Chapter 5  
Major Findings and Discussion

5 Overview

This chapter presents the discussion on results of the analysis done in previous chapter. The chapter describes the basic information derived from analysis of each variable through descriptive statistic and presents the results derived from factor analysis and regression analysis. The chapter covers the findings, suggestions and implication of the research. It also describes original contribution to knowledge and further research scope.

The goals of this chapter are:

- Introduction (section 5.1)
- Major findings (section 5.2)
- Discussion: Aims and Objectives (section 5.3)
- Suggestions/Implications (section 5.4)
- Original contribution to knowledge (section 5.5)
- Further research (section 5.6)
- Chapter summary (section 5.7)

5.1 Introduction

Previous chapters cover the details of RFID technology and its use in manufacturing sector, key drivers for adoption, challenges in adoption and the benefits after adoption. All of the above mentioned was studied on the basis of the literature review done. After discussions with some senior executives of the organization using RFID technology and the service providers of the technology, a Questionnaire was developed and modified for getting the key
insights of the benefits being achieved by the organizations using RFID Technology. For the study, there were five objectives formed based on the literature review and the meetings with the senior executives. The next section will provide a brief of the objectives and the result of the analysis.

5.2 Major Findings:

One of the basic need was to understand the extent of utilization of RFID technology in the manufacturing organizations. In total, 52 organizations were studied from different industries, namely cement/ceramic, boilers, tubes & pipes and textile industry and the data was collected from senior level executives, dealing with RFID in the organizations, and their association with the organization varied from 2 years to 10 years or more. All of these organizations/manufacturing units had RFID in full extent usage, and they had various practices of the technology. Henceforth, study had a flow to understand the different drivers for adoption, the effect of drivers on the practices being adopted by the organization and its relation with the benefits achieved by the organization. The main purpose of the study was to understand if the adoption of the technology creates a positive effect on the efficiency of the organization at operational level. First part of the study included general details of RFID technology used in the organisation and the second part consisted of various drivers of RFID adoption, challenges for adoption, practices followed by the organizations and benefits received by the organizations. The findings from the research conducted is as below:

a. The data shows that the technology being new, almost all the organizations are in the pilot stage of adoption and are none of them has full stage adoption.

b. Data shows that most of the organizations are using the technology for internal operations, and very few are using it for business to customer marketing and after sales services and logistics.

c. Out of the firms surveyed maximum organizations understand the principle of RFID but are not fully conversant with the functioning of RFID technology.
d. Data shows that organizations have integrated RFID technology with the IT infrastructure or overall IT strategy, none of the organization has stand alone stage of RFID.

e. The largest cost items in the adoption of technology are RFID tags, middleware and readers.

f. Most of the organizations are using passive reusable read and write tags.

g. Smart card and Smart chip are the maximum used forms of tags in the organizations.

h. Most of the organizations have about 30% of their items tagged and very few have tagged above 40% of their total items.

i. All the organizations have item level tagging and very few have case level or container level tagging.

j. There are organizations who are not aware of the Electronic Product Code (EPC) Global Standards for RFID adoption, and a few of them are aware, but are not interested in taking membership for the same.

k. An exploratory factor analysis was conducted for grouping drivers for RFID adoption, using maximum likelihood method, followed by varimax rotation. The four factors for RFID adoption are Organizational Drivers, Technological Drivers, Competitive Drives and Environmental Drivers.

l. An exploratory factor analysis was conducted for grouping challenges for RFID adoption, using maximum likelihood method, followed by varimax rotation. The three factors for Challenges are Technical Issues, Business level Issues and Organizational level Issues.

m. An exploratory factor analysis was conducted for grouping practices for RFID adoption, using maximum likelihood method, followed by varimax rotation. The five factors for RFID practices are Work In Progress Management, Inventory Management, Logistics Management, Warehouse Management, In-Process Logistics Management.

n. An exploratory factor analysis was conducted for grouping benefits achieved by implementing RFID technology, using maximum likelihood method, followed by varimax rotation. The five factors for benefits through RFID Implementation are Improved Operational Efficiency, Improved Inventory Management, Improved Information Sharing, Improved Supply Chain Management and Improved Visibility.

o. The regression analysis of Drivers for usage of RFID on RFID Practices reveals the following major findings:
i. Organizational Driver, Technological Driver and Competitive Driver are significant with regression coefficients +0.345, +0.554 and +0.189 respectively at 5% level of significance on the practice of Work In Progress Management; while Environmental Driver with a regression coefficient of -0.182 is insignificant and the model can explain 65% of variations in RFID usage in Work In progress Management.

ii. Organizational Driver, Technological Driver and Competitive Driver are significant with regression coefficients +0.361, +0.339 and +0.393 respectively at 5% level of significance on the practice of Inventory Management; while Environmental Driver with a regression coefficient of +0.197 is insignificant and the model can explain 51.7% of variations in RFID usage in Inventory Management.

iii. Organizational Driver, Technological Driver and Competitive Drivers are significant with regression coefficients +0.270, +0.507 and +0.287 respectively at 5% level of significance on the practice of Logistics Management; while Environmental Driver with a regression coefficient of -0.138 is insignificant and the model can explain 59.5% of variations in RFID usage in Logistics Management.

iv. Organizational Driver and Technological Driver are significant with regression coefficients +0.844 and +0.291 respectively at 5% level of significance on the practice of Warehouse Management; while Competitive Driver and Environmental Driver with a regression coefficient of +0.002 and +0.026 respectively are insignificant and the model can explain 87.4% of variations in RFID usage in Warehouse Management.

v. Technological Driver and Competitive Driver are significant with regression coefficients +0.645 and +0.242 respectively at 5% level of significance on the practice of In-Process Logistics Management; while Organizational Driver and Environmental Driver with a regression coefficient of -0.062 and +0.104 respectively are insignificant and the model can explain 45.2% of variations in RFID usage in In-Process Logistics Management.

vi. It can be seen that overall Environmental Drivers does not have any effect on any of the practices of RFