between the various dimensions are illustrated in Table 4-15.

Table 4-15: Spearman's Rho correlations with all scale dimensions

Dimension		Technology Readiness (TR)	Performance Expectancy (PE)	Effort Expectancy (EE)	Social Influence (SI)	Attitude toward using Technology (ATUT)	Self-Efficacy (SE)	Behavioural Intention (BI)
	Count (N)	117	117	117	117	117	117	117
TR	Correlation Coefficient	1.000	.429**	.455**	.320**	.415**	0.150	.420**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.105	0.000
PE	Correlation Coefficient		1.000	.528**	.587**	.609**	.283**	.670**
	Sig. (2-tailed)			0.000	0.000	0.000	0.002	0.000
EE	Correlation Coefficient			1.000	.480**	.535**	.294**	.597**
	Sig. (2-tailed)				0.000	0.000	0.001	0.000
SI	Correlation Coefficient				1.000	.630**	.426**	.664**
	Sig. (2-tailed)					0.000	0.000	0.000
ATUT	Correlation Coefficient					1.000	.371**	.709**
	Sig. (2-tailed)						0.000	0.000
SE	Correlation Coefficient						1.000	.379**
	Sig. (2-tailed)							0.000
BI	Correlation Coefficient							1.000
	Sig. (2-tailed)							

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

The results presented in Table 4-15 show no practical significant correlation between TR and SE dimensions with $r_s = 0.150$ ($p > 0.05$). All other dimensions are practically visible to practically significantly correlated. The results indicate a practical visible correlation between TR ($r_s = .420$; $p < 0.001$) and SE ($r_s = .379$; $p < 0.001$) dimensions with the Behavioural Intention (BI) dimension. Whereas the correlations between PE, EE, SI and ATUT with the BI dimension are all practically significant with $r_s = .597 - 0.709$ ($p < 0.001$). These positive correlations indicate that when combined, the six selected human factors

(TR, PE, EE, SI, ATUT, and SE) act as antecedents to the Behavioural Intention (BI) to adopt RFID technology by affecting one another.

4.9 LINEAR REGRESSION ANALYSIS

According to Malhotra (2010:536), regression analysis is a robust and adaptable statistical method to examine the relationships between a dependent and one or more independent variables.

In this study, Linear Regression analysis was undertaken to measure the importance of the influences of Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Attitude toward using technology (ATUT), Self-Efficacy (SE) and Technology Readiness (TR) on the dependent variable, Behavioural Intention (BI) to adopt RFID technology. The square of the multiple correlation coefficient (R^2), also known as the coefficient of multiple determination, is used to calculate the strength of association in multiple regression (Malhotra, 2010:546). The results indicated that the model explained 72% of the variation in Behavioural Intention (BI) to adopt RFID technology ($R^2 = 0.721$).

Table 4-16: Regression model Coefficient data

	Unstandardised Coefficients		Standardised Coefficients	Sig.	VIF
	B	Std. Error	Beta (<i>b_i</i>)		
(Constant)	-0.413	0.338		0.224	
PE	0.219	0.095	.191	0.023	2.696
EE	0.238	0.088	.204	0.008	2.243
SI	0.161	0.074	.167	0.033	2.345
SE	0.082	0.068	.068	0.229	1.248
ATUT	0.353	0.086	.334	0.000	2.630
TR	0.097	0.074	.076	0.196	1.349

A state of extremely high intercorrelations among independent variables is called multicollinearity. Multicollinearity can cause several issues, including difficulty determining the relative importance of the independent variables in explaining variance in the dependent variable (Malhotra, 2010:554). The Variance Inflation Factor (VIF) measures whether one independent variable has a strong linear association with another, which indicates multicollinearity. High VIF levels indicate high degrees of multicollinearity.

Generally, a VIF of 10 and higher indicates high multicollinearity (Field, 2009:224). The VIF values presented in Table 4-16 for all the independent variables are well below 10 (VIF = 1.248 – 2.696), indicating low degrees of intercorrelations between independent variables (Malhotra, 2010:554).

According to Field (2009:578), independent variables with relatively large standardised coefficients contribute more to the function's discriminating power than independent variables with smaller coefficients and are thus more important. The regression weight (*bi*) presented in Table 4-16 (p. 78) portrays the relative importance of PE on Behavioural Intention (BI) to be .191 ($p < 0.05$). Compared to PE, the influence of ATUT on Behavioural Intention (BI) with a regression weight of .334 ($p < 0.001$) indicates that ATUT is regarded to have a more important influence on Behavioural Intention (BI) than PE. The relative importance of the other independent variables' influences on Behavioural Intention (BI) is interpreted similarly and ranked in order of importance. Accordingly, these variables are ranked as follows:

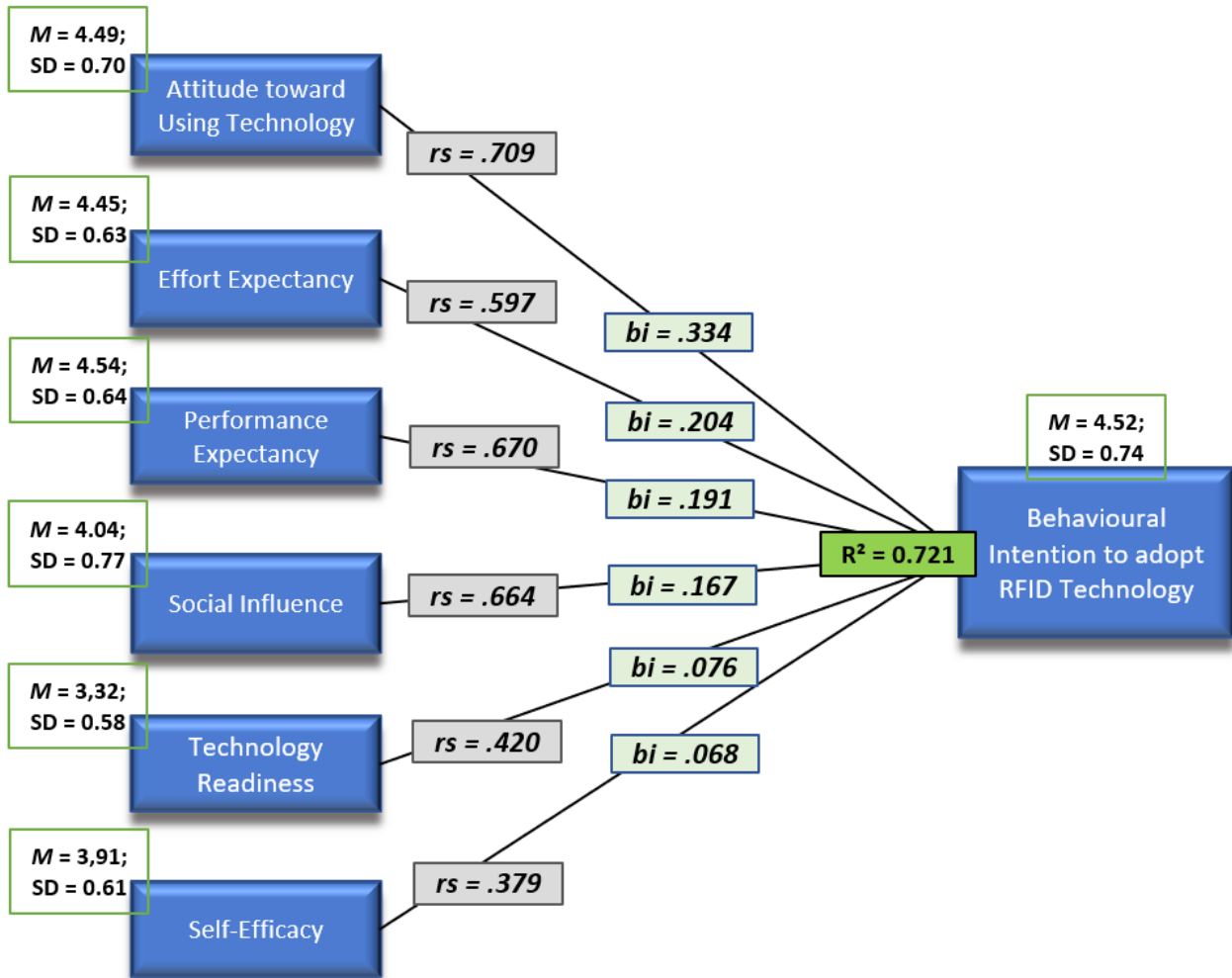
ATUT ($bi = .334; p < 0.001$), EE ($bi = .204; p < 0.05$), PE ($bi = .191; p < 0.05$), SI ($bi = .167; p < 0.05$), TR ($bi = .076; p > 0.05$) and SE ($bi = .068; p > 0.05$)

These results indicate that ATUT has the most important influence of all the variables on Behavioural Intention (BI), followed by EE. In contrast, SE has the least important influence on Behavioural Intention (BI) to adopt RFID technology, followed by TR. Thus, individuals tend to deem their own abilities to accomplish work tasks using the technology (SE) and their readiness (TR) as less important than the social influences of prominent individuals in the organisation (SI) when deciding whether to use the technology. Clearly, the strengths predictors of this model lie in the Attitude toward Using Technology (ATUT) and the considerable savings in effort (EE) respondents expect. The expectancy that the technology assists workers in enhancing their performance (PE) is relatively impactful. However, Social Influences tend to be less important, as are Readiness and Self-Efficacy. Once again, the organisation's effort in promoting the adoption of technology should include helping lower-level workers to understand the personal benefits and gains of the technology to prepare them for technology adoption. Therefore, if the organisation can successfully demonstrate that using the technology will require minimal effort and enhance the workers' performance, the already positive attitude toward technology could convert into the intentional direction of behaviour towards adopting the technology.

4.10 KEY FINDINGS

This section summarises this chapter's findings by graphically presenting the empirical results in Figure 4-9 and then briefly listing the key findings drawn from the illustration below and other analyses in this chapter.

Figure 4-9: Summary of the key empirical results



The following key findings were drawn from the empirical study in this chapter:

- Based on the regression weights (*bi*) presented in Figure 4-9, ATUT has the most important influence of all the variables on Behavioural Intention (BI) to adopt RFID technology, followed by EE, PE, SI, TR, and SE.
- The linear regression analysis in the chapter found that the model explained 72% of the variation in Behavioural Intention (BI) to adopt RFID technology ($R^2 = 0.721$).

- Based on the effect sizes (r_s), Spearman's Rho correlation analysis showed that the TR and SE dimensions have practical visible correlations with BI. In comparison, the correlations between PE, EE, SI and ATUT with BI are all practically significant. These positive correlations indicate that when combined, the six selected human factors (TR, PE, EE, SI, ATUT, and SE) act as antecedents to the Behavioural Intention (BI) to adopt RFID technology by affecting one another.
- High RFID technology awareness was identified as a driver for RFID technology adoption. Significantly, lower-level workers exhibited a lack of RFID technology awareness compared to senior management.
- Respondents with a degree or higher qualification reported lower Social Influence (SI) and Self-efficacy (SE) than those with lower qualifications. All other effect sizes regarding qualification were practically insignificant, indicating that a lack of qualified tertiary personnel is not regarded as a barrier to adopting RFID technology by an organisation in the wholesale distribution industry.
- Based on the ANOVA analyses, the study revealed that employees' age and work experience are not barriers to the wholesale distribution industry's adoption of RFID technology.
- The Technology Readiness Index score of 3.32 (SD = 0.58) is positioned in the highest TR tier, indicating that the respondents possess a high level of Technology Readiness (TR) toward adopting new technologies. Therefore, this result implies that, on average, the respondents demonstrate strong positive beliefs and attitudes toward adopting new cutting-edge technologies such as RFID to accomplish their work goals.
- On average, lower-level workers demonstrated a higher level of Technology Readiness and more strongly expressed their acceptance of RFID technology compared to the senior management group.
- The respondents demonstrated a strong Behavioural Intention (BI) to adopt RFID technology in their workplace and, to a high degree, expressed their acceptance of RFID technology by directing behaviour towards the adopted technology ($M = 4.52$; $SD = 0.74$).

4.11 CHAPTER SUMMARY

This chapter was the descriptive and instructive component of an empirical study undertaken to determine the human factors influencing RFID technology adoption in the South African wholesale distribution industry. The chapter's main focus was the statistical analysis and discussion of results obtained from the questionnaire. Several statistical techniques were used to determine the factors which provided meaningful results. These statistical techniques revealed that reported Cronbach Alpha values of the scale dimensions were above the guideline value of 0.7 or at least 0.5 (Field, 2009:675), which signifies that the resulting scale dimensions are reliable.

The chapter also reported that the mean scores of all the scale dimensions are above the scale's midpoint of 3.0, indicating that, on average, the respondents expressed positive beliefs toward the readiness and acceptance of RFID technology. Finally, the chapter concluded with the key findings of the empirical study. The preceding and final chapter will include conclusions, limitations, and recommendations from the present study to formulate appropriate practical recommendations to enhance the adoption of RFID technology.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The primary objective of this study was to identify the human factors influencing the adoption of RFID technology in the South African wholesale distribution industry since, despite the abundance of benefits for the industry, the adoption of the technology in this country has been sluggish. Thus, the researcher argues that there is a need to achieve this objective since knowing and understanding these factors places the researcher in the best position to offer practical recommendations to address the problem of low RFID adoption. In particular, the comprehensive literature review conducted in Chapter 2 and the empirical study outlined in the previous chapter assisted in achieving the research objectives.

This final chapter first draws conclusions and makes practical recommendations, followed by an appropriate action plan that management can use to consider and prepare wholesale distribution organisations to successfully adopt RFID technology and thus enable greater adoption of the technology in South Africa. Subsequently, the chapter ascertains whether the study's research objectives were achieved. To conclude, the study's contribution and limitations are underscored, and recommendations for further research are tendered, followed by the study summary.

5.2 CONCLUSIONS

This study empirically showed that workers and management in the wholesale distribution industry were ready and positive about RFID technology and prone to adopt it if organisations were to introduce the technology. In general, the employees' Technology Readiness (TR) level is high, and they are thus open to the idea of embracing new cutting-edge technologies to accomplish their work goals. In addition, the employees' expressed strong positive beliefs and acceptance towards adopting RFID technology. The findings from the empirical study revealed that all the dimensions of the conceptual model (PE, EE, SI, ATUT, SE & TR) influence RFID technology adoption. Furthermore, the linear regression study revealed that the model explained 72% of the variation in Behavioural Intention (BI) to adopt RFID technology, which is similar to Venkatesh *et al.* (2003:467) findings that the original UTAUT model explained 70% of the variance in usage intention.

The study furthermore found that Attitude toward Using Technology (ATUT) has the most important influence on RFID technology adoption, followed by Effort Expectancy (EE), which refers to the degree of ease with which users perceive the required effort exerted to use RFID technology. The respondents demonstrated an overall positive affective reaction towards RFID technology and perceived the technology as requiring less effort than interaction with complex systems and as easy to learn how to use.

The employees in the wholesale distribution industry also expressed strong positive beliefs toward Performance Expectancy (PE), reflecting their belief that using RFID technology will enhance their work performance. Even though Social Influence (SI) tend to be less important, lower-level workers indicated that their decision to accept and adopt RFID technology in the workplace could be influenced by people deemed as important to them, such as executives and other senior managers. These findings compare favourably with previous study findings, where Zainab *et al.* (2018:29-30) identified that PE, EE, ATUT, SI, and SE influenced RFID adoption in the library services industry. Similarly, Tang *et al.* (2019:199) identified PE, EE, SI and FC as factors influencing health professionals' behaviour intent to use RFID technology.

However, the picture is not all rosy since the lower Self-Efficacy (SE) levels showed that, generally, employees do not have overly high self-confidence in their ability to accomplish a job or specific task using the technology. It is also important to consider that this study was conducted as a pre-adoption study. Therefore, even though respondents were accustomed to the appropriate conceptualisation of RFID technology in the introduction of the survey questionnaire, lower-level workers exhibited a lack of RFID technology awareness compared to senior management. This study revealed that high awareness of RFID technology drives RFID technology adoption. As discussed in section 2.8, this result aligns with the findings of Haibi *et al.* (2022:6363), Khayyam *et al.* (2022:35), Noor (2022:354), Seng and Yew (2019:151) and Upfold and Liu (2010:16) that identified a lack of RFID awareness as a barrier to RFID technology. Therefore, indicating that individuals' level of RFID technology awareness could either drive or hinder their willingness to adopt RFID technology. In addition, this study's findings correspond with the findings of Abugabah *et al.* (2021:1343) that human factors influence the adoption of RFID technology and, hence are crucial factors to consider ahead of the adoption and

implementation of RFID applications instead of as a post-implementation issue, as discussed in section 2.10.

Based on the study's findings, it was concluded that the workers and management in the South African wholesale distribution industry were ready to accept and adopt RFID technology to enhance their work performance. However, the findings also highlighted factors requiring improvement to prepare wholesale distribution organisations for the successful adoption of RFID technology. As a result, the next section will focus on these factors to make appropriate practical recommendations to the management level of wholesale distribution organisations.

5.3 RECOMMENDATIONS TO MANagements OF WAREHOUSE DISTRIBUTION ORGANISATIONS

Even though the study determined that workers and management in the wholesale distribution industry are ready and have strong positive attitudes toward the adoption of RFID technology, most humans dislike change (Hodgetts, 2020:4). Yet change is inevitable for all RFID adopters since the technology impacts how companies conduct business and employees perform their duties (Brown & Russell, 2007:264). The regression analysis demonstrated that the strengths predictors of the model lie in the Attitude toward Using Technology (ATUT) and the considerable savings in effort (EE) respondents expect. However, all the models' dimensions (PE, EE, SI, SE, ATUT, and TR) were determined as human factors influencing the BI to adopt RFID technology.

Thus, the key to successfully implementing RFID technology is comprehending all these factors upfront to allow organisations to plan and strategise accordingly. In addition, the study acknowledges that the management of wholesale distribution organisations is regarded as the implementation drivers, while the lower-lever workers are the RFID technology users. Therefore, the following recommendations are suggested based on the study findings and conclusions to prepare the various implementor and user groups for successful RFID technology adoption in their organisation:

- **Involve all stakeholders:**

The study indicated that the prospective implementors and users already possess a positive attitude and thus have a strong overall affective reaction to using RFID technology. Therefore, organisations' implementation strategies must build and leverage

this positive attitude by incorporating all stakeholders during the planning and implementation processes. This would make both the users and implementors of the technology implementation feel part of the decision-making process in adopting the technology, resulting in buy-in by all stakeholders to adopt RFID technology and further strengthening their attitude towards implementing and using the technology (ATUT).

- **Build a compelling argument for change:**

The point of departure of the implementation phase is to obtain top management's commitment to adopt the technology by promoting the business benefits of RFID, such as improved productivity and efficiency. This study thus recommends the use of key opinion leaders in the sector to advocate the unique value propositions of RFID technology and develop RFID awareness amongst top management. This study's findings that the users possess a high Technology Readiness (TR) and are thus ready to embrace new cutting-edge technologies would further strengthen the argument for RFID adoption. Secondly, the organisation's strategic RFID implementation plan must include a solid case for change to get buy-in from management, who should be responsible for driving the RFID implementation process. This could be achieved by demonstrating to management the minimal effort required to use the technology (EE) and how it will improve the performance of their workers (PE). As a result, their own work performance could improve by allowing them more time to focus on other important duties. Similarly, the implementation strategy must make provisions in the pre-adoption phase to demonstrate the ease of use required to operate the technology to the users and how it would lead to performance gains.

- **Assist implementors and users in understanding and using the technology:**

Workers may fear that adopting RFID technology would result in job losses or require technological skills beyond what they already possess. Therefore, even though the users demonstrated positive attitudes and beliefs toward adopting RFID technology, they may reject it if they do not fully understand how it will impact their positions and performance. They must understand that RFID adoption would not necessarily eliminate their employment but would instead make their work easier and improve their performance (PE). Companies must also understand that not everyone in their organisations is familiar with the concepts of RFID technology. Additionally, users' self-confidence (SE) in their ability to use the technology should be boosted before commencing the implementation process. These goals could be achieved by conducting pre-adoption workshops with the

prospective implementation drivers and users of the new technology. In these workshops, the meaningful impact of RFID on their daily duties and how their roles would change must clearly be explained to them by top management. Additionally, RFID experts must comprehensively explain and demonstrate what RFID entails, its capabilities, and its advantages over barcode technology, which would develop RFID awareness. Furthermore, the managers and users must be allowed to practice using the technology during the workshops to demonstrate its ease of use (EE) and improve their self-confidence in their abilities to use RFID technology (SE).

- **Establish a project implementation team:**

This study has shown that the Behavioural Intention (BI) to adopt RFID technology is influenced by the Social Influences (SI) of prominent individuals in the organisation that employees believe might affect their decision to adopt the technology. Thus, when an organisation decides to adopt RFID technology, a project implementation team should be established consisting of meticulously selected individuals with the necessary technical skills, knowledge, and persuasive authority to oversee and guide the implementation process. This team should be led by a team leader responsible for developing a strategic RFID implementation plan and goal setting. In addition, the project team should identify and select one or more users to be trained as “super users” and several managers to fulfil the role of “RFID system champions” by working closely with the project team to ensure that all the employees are comprehensively trained on how to use the technology. The project team, super users and system champions must thus receive in-depth training from external companies to make them RFID technology experts. The project team should also collaborate with the managers who will assist in driving the implementation process.

- **Select the appropriate RFID system:**

According to the study's findings, users would be more likely to adopt RFID technology if they believed it would be easy to use, has a short learning curve (EE) and improve their performance (PE). Managers would also be more likely to adopt the technology if the systems could enable them to easily track and monitor their worker's performance. The literature review unearthed that organisations have several decisions to make when selecting the appropriate RFID system to meet their needs, such as deciding between active or passive tags, various frequency ranges and whether to use fixed or mobile RFID readers, to name a few. However, organisations should guard against selecting overly complex RFID systems since managers and users could be less inclined to adopt the

technology. Thus, it is recommended that organisations carefully select the appropriate RFID system components to implement a system which is easy to use, has a short learning curve, improves the performances of their employees, and meets its business requirements.

- **Gradually implement RFID technology and evaluate work performance:**

A hasty or rushed implementation of RFID technology in an organisation could cause technical difficulties and, thus, user resistance, which can hinder adoption success. Since the employees in the industry have an existing positive attitude towards adopting RFID technology, their attitude towards the technology should not be dampened by poor implementation. Hence, organisations should consider first running a small-scale pilot project to identify and eliminate potential problems before the technology is implemented officially. After successfully running the pilot project, the technology implementation should ideally be phased per department and warehouse instead of immediate full-scale implementation across the organisation. This will allow employees time to acclimate to the new technology and aid in ensuring seamless and effective deployment of the RFID system. For instance, the organisation where this study was conducted could implement the technology in one of its smaller warehouses in Kwazulu-Natal or the Western Cape before implementing it in its central Gauteng warehouses. Furthermore, the researcher recommends that the technology is first implemented in the dispatch departments before it is introduced in the organisations' inbound and outbound warehouse departments. In addition, the success and performance of the system should be continuously evaluated, and the results made available to all employees to emphasise how the technology has improved their performance.

5.4 MANAGERIAL IMPLICATIONS

This research holds practical managerial implications since it aims to prepare wholesale distribution organisations and their employees for RFID technology adoption by enabling executives to comprehend the human factors influencing RFID technology adoption. This section thus highlights the key recommendations from section 5.3 to formulate a practical implementation plan for the wholesale distribution organisation where the study was conducted to use as a roadmap for RFID implementation. The practical RFID implementation plan is presented in Table 5.1 (p .89).

Table 5-1: RFID implementation plan

Task	Responsibility	Approach	Timeline	Priority
Present study findings to the organisation	Researcher	PowerPoint presentation	February 2023	High
Key opinion leader (RFID specialist) to address top management	Researcher	Meeting and presentation	March 2023	High
Establish a project implementation team and appoint a team leader	Top management	Talent management	March 2023	High
Identify super users and RFID system champions in each warehouse	Project team leader	Talent management	April 2023	High
Send the project team, super users, and RFID system champions for external training	Project team leader	Practical training sessions	April 2023	High
Select the appropriate RFID components and overall system	Project team and top management	Product research	May 2023	High
Explain how the technology will impact the employee's work roles and performance	Project team and top management	Workshops	June – July 2023	High
Demonstrate the RFID capabilities and allow users and managers to operate the scanners	Project team and external RFID experts	Workshops	June – July 2023	High
Run a pilot project in a Kwazulu-Natal warehouse and train employees	Project team	Pilot project	September 2023	High
Implement the technology in KwaZulu-Natal warehouse dispatch departments	Project team, super users, and champions	Hands-on approach	October – November 2023	High
Training and implementation in the Western Cape warehouses	Project team, super users, and champions	Hands-on approach	January – February 2024	High
Training and implementation in the Mpumalanga warehouse	Project team, super users, and champions	Hands-on approach	March – April 2024	High
Training and implementation in the Gauteng warehouses	Project team, super users, and champions	Hands-on approach	May – June 2024	High
Implement the technology in the outbound and inbound departments	Project team, super users, and champions	Hands-on approach	July – August 2024	High
Evaluate system and user performance and disclose the results	Project team, champions, and managers	Extracting performance data reports	Continuously	High
Investigate opportunities to upgrade or expand the RFID systems	Project team and top management	Product research	Frequently	Medium

5.5 ACHIEVEMENT OF THE STUDY OBJECTIVES

As underlined in section 1.4, the primary study objective is supported by four secondary objectives. Thus, the success of this research study is determined by whether the following secondary objectives were achieved in reaching the primary objective:

5.5.1 Secondary research objective one

This objective aimed to perform a literature study to conceptualise the factors influencing RFID technology adoption. The comprehensive literature study revealed several factors influencing RFID adoption from previous studies. Subsequently, the literature study revealed a gap in the literature in that human and individual factors seemed to have received less research attention, which led to the concept of the problem statement. In addition, appropriate theoretical technology adoption models were identified from the literature to gather the empirical research data. As a result, this objective was realised.

5.5.2 Secondary research objective two

The second objective aimed to empirically determine individuals' Technology Readiness (TR) and Behavioural Intention (BI) towards the acceptance and adoption of RFID technology based on the TRI 2.0 and UTAUT models. Descriptive statistics were used to analyse the empirical data gathered using an integrated TRI 2.0 and UTAUT conceptual model to determine respondents' readiness and acceptance of RFID technology. The results indicated that the respondents possess a high Technology Readiness (TR) level and demonstrated strong acceptance beliefs toward RFID technology, as presented in section 4.4.1. In fact, the respondents measured in the highest TR tier, implying that, on average, they demonstrated strong positive beliefs and attitudes toward adopting new cutting-edge technologies such as RFID to accomplish their work goals. Similarly, the results discussed in section 4.6 signify that the individuals working in the wholesale distribution industry have a strong behavioural intent to adopt RFID technology in their workplace. These results suggested that, to a high degree, they expressed their acceptance of RFID technology by directing behaviour towards the adoption of the technology. Thus, the second objective was realised.

5.5.3 Secondary research objective three

With this objective, the researcher aimed to determine the human drivers and barriers to RFID technology adoption by examining group differences in the empirical sample. ANOVA and t-tests were conducted to test for differences in the scale dimensions between the demographic variables. Significantly, high RFID technology awareness was identified as a driver. In addition, all the dimensions of the study's conceptual model were determined as drivers of RFID technology adoption. However, based on the regression weights, ATUT has the most important influence of all the variables on Behavioural Intention (BI) to adopt RFID technology, followed by EE, PE, SI, TR, and SE. Even though no barriers were identified, the study importantly determined that employees' age, work experience and a lack of qualified tertiary personnel are not barriers to the wholesale distribution industry's adoption of RFID technology. Considering that only human drivers of RFID technology were identified, this research objective was partially realised.

5.5.4 Secondary research objective four

The final secondary research objective aimed to formulate appropriate practical recommendations that management can use to consider and prepare wholesale distribution organisations to adopt RFID technology successfully. Since the adoption of RFID technology in the South African wholesale distribution industry has been sluggish, the researcher considers the achievement of this objective as critical in that it holds practical contribution potential for organisations in the industry to improve productivity and efficiency.

Based on the practical recommendations made in section 5.3 for successful RFID adoption and the implementation plan in section 5.4, the researcher believes that this study made a valuable contribution to the South African wholesale distribution industry in that it could enhance RFID technology adoption and its associated advantages. Therefore, this research objective was realised.

5.5.5 Primary research objective

In achieving the above-mentioned secondary objectives, the study accomplished its primary objective in that Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Attitude toward Using Technology (ATUT), Self-Efficacy (SE), Technology Readiness (TR) and high RFID technology awareness were identified as human factors influencing the adoption of RFID technology in the South African wholesale distribution industry.

5.6 CONTRIBUTION OF THE STUDY

This study aimed to contribute to the South African wholesale distribution industry and the Information Communication and Technology Management cluster at the NWU Business School by assisting local firms considering adopting RFID technology in making practical and informed decisions that facilitate the adoption and implementation of this technology. From the theoretical lens, this study makes a considerable contribution in that it is one of the first known studies to incorporate the 10-item TRI 2.0 in the UTAUT model. In addition, this study is also one of a limited number of local studies known to have been undertaken to determine the human factors influencing RFID technology adoption. As a result, the research adds value to the body of knowledge relating to RFID technology within the wholesale distribution industry in South Africa. Furthermore, this research holds practical contribution potential for organisations in the industry to improve productivity and efficiency. The significance of the study could be instrumental in helping executive management make better-calculated decisions since it enables executives to better comprehend the human factors influencing RFID technology adoption and the technology readiness levels of the workers and all levels of management.

Since the adoption of RFID technology in the wholesale distribution industry is inevitable, these results significantly impact the wholesale distribution industry and the future thereof (Liyanage & Gbededo, 2014:1). RFID technology has immense value-adding prospects in organisations by providing real-time data tracking, increasing capital product visibility, reducing out-of-stock items and more substantial operating margins. Thus, this study's results mutually benefit the executive management of warehouses and their customers. Although unintentional, the researcher believes this study also holds value for the

manufacturers of RFID systems in that it could guide them in designing and marketing the systems in line with the user's expectations of the technology identified in this study.

5.7 LIMITATIONS OF THE STUDY

Even the best research has some limitations, as is the case with this study. The limitations of this study are listed and discussed below:

- First, despite obtaining responses from four provinces in South Africa, the main limitation of this study was that the sample was limited to respondents from only one organisation. This situation may limit the generalisability of the findings to the broader wholesale distribution industry.
- Secondly, a single cross-sectional research design was employed, which provided a single snapshot in time instead of multiple observations over an extended time taken by a longitudinal design. As a result, changes in individuals' Technology Readiness and their Behavioural Intention towards adopting RFID technology were not captured over time.
- Thirdly, since convenience sampling was employed, the study results may not necessarily reflect the point of view of the entire population under investigation.
- Finally, even though the sample size reached a respectable number of 117, the size of the sample limited the execution of some of the planned statistical analyses. For instance, after consultation, the NWU statistician recommended not performing an Exploratory Factor Analysis since the sample size would influence the results.

5.8 RECOMMENDATIONS FOR FUTURE RESEARCH

Similar studies in the future may employ a mix of qualitative and quantitative methodologies to examine the acceptance and readiness for RFID technology adoption to unearth additional human factors influencing the adoption of this technology. Furthermore, the influence of users' personality types on RFID adoption could be investigated by incorporating various personality type dimensions in the research model. In addition, the acceptance of technology and readiness of other sets of respondents in different organisations or industries could be examined by replicating this study. Similarly, this study's research model could be utilised to determine the human factors influencing the adoption of other technologies, such as blockchain technology.

5.9 CONCLUDING STUDY SUMMARY

In this final chapter, conclusions and recommendations were drawn based on the literature review and results of the empirical study in the previous chapters. From the literature, a research gap was identified, which was defined in the problem statement in Chapter 1, explored through a literature study in Chapter 2, and then investigated by means of an empirical study in Chapter 4 according to the study's research methodology outlined in Chapter 3.

The purpose of the literature study was to familiarise the reader with RFID technology fundamentals and conceptualise the factors influencing RFID technology adoption from previous literature studies. The empirical study was conducted as a cross-sectional survey design through a quantitative online survey questionnaire employing TRI 2.0 and UTAUT measuring scales. Followed by various statistical techniques such as ANOVA, t-tests, and Linear Regression Analysis to analyse the empirical data gathered from 117 respondents working for an organisation in the industry under investigation.

Based on this study's findings, it is concluded that Performance Expectancy, Effort Expectancy, Social Influence, Attitude toward Using Technology, Self-Efficacy, Technology Readiness and RFID awareness influence RFID technology adoption in the South African wholesale distribution industry. Since these human factors influence the adoption of RFID technology, the factors should be taken into consideration by the management of organisations in the South African wholesale distribution industry ahead of the adoption and implementation of RFID technology applications. Significantly, this study's contribution could be instrumental in assisting organisations in unlocking the advantages of RFID technology by preparing users and implementors of the technology for successful adoption.

REFERENCE LIST

- Abugabah, A., Sanzogni, L., Houghton, L., AlZubi, A.A. & Abuqabbah, A. 2021. RFID adaption in healthcare organizations: An integrative framework. *Computers, Materials and Continua*, 70(1):1335-1348. doi: 10.32604/cmc.2022.019097
- Agarwal, V. & Ankolikar, S. 2022. Deployment of RFID sensors in supply chain management—a review. *Journal of Mechatronics and Artificial Intelligence in Engineering*, 1(1):1-18. <https://doi.org/10.21595/jmai.2022.22565>
- Akhtar, M.N., Adrees, M., Qureshi, M.M. & Ali, Z. 2020. Ethical Issues of Radio Frequency Identification Chips Implanted in Human Bodies: A Review. *Indian Journal Of Science And Technology*, 13(03):269-276. doi: 10.17485/ijst/2020/v13i03/147192
- Ali, O., Shrestha, A., Jaradat, A. & Al-Ahmad, A. 2022. An Evaluation of Key Adoption Factors towards Using the Fog Technology. *Big Data and Cognitive Computing*, 6(3):1-35. <https://doi.org/10.3390/bdcc6030081>
- Andersson, U., Dasí, Á., Mudambi, R. & Pedersen, T. 2016. Technology, innovation and knowledge: The importance of ideas and international connectivity. *Journal of World Business*, 51(1):153-162. <http://dx.doi.org/10.1016/j.jwb.2015.08.017>
- Badru, A. & Ajayi, N. 2017. *Adoption of RFID in large-scale organisation: A review of challenges and solutions*. Paper presented at the 2017 IST-Africa Week Conference (IST-Africa). doi: 10.23919/ISTAFRICA.2017.8102394 Date of access: 14 Jul. 2021.
- Bisschoff, C.A. & Barnard, H.C. 2019. A Model to Measure the Service Quality of Pharmaceutical Wholesalers. *Journal of Economics and Behavioral Studies*, 11(3):23-38. [https://doi.org/10.22610/jebbs.v11i3\(J\).2866](https://doi.org/10.22610/jebbs.v11i3(J).2866)
- Brown, I. & Russell, J. 2007. Radio frequency identification technology: An exploratory study on adoption in the South African retail sector. *International journal of information management*, 27(4):250-265. doi: 10.1016/j.ijinfomgt.2007.02.007
- Bryman, A., Bell, E., Hirschsohn, P., Dos Santos, A., Du Toit, J., Masenge, A., ... Wagner, C. 2014. *Research methodology: Business and management contexts*. Cape Town: Oxford University Press.

- Carroll, L.S.L. 2017. A comprehensive definition of technology from an ethological perspective. *Social Sciences*, 6(4):1-20. <http://dx.doi.org/10.3390/socsci6040126>
- Casella, G., Bigliardi, B. & Bottani, E. 2022. The evolution of RFID technology in the logistics field: a review. *Procedia Computer Science*, 200(1):1582-1592. doi: 10.1016/j.procs.2022.01.359
- Chanchaichujit, J., Balasubramanian, S. & Charmaine, N.S.M. 2020. A systematic literature review on the benefit-drivers of RFID implementation in supply chains and its impact on organizational competitive advantage. *Cogent Business & Management*, 7(1):1-20. doi:10.1080/23311975.2020.1818408
- Chang, Y.Z., Yu, C.W., Chao, C.M. & Lin, F.C. 2020. Influences on medical app adoption by patients: the unified theory of acceptance and use of technology model and the moderating effects of technology readiness. *The Social Science Journal*:1-14(1):1-14. doi: 10.1080/03623319.2020.1848338
- Chen, S.C., Li, S.H., Liu, S.C., Yen, D.C. & Ruangkanjanases, A. 2021. Assessing Determinants of Continuance Intention towards Personal Cloud Services: Extending UTAUT2 with Technology Readiness. *Symmetry*, 13(3):1-17. <https://doi.org/10.3390/sym13030467>
- Chong, A.Y.L., Blut, M. & Zheng, S. 2022. Factors influencing the acceptance of healthcare information technologies: A meta-analysis. *Information & Management*, 59(3):1-19. <https://doi.org/10.1016/j.im.2022.103604>
- Cimini, C., Lagorio, A., Pirola, F. & Pinto, R. 2021. How human factors affect operators' task evolution in Logistics 4.0. *Human Factors and Ergonomics in Manufacturing & Service Industries*, 31(1):98-117. doi: 10.1002/hfm.20872
- Creswell, J.W. 2014. *Research design: Qualitative, quantitative, and mixed methods approaches*. 4th ed. London: Sage publications.
- Custodio, L. & Machado, R. 2020. Flexible automated warehouse: a literature review and an innovative framework. *The International Journal of Advanced Manufacturing Technology*, 106(1):533-558. <https://doi.org/10.1007/s00170-019-04588-z>

Donmez-Turan, A. & Zehir, C. 2021. Personal Innovativeness and Perceived System Quality for Information System Success: the Role of Diffusability of Innovation. *Technical Gazette*, 28(5):1717-1726. <https://doi.org/10.17559/TV-20200415165146>

Dube, T., Van Eck, R. & Zuva, T. 2020. Review of technology adoption models and theories to measure readiness and acceptable use of technology in a business organization. *Journal of Information Technology*, 2(4):207-212. <https://doi.org/10.36548/jitdw.2020.4.003>

Duroc, Y. & Tedjini, S. 2018. RFID: A key technology for Humanity. *Comptes Rendus Physique*, 19(1):64-71. <https://doi.org/10.1016/j.crhy.2018.01.003>

Dwivedi, Y.K., Rana, N.P., Jeyaraj, A., Clement, M. & Williams, M.D. 2019. Re-examining the unified theory of acceptance and use of technology (UTAUT): Towards a revised theoretical model. *Information Systems Frontiers*, 21(3):719-734. doi: 10.1007/s10796-017-9774-y

Field, A. 2009. *Discovering statistics using SPSS*. 3rd ed. London: Sage.

Gladysz, B., Corti, D. & Montini, E. 2021. Forecasting the Development of RFID Technology. *Management and Production Engineering Review*, 12(1):38-47. doi: 10.24425/mper.2021.136870

Gökalp, E., Gökalp, M.O. & Coban, S. 2022. Blockchain-based supply chain management: understanding the determinants of adoption in the context of organizations. *Information systems management*, 39(2):100-121. doi: 10.1080/10580530.2020.1812014

Haibi, A., Oufaska, K., El Yassini, K., Boulmalf, M. & Bouya, M. 2022. Systematic mapping study on RFID technology. *IEEE Access*, 10(1):6363-6380. doi: 10.1109/ACCESS.2022.3140475

Helen Suzman Foundation. 2018. *The supply of pharmaceuticals in South Africa*. <https://hsf.org.za/publications/special-publications/pharmaceuticals-in-south-africa/pharma-report-2018.pdf> Date of access: 14 Mar. 2022.

- Hewavitharana, T., Nanayakkara, S., Perera, A. & Perera, P. 2021. Modifying the Unified Theory of Acceptance and Use of Technology (UTAUT) Model for the Digital Transformation of the Construction Industry from the User Perspective. *Informatics*, 8(4):1-22. <https://doi.org/10.3390/informatics8040081>
- Hodgetts, B.T. 2020. Innovating at PACE during crisis—military lessons for the COVID environment. *BMJ Leader*, 1(1):1-4. doi:10.1136/leader-2020-000267
- Kelley-Quon, L.I. 2018. Surveys: Merging qualitative and quantitative research methods. *Seminars in pediatric surgery*, 27(6):361-366. <https://doi.org/10.1053/j.sempedsurg.2018.10.007>
- Kgobe, P. & Ozor, P. 2021. Integration of Radio Frequency Identification Technology in Supply Chain Management: A Critical Review. *Operations and Supply Chain Management: An International Journal*, 14(3):289-300. <http://doi.org/10.31387/oscm0460303>
- Khayyam, S., Ramish, A., Rehman, K. & Syed, A. 2022. Strategizing Radio Frequency Identification (RFID) in the Retail Supply Chains of Pakistan: A Multiple Case Study. *Operations and Supply Chain Management: An International Journal*, 15(1):27-40.
- Khazetdinov, A., Aleksandrov, A., Zakiev, A. & Magid, E. 2020. *RFID-based warehouse management system prototyping using a heterogeneous team of robots*. Paper presented at the 23rd International Conference on Climbing and Walking Robots and the Support Technologies for Mobile Machines, Moscow, Russia Federation, 24-26 Aug 2022. <https://doi.org/10.13180/clawar.2020.24-26.08.32> Date of access: 3 Aug. 2021.
- Kim, T. & Chiu, W. 2018. Consumer acceptance of sports wearable technology: The role of technology readiness. *International Journal of Sports Marketing and Sponsorship*, 20(1):109-126. doi 10.1108/IJSMS-06-2017-0050
- Kumar, S., Narkhede, B.E. & Jain, K. 2021. Revisiting the warehouse research through an evolutionary lens: a review from 1990 to 2019. *International Journal of Production Research*, 59(11):3470-3492. doi: 10.1080/00207543.2020.1867923
- Kundu, D.K. 2021. *E-Learning-Teaching Strategies and Teachers' Stress in Post Covid-19*. 1st ed. New Delhi: Kanishka publishers.

- Landt, J. 2005. The history of RFID. *IEEE potentials*, 24(4):8-11.
- Lee, S. & Jung, K. 2016. A meta-analysis of determinants of RFID adoption around the world: Organization, technology, and public policy. *Asia Pacific Journal of Innovation and Entrepreneurship*, 10(1):67-90. doi 10.1108/APJIE-12-2016-010
- Liyanage, K. & Gbededo, M.A. 2014. *Radio frequency identification (RFID) adoption strategy for strategic supply chain*. Paper presented at the 12th International Conference on Manufacturing Research (ICMR 2014), Solent Centre, Southampton. <https://derby.openrepository.com/bitstream/handle/10545/620590/Paper%20on%20RFID%20Adoption%20Strategy%20-Final%20submission.pdf?sequence=1> Date of access: 5 Aug. 2021.
- Lyu, J., Huang, Y.C., Ding, H.Y., Fu, H.C. & Huang, Y.T. 2014. A study of RFID readiness framework and its application. *International Journal of Electronic Business Management*, 12(2):111-121.
- Macedo, I.M. 2017. Predicting the acceptance and use of information and communication technology by older adults: An empirical examination of the revised UTAUT2. *Computers in Human Behavior*, 75(1):935-948. <http://dx.doi.org/10.1016/j.chb.2017.06.013>
- Mahroof, K. 2019. A human-centric perspective exploring the readiness towards smart warehousing: The case of a large retail distribution warehouse. *International Journal of Information Management*, 45(1):176-190. <https://doi.org/10.1016/j.ijinfomgt.2018.11.008>
- Malhotra, N.K. 2010. *Marketing research: An applied orientation*. New Jersey, NJ: Prentice Hall.
- Maruthaveni, R. & Kathiresan, V. 2018. A Critical Study on RFID. *International Journal of Scientific Research in Network Security and Communication*, 6(2):62-65. <http://doi.org/10.26438/ijsrnsc>
- Matarirano, O., Yeboah, A. & Gqokonqana, O. 2021. Readiness of Students for Multi-Modal Emergency Remote Teaching at A Selected South African Higher Education Institution. *International Journal of Higher Education*, 10(6):135-152. doi:10.5430/ijhe.v10n6p135

Mathu, K. & Phetla, S. 2018. Supply chain collaboration and integration enhance the response of fast-moving consumer goods manufacturers and retailers to customer's requirements. *South African Journal of Business Management*, 49(1):1-8.

<https://doi.org/10.4102/sajbm.v49i1.192>

Noor, O. 2022. IoT and RFID in Supply Chain: Benefits, Barriers and Analysis. *International Journal of Research Publication and Reviews*, 3(2):334-358.

Olasina, G. 2019. Human and social factors affecting the decision of students to accept e-learning. *Interactive Learning Environments*, 27(3):363-376.

<https://doi.org/10.1080/10494820.2018.1474233>

Oni, J., Dakora, E. & Owei, V. 2011. RFID: A Review of its Relevance and Application in South African Retailing Systems. In: ICIME 2011-Proceedings of the 2nd International Conference on Information Management and Evaluation: ICIME 2011 Ryerson University, Toronto, Canada, 27-28 April 2011. Toronto: Academic Conferences Limited. pp. 351-359.

Pangriya, R. & Singh, A.P. 2021. The Differencing Views of Technology Readiness and Acceptance Model: A Literature Review. *Turkish Journal of Computer and Mathematics Education* 12(4):1-22.

Parasuraman, A. 2000. Technology Readiness Index (TRI) a multiple-item scale to measure readiness to embrace new technologies. *Journal of service research*, 2(4):307-320. <https://doi.org/10.1177/109467050024001>

Parasuraman, A. & Colby, C.L. 2015. An updated and streamlined technology readiness index: TRI 2.0. *Journal of service research*, 18(1):1-16. doi: 10.1177/1094670514539730

Phalitnonkiat, P., Kunnapapdeelert, S. & Pitchayadejanant, K. 2020. Behavioral Intentions of Radio Frequency Identification Users at Hospitals in Thailand. *Human Behavior, Development and Society*, 21(2):30–39.

Protection of Personal Information Act 4 of 2013.

Plouffe, C.R., Hulland, J.S. & Vandenbosch, M. 2001. Richness versus parsimony in modeling technology adoption decisions—understanding merchant adoption of a smart card-based payment system. *Information systems research*, 12(2):208-222.

Rafiquea, M.Z., Haidera, M., Raheema, A., Ab Rahmanb, M.N. & Amjada, M.S. 2022. Essential Elements for Radio Frequency Identification (RFID) adoption for Industry 4.0 Smart Manufacturing in Context of Technology-Organization-Environment (TOE) Framework—A Review. *Jurnal Kejuruteraan*, 34(1):1-10. [https://doi.org/10.17576/jkukm-2022-34\(1\)-01](https://doi.org/10.17576/jkukm-2022-34(1)-01)

Raza, S.A. 2021. A systematic literature review of RFID in supply chain management. *Journal of Enterprise Information Management*, 35(2):617-649. doi 10.1108/JEIM-08-2020-0322

Reddy, K.R., Krishna, P.V., Sravya, B. & Tarakumari, P. 2018. Automatic Identification and Data Capture in Mobile via RFID. *International Journal of Pure and Applied Mathematics*, 118(9):593-601.

Reyes, P.M., Li, S. & Visich, J.K. 2016. Determinants of RFID adoption stage and perceived benefits. *European Journal of Operational Research*, 254(3):801-812. <http://dx.doi.org/10.1016/j.ejor.2016.03.051>

Richards, G. 2014. *Warehouse management: a complete guide to improving efficiency and minimizing costs in the modern warehouse*. London: Kogan Page Publishers.

Rieback, M.R., Crispo, B. & Tanenbaum, A.S. 2006. The evolution of RFID security. *IEEE Pervasive Computing*, 5(1):62-69.

SAHPRA (South African Health Products Regulatory Authority). 2016. *South African Good Wholesaling practice for wholesalers*. https://www.sahpra.org.za/wp-content/uploads/2020/04/SA-Guide-for-GWP-Jul2016_v2.pdf Date of access: 28 Mar. 2021.

Sanil, N., Venkat, P.A.N. & Ahmed, M.R. 2018. Design of an U shaped slotted patch antenna for RFID Vehicle Identification. In: 2018 Second International Conference on Green Computing and Internet of Things (ICGCIoT), University Bengaluru. IEEE. pp. 300-304.

Saunders, M., Venter, E., Lewis, P. & Thornhill, A. 2007. *Research methods for business students*. 4th ed. Harlow, UK: Pearson.

Seng, L.C. & Yew, L.K. 2019. RFID Technology Adoption Rate in Warehousing: A Study of Manufacturing Companies in Johor. *International Journal of Trend in Scientific Research and Development*, 3(3):143-153. doi: 10.5281/zenodo.2592105

Sharma, V. & Hashmi, M. 2021. On the Seamless Integration and Co-Existence of Chipless RFID in Broad IoT Framework. *IEEE Access*, 9(1):69839-69849. doi: 10.1109/ACCESS.2021.3078318

Smith, A.D. 2021. RFID Technologies and Warehouse Applications: Case Studies. In: *Encyclopedia of Organizational Knowledge, Administration, and Technology*. https://digitalcommons.kennesaw.edu/cgi/viewcontent.cgi?article=1282&context=ama_p roceedings Date of access: 15 Jul. 2021.

Soe, N. & Aung, T.H. 2019. Implementation of Secure Electronic Payment System Using RFID and ECC Digital Signature. *International Journal of Science, Engineering and Technology Research*, 8(6):243-248.

South African Pharmacy Council. 2022. *Pharmacies By Sector*. <https://interns.pharma.mm3.co.za/Statistics/PharmaciesBySector?class=btn%20btn-primary> Date of access: 11 Mar. 2022.

Stats SA (Statistics South Africa). 2021. *Wholesale trade sales: December 2021*. (Statistical release P6141.2). <http://www.statssa.gov.za/publications/P61412/P61412December2021.pdf> Date of access: 14 Mar. 2022.

Stern, H. & Becker, T. 2019. Concept and evaluation of a method for the integration of human factors into human-oriented work design in cyber-physical production systems. *Sustainability*, 11(16):1-33. doi:10.3390/su11164508

Steyn, H. & Ellis, S. 2003. Practical significance (effect sizes) versus or in combination with statistical significance (P-values): Research note. *Management Dynamics: Journal of the Southern African Institute for Management Scientists*, 12(4):51-53.

- Tan, W.C., Sidhu, M.S. & Shah, S.M. 2021. Survey of RFID-IoTin Supply Chain Management. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, 12(3):1754-1762. <https://doi.org/10.17762/turcomat.v12i3.1002>
- Tang, L.-L., Chan, Y.-W. & Shen, S.-L. 2019. Investigating radio-frequency identification usage behaviours and organisational performance according to factors of user perception. *International Journal of Services Technology and Management*, 25(3):199-214. doi:10.1504/IJSTM.2019.100047
- Tatnall, A. & Burgess, S. 2009. Adoption of e-commerce in smes. In: *Encyclopedia of Information Science and Technology, Second Edition*. Melbourne: IGI Global. pp. 41-45.
- Upfold, C. & Liu, H. 2010. Radio Frequency Identification (RFID) adoption in the South African retail sector: an investigation of perceptions held by members of the retail sector regarding the adoption constraints. *Electronic Journal of Information Systems Evaluation*, 13(1):87-96.
- van Tonder, E., Saunders, S.G., Lisita, I.T. & de Beer, L.T. 2018. The importance of customer citizenship behaviour in the modern retail environment: Introducing and testing a social exchange model. *Journal of Retailing and Consumer Services*, 45(1):92-102. <https://doi.org/10.1016/j.jretconser.2018.08.011>
- Venkatesh, V. 2000. Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information systems research*, 11(4):342-365.
- Venkatesh, V., Thong, J.Y. & Xu, X. 2012. Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS quarterly*, 36(1):157-178.
- Venkatesh, V., Thong, J.Y. & Xu, X. 2016. Unified theory of acceptance and use of technology: A synthesis and the road ahead. *Journal of the association for Information Systems*, 17(5):328-376.
- Venkatesh, V., Morris, M.G., Davis, G.B. & Davis, F.D. 2003. User acceptance of information technology: Toward a unified view. *MIS quarterly*, 27(3):425-478.

- Wamba, S.F., Gunasekaran, A., Bhattacharya, M. & Dubey, R. 2016. Determinants of RFID adoption intention by SMEs: an empirical investigation. *Production Planning & Control*, 27(12):1-32. <http://dx.doi.org/10.1080/09537287.2016.1167981>
- Wanjari, S.S. 2020. Analyzing the Impact of Human and Technological Factors on Warehouse Productivity. *European Journal of Business and Management Research*, 5(5):1-6. <http://dx.doi.org/10.24018/ejbmr.2020.5.5.539>
- Want, R. 2006. An introduction to RFID technology. *IEEE pervasive computing*, 5(1):25-33.
- Wong, L.-W., Tan, G.W.-H., Lee, V.-H., Ooi, K.-B. & Sohal, A. 2020. Unearthing the determinants of Blockchain adoption in supply chain management. *International Journal of Production Research*, 58(7):2100-2123. doi:10.1080/00207543.2020.1730463
- Xu, L.D., Xu, E.L. & Li, L. 2018. Industry 4.0: state of the art and future trends. *International Journal of Production Research*, 56(8):2941-2962. doi: 10.1080/00207543.2018.1444806
- Zainab, A., Kiran, K., Karim, N.H.A. & Sukmawati, M. 2018. UTAUT'S performance consistency: Empirical evidence from a library management system. *Malaysian Journal of Library & Information Science*, 23(1):17-32. <https://doi.org/10.22452/mjlis.vol23no1.2>
- Zelbst, P.J., Green, K.W., Sower, V.E. & Bond, P.L. 2019. The impact of RFID, IIoT, and Blockchain technologies on supply chain transparency. *Journal of Manufacturing Technology Management*, 31(3):441-457. doi: 10.1108/JMTM-03-2019-0118
- Zhou, D. 2019. Intelligent library system based on RFID technology. *Journal of Physics*, 1345(4):1-5. doi:10.1088/1742-6596/1345/4/042047
- Zhou, W., Piramuthu, S., Chu, F. & Chu, C. 2017. RFID-enabled flexible warehousing. *Decision Support Systems*, 98(1):99-112. doi: 10.1016/j.dss.2017.05.002

APPENDICES

APPENDIX 1: SURVEY QUESTIONNAIRE WITH INFORMED CONSENT

Radio Frequency Identification (RFID) Survey

INFORMED CONSENT

TITLE OF THE RESEARCH STUDY: Determining the human factors influencing RFID technology adoption in the South African wholesale distribution industry

ETHICS REFERENCE NUMBER: NWU-00638-22-A4

PRINCIPAL INVESTIGATOR: Prof Wim Roestenburg

POST-GRADUATE STUDENT: Mr Chris Botha

Technology influences most of our lives quite dramatically. Therefore, you are invited to participate in a research study towards my MBA dissertation. This research is about the influence of RFID technology on your life and your acceptance of RFID technology in your work context. Please contact the researchers if you have any questions regarding any part of this study that you do not fully understand. It is imperative that you are fully satisfied that you clearly understand this research and how you might be involved. Your participation is entirely voluntary, and you are free to decline further participation at any time. If you say no, this will not affect you negatively in any way whatsoever.

This study has been approved by the Economic and Management Sciences Research Ethics Committee of the Faculty of Management and Economic Sciences of the North-West University (NWU-00638-22-A4) and will be conducted according to the ethical guidelines and principles of Ethics in Business Research: Principles, Processes and Structures and other international ethical guidelines applicable to this study. It might be necessary for the research ethics committee members or other relevant people to inspect the research records.

What is radio-frequency identification (RFID) technology?

RFID, or radio-frequency identification, is a radio wave-based technology used to monitor inventory. Many of us use RFID technology in our everyday lives, most of the time without knowing it, from effortlessly capturing payment information through a touchless toll pass system to tapping your credit card to pay for your groceries. You may have even scanned an ID badge with an RFID chip in it to enter your workplace or hotel room. The use of RFID in warehouses is similar to bar code scanners. However, the beauty of RFID is that you do not need a line of sight to scan the labels. In fact, RFID users can scan entire pallets of inventory without seeing a barcode.

The images below are visual examples of some of the applications and benefits of RFID Technology.

RFID Tolling Systems



Contactless Credit Card Payments & RFID Door Access



Data can be read long-distance - Data can be read from a tag that is in a high, relatively inaccessible place. Inventory count in large warehouses can be easily done while securing the operator's safety.





RFID-enabled Intelligent Forklift - Eliminate manual data capturing to provide real-time and accurate inventory records to enable a flexible and agile warehouse.



INFORMED CONSENT

What is this research study all about?

The study is about the Technology Readiness of workers in South African wholesalers and whether you will accept RFID technology in your work context.

Why have you been invited to participate?

You have been invited to be part of this research because you are an experienced employee in the wholesale distribution industry and can add valuable insight into this research topic. Unfortunately, you will not participate in this research if you report to the researcher.

What is expected of you?

You will be required to complete a user-friendly online questionnaire, which will take approximately 15-20 minutes to complete.

Will you gain anything from taking part in this research?

You will not benefit anything by participating in this survey. However, your participation will indirectly influence the wholesale distribution industry, and you will contribute in this manner by providing valuable insights into the use of RFID Technology by warehouse and logistics organisations.

Are there risks involved in taking part in this research?

There are no direct risks involved in participating.

How will we protect your confidentiality, and who will see your findings?

This survey is set not to collect e-mail addresses or contact numbers. This ensures the complete anonymity of your data. All other information collected is not personal, and in this way, the researcher cannot identify you in any way.

What will happen with the findings or samples?

The findings of this study will only be used for educational purposes. Demographic information is only gathered for statistical purposes to make comparisons among the various demographic groups. All data will be kept safe and stored according to the Record Management guideline of the North-West University for five years.

How will you know the results of this research?

The results of this study may be published in an academic journal, and a short report will be made available to your organisation, who may choose to make the results available to you.

Will you be paid to take part in this study, and are there any costs for you?

There will be no costs involved if you participate in this study, and you will not be rewarded for your participation.

Is there anything else that you should know or do?

You can contact the researcher, Chris Botha, on 0795124193, should you require additional information or Prof Wim Roestenburg on 0836758054 if you have any further questions or have any problems.

Your valuable participation in the study will be greatly appreciated. If you are willing to participate in this survey, you are welcome to proceed to the survey by answering the following question and selecting the **NEXT** button.

* 1. I have read the above information and

- Agree to Participate
- Disagree to Participate

Radio Frequency Identification (RFID) Survey

SECTION A: DEMOGRAPHIC INFORMATION

*** 2. Age Group**

- | | |
|-----------------------------|-----------------------------|
| <input type="radio"/> 18-24 | <input type="radio"/> 45-54 |
| <input type="radio"/> 25-34 | <input type="radio"/> 55-64 |
| <input type="radio"/> 35-44 | <input type="radio"/> 65+ |

*** 3. Highest Qualification**

- | | |
|-----------------------------------|---|
| <input type="radio"/> Matric | <input type="radio"/> Degree |
| <input type="radio"/> Certificate | <input type="radio"/> Post-graduate certificate |
| <input type="radio"/> Diploma | <input type="radio"/> Post-graduate degree |

*** 4. Indicate the Province that you currently work in**

- Gauteng
 KwaZulu Natal
 Mpumalanga
 Western Cape

*** 5. Industry**

- Pharmaceutical warehousing and logistics
 FMCG (retail) warehousing and logistics
 Cosmetic warehousing and logistics
 Other (please specify)

*** 6. Position**

- | | |
|--|---|
| <input type="radio"/> Warehouse worker | <input type="radio"/> Senior Management |
| <input type="radio"/> Supervisor | <input type="radio"/> Executive |
| <input type="radio"/> Middle Management | <input type="radio"/> IT Personnel |
| <input type="radio"/> Other (please specify) | |

* 7. Work Experience (years)

- 0-5 16-20
 6-10 21+
 11-15

* 8. How familiar are you with RFID technology?

- Not at all Moderately
 A little Extremely
 Somewhat

SECTION B: TECHNOLOGY READINESS

We are interested in your views on how technology influences your life. Please indicate how much you agree with the following statements.

* 9. Technology gives freedom to move/travel between places easily

- Strongly Disagree
 Somewhat Disagree
 Neutral
 Somewhat Agree
 Strongly Agree

* 10. Technology makes me more productive in my personal life.

- Strongly Disagree
 Somewhat Disagree
 Neutral
 Somewhat Agree
 Strongly Agree

* 11. Other people come to me for advice on new technologies.

- Strongly Disagree
 Somewhat Disagree
 Neutral
 Somewhat Agree
 Strongly Agree

* 12. In general, I am among the first in my circle of friends to acquire new technology when it appears.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 13. I keep up with the latest technological developments in my areas of interest.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 14. Technical support lines are not helpful because they don't explain things in terms I understand.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 15. Sometimes, I think that technology systems are not designed for use by ordinary people.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 16. People are too dependent on technology to do things for them.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 17. Too much technology distracts people to a point that is harmful.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 18. Technology lowers the quality of relationships by reducing personal interaction.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

SECTION C: RFID TECHNOLOGY ADOPTION INTENTION

The following questions concern the idea of using RFID Technology:

* 19. I would find the technology useful in my job.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 20. Using the technology would enable me to accomplish tasks more quickly.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 21. Using the technology would increase my productivity.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 22. If I use the technology, I will increase my chances of career advancement.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 23. My interaction with the technology would be clear and understandable.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 24. It would be easy for me to become skilful at using the technology.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 25. I think that I would find the technology easy to use.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 26. I think it will be easy to learn how to use the technology.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 27. People who influence my behaviour think that I should use the technology.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 28. People who are important to me think that I should use the technology.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 29. In general, the organisation will support the use of the technology.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 30. The senior management of this business will be helpful in the use of the technology.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 31. I intend to use the technology in the future.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 32. I predict that I will use the technology in the future.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 33. I plan to use the technology in the future.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 34. Using the technology is a good idea.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 35. I think the technology will make my work more interesting.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 36. I think working with the technology will be fun.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 37. I think I will enjoy working with the technology.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

I could complete a job or task using RFID Technology...

* 38. if there was no one around to tell me what to do.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 39. if I could call someone for help if I got stuck.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 40. if I only had the system manuals for reference.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

* 41. if I had a lot of time to complete the job for which the technology was provided.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

APPENDIX 2: PERMISSION LETTERS FROM THE ORGANISATION

North-West University Research Ethics Committee
Building E3 Room 402
North-West University Potchefstroom Campus
Potchefstroom
2531

31 January 2022

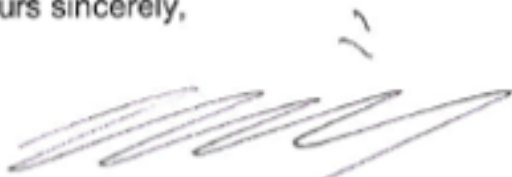
PERMISSION TO CONDUCT RESEARCH

Research Topic: **Determining the human factors influencing RFID technology adoption in the South African wholesale distribution industry**

Dear Mr Chris Botha

██████████ hereby permits you to conduct research in our ██████████ and ██████████ distribution centres on the above-mentioned topic by administering a survey questionnaire to employees in our organisation. The approved timeframe for the research is from 1 February 2022 until 30 November 2022. Further, the researcher is granted permission to liaise with the management in the above-mentioned distribution centres. ██████████ acknowledges that the results of this research will be used to fulfil the requirements of your Master of Business Administration degree at the North-West University.

Yours sincerely,



██████████
██████████ Director

North-West University Research Ethics Committee
Building E3 Room 402
North-West University Potchefstroom Campus
Potchefstroom
2531

31 January 2022

PERMISSION TO CONDUCT RESEARCH

Research Topic: **Determining the human factors influencing RFID technology adoption in the South African wholesale distribution industry**

Dear Mr Chris Botha

I hereby confirmed that as HR Business Partner for the Distribution Centre. I will assist you in distributing the link on your behalf to all DC employees. I also confirm that I will present your information re the above topic on our TV Content Screens.

Yours sincerely,

A handwritten signature in black ink, appearing to be 'M. Botha', with a circular scribble over the middle part of the name.


HR Business Partner

APPENDIX 3: NWU ETHICS APPROVAL LETTER OF STUDY



Private Bag X1290, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Fax: 018 299-4910
Web: <http://www.nwu.ac.za>

Senate Committee for Research Ethics
Tel: 018 299-4849
Email: nkosinathl.machine@nwu.ac.za

25 April 2022

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the Economic and Management Sciences Research Ethics Committee (EMS-REC) on 22/04/2022, the Economic and Management Sciences Research Ethics Committee hereby approves your study as indicated below. This implies that the North-West University Senate Committee for Research Ethics (NWU-RERC) grants its permission that, provided the special conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: Determining the human factors influencing RFID technology adoption in the South African wholesale distribution industry																
Study Leader/Supervisor (Principal Investigator)/Researcher: Prof W Roestenburg / Dr J Jordaan - MBA																
Student: Botha, CP (12129895)																
Ethics number:	N	W	U	-	0	0	6	3	8	-	2	2	-	A	4	
	Institution				Study Number						Year			Status		
	<i>Status:</i> S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation															
Application Type:																
Commencement date: 25/04/2022											Risk:	Low				
Expiry date: 25/04/2023																
Approval of the study is initially provided for a year, after which continuation of the study is dependent on receipt and review of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation.																

Special in process conditions of the research for approval (if applicable):

<p>General conditions:</p> <p><i>While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:</i></p> <ul style="list-style-type: none">• <i>The study leader/supervisor (principle investigator)/researcher must report in the prescribed format to the EMS-REC:</i><ul style="list-style-type: none">- <i>annually (or as otherwise requested) on the monitoring of the study, whereby a letter of continuation will be provided, and upon completion of the study; and</i>- <i>without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.</i>• <i>The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the study leader/researcher must apply for approval of these amendments at the EMS-REC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.</i>• <i>Annually a number of studies may be randomly selected for an external audit.</i>• <i>The date of approval indicates the first date that the study may be started.</i>• <i>In the interest of ethical responsibility, the NWU-SCRE and EMS-REC reserves the right to:</i><ul style="list-style-type: none">- <i>request access to any information or data at any time during the course or after completion of the study;</i>
--

- *to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;*
- *withdraw or postpone approval if:*
 - *any unethical principles or practices of the study are revealed or suspected;*
 - *it becomes apparent that any relevant information was withheld from the EMS-REC or that information has been false or misrepresented;*
 - *submission of the annual (or otherwise stipulated) monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and / or*
 - *new institutional rules, national legislation or international conventions deem it necessary.*
- *Please note that the ethics approval of this application is subject to the Covid-19 protocols.*

The EMS-REC would like to remain at your service as scientist and researcher, and wishes you well with your study. Please do not hesitate to contact the EMS-REC or the NWU-SCRE for any further enquiries or requests for assistance.

Yours sincerely,

**Mark
Rathbone**

Digitally signed by Mark Rathbone
DN: cn=Mark Rathbone, o=North-
West University, ou=Business
management,
email=mark.rathbone@nwu.ac.za,
c=ZA
Date: 2022.04.25 16:55:36 +02'00'

Prof Mark Rathbone
Chairperson: NWU Economic and Management Sciences Research Ethics Committee

APPENDIX 4: RESPONDENT RECRUITMENT ADVERT



Many of us use **RFID technology** in our everyday lives, most of the time without knowing it, from effortlessly scanning your ID card to enter your workplace to tapping your credit card to pay for your groceries.



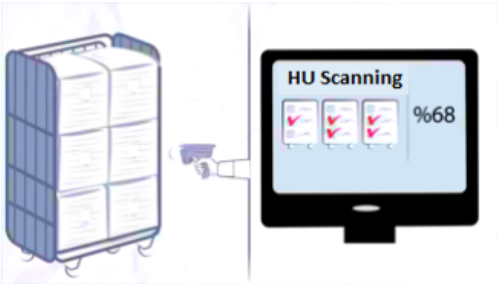
The use of RFID in warehouses is similar to bar code scanners. However, the beauty of RFID is that you do not need a line of sight to scan the labels. In fact, *RFID users can scan entire pallets of inventory without seeing a barcode.*



RFID Tolling Systems



Contactless Payments & Door Access



RFID Dispatch Process



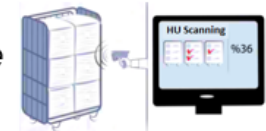
RESEARCH PARTICIPANTS NEEDED



As an experienced wholesale distribution employee, you are invited to participate in a research study contributing towards my MBA dissertation



Study Title: *Determining the human factors influencing RFID technology adoption in the South African wholesale distribution industry*



Your **valuable participation** in the study will be greatly appreciated. To participate in this study, kindly send a SMS with "YES" to **079 512 4193**

Post-Graduate Student: **Chris Botha**
Contact number: **079 512 4193**
Principle Investigator: **Prof Wim Roestenburg**
Study Period:

**Study has obtained ethical clearance from the North-West University Ethics Committee*

Participation in this study is

- Entirely voluntary and anonymous.
- Participation involves completing an online survey questionnaire, requiring 15-20 minutes to complete.
- No benefits or rewards will be offered to participants.

To participate in this research study, you must:

- Currently be employed in the wholesale distribution industry.

Unfortunately, you may not participate if you:

- Report directly to the researcher.

APPENDIX 5: LICENCES AND PERMISSION TO USE UTAUT AND TRI 2.0

Permission Granted

VVenkatesh Website <admin@vvenkatesh.com>
Yo Chris Botha

Reply Reply All Forward

Thank you for your interest. Your permission to use content from the paper is granted. Please cite the work appropriately. Note that this permission does not exempt you from seeking the necessary permission from the copyright owner (typically, the publisher of the journal) for any reproduction of any materials contained in this paper.

Sincerely,
Viswanath Venkatesh
Eminent Scholar and Verizon Chair of Business Information Technology
Email: vvenkatesh@vvenkatesh.us
Website: <http://vvenkatesh.com>

License from the copyright owner:



This is a License Agreement between Chris Botha ("User") and Copyright Clearance Center, Inc. ("CCC") on behalf of the Rightsholder identified in the order details below. The license consists of the order details, the CCC Terms and Conditions below, and any Rightsholder Terms and Conditions which are included below. All payments must be made in full to CCC in accordance with the CCC Terms and Conditions below.

Order Date	02-Feb-2022	Type of Use	Republish in a thesis/dissertation
Order License ID	1184970-1	Publisher	Society for Management Information Systems and Management Information Systems Research Center of the University of Minnesota
ISSN	0276-7783	Portion	Chart/graph/table/figure

LICENSED CONTENT

Publication Title	MIS quarterly	Publication Type	e-Journal
Article Title	User acceptance of information technology: Toward a unified view	Start Page	425
Author/Editor	Society for Information Management (U.S.), University of Minnesota, Management Information Systems Research Center	End Page	478
Date	01/01/1984	Issue	3
Language	English	Volume	27
Country	United States of America	URL	http://www.misq.org
Rightsholder	M I S Quarterly		

REQUEST DETAILS

Portion Type	Chart/graph/table/figure	Distribution	Worldwide
Number of charts / graphs / tables / figures requested	1	Translation	Original language of publication
Format (select all that apply)	Electronic	Copies for the disabled?	No
Who will republish the content?	Academic institution	Minor editing privileges?	No
Duration of Use	Current edition and up to 5 years	Incidental promotional use?	No
Lifetime Unit Quantity	Up to 499	Currency	USD
Rights Requested	Main product		

NEW WORK DETAILS

Title	Mr	Institution name	North-West University, Potchefstroom, South Africa
Instructor name	Chris	Expected presentation date	2022-10-01

REUSE CONTENT DETAILS

Title, description or numeric reference of the portion(s)	UTAUT Model	Title of the article/chapter the portion is from	User acceptance of information technology: Toward a unified view
Editor of portion(s)	Davis, Fred D.; Davis, Gordon B.; Morris, Michael G.; Venkatesh, Viswanath	Author of portion(s)	Davis, Fred D.; Davis, Gordon B.; Morris, Michael G.; Venkatesh, Viswanath
Volume of serial or monograph	27	Issue, if republishing an article from a serial	3
Page or page range of portion	425-478	Publication date of portion	2003-09-01

RE: Request to use TRI version 2.0



Charles Colby <ccolby@rockresearch.com>
To: chrisbotha809@gmail.com

Reply Reply All Forward

Mon 2021/10/11 18:19

You forwarded this message on 2021/12/12 15:41.

TR Index 2.0 List for Academic Subscribers.docx
24 KB

H Chris, all looks good. You now officially have a license to use the TRI 2.0 for academic use. I am attaching a list of scale items and recommendations on administration that may be useful. Let me know if you have questions.

Regards,



Charles L. Colby

Principal, Chief Methodologist and Founder

Office: [703 757 5213](tel:7037575213) ext. 112

10130 G Colvin Run Road, Great Falls, VA 22066

www.rockresearch.com | ccolby@rockresearch.com

APPENDIX 6: ANOVA RESULTS REGARDING AGE

	Age group	N	Mean	SD	Anova Sig.	Welsch Sig.	Effect sizes	
							18-34 with	35-44 with
TR	18-34	54	3.26	0.58	0.467	0.507		
	35-44	37	3.34	0.56			0.13	
	45+	26	3.43	0.64			0.27	0.16
PE	18-34	54	4.46	0.65	0.362	0.167		
	35-44	37	4.55	0.77			0.11	
	45+	26	4.68	0.38			0.34	0.18
EE	18-34	54	4.44	0.59	0.799	0.808		
	35-44	37	4.50	0.78			0.08	
	45+	26	4.39	0.50			0.07	0.14
SI	18-34	54	3.97	0.78	0.680	0.679		
	35-44	37	4.07	0.78			0.12	
	45+	26	4.13	0.75			0.20	0.07
BI	18-34	54	4.52	0.69	0.941	0.942		
	35-44	37	4.54	0.85			0.03	
	45+	26	4.47	0.71			0.06	0.08
ATUT	18-34	54	4.47	0.70	0.962	0.949		
	35-44	37	4.49	0.80			0.02	
	45+	26	4.52	0.57			0.07	0.04
SE	18-34	54	3.87	0.62	0.732	0.724		
	35-44	37	3.97	0.59			0.17	
	45+	26	3.89	0.65			0.04	0.12

APPENDIX 7: ANOVA RESULTS REGARDING WORK EXPERIENCE

	Work experience (years)	N	Mean	SD	Anova Sig.	Welsch Sig.	Effect sizes	
							0-5 with	6-10 with
TR	0-5	38	3.38	0.62	0.723	0.747		
	6-10	38	3.27	0.61			0.17	
	11+	41	3.32	0.53			0.10	0.07
PE	0-5	38	4.49	0.60	0.591	0.480		
	6-10	38	4.50	0.84			0.02	
	11+	41	4.62	0.46			0.22	0.15
EE	0-5	38	4.46	0.58	0.931	0.948		
	6-10	38	4.41	0.82			0.06	
	11+	41	4.46	0.48			0.00	0.06
SI	0-5	38	4.01	0.79	0.779	0.762		
	6-10	38	3.99	0.85			0.03	
	11+	41	4.10	0.67			0.11	0.14
BI	0-5	38	4.62	0.64	0.536	0.512		
	6-10	38	4.44	0.90			0.20	
	11+	41	4.49	0.67			0.20	0.05
ATUT	0-5	38	4.46	0.73	0.784	0.739		
	6-10	38	4.45	0.84			0.02	
	11+	41	4.55	0.52			0.12	0.12
SE	0-5	38	3.83	0.69	0.442	0.455		
	6-10	38	4.01	0.58			0.26	
	11+	41	3.89	0.56			0.09	0.20

APPENDIX 8: T-TEST RESULTS REGARDING INDUSTRY

Dimension	Industry	N	Mean	SD	Sig. (2-tailed)	Effect size
Technology Readiness (TR)	Pharmaceutical	79	3.33	0.62	0.560	0.10
	FMCG	35	3.27	0.48		
Performance Expectancy (PE)	Pharmaceutical	79	4.48	0.67	0.070	0.33
	FMCG	35	4.70	0.55		
Effort Expectancy (EE)	Pharmaceutical	79	4.42	0.70	0.612	0.08
	FMCG	35	4.48	0.48		
Social Influence (SI)	Pharmaceutical	79	4.02	0.81	0.691	0.07
	FMCG	35	4.08	0.70		
Behavioural Intention (BI)	Pharmaceutical	79	4.49	0.78	0.392	0.15
	FMCG	35	4.61	0.64		
Attitude toward using technology (ATUT)	Pharmaceutical	79	4.44	0.75	0.127	0.27
	FMCG	35	4.64	0.58		
Self-Efficacy (SE)	Pharmaceutical	79	3.89	0.62	0.688	0.08
	FMCG	35	3.94	0.62		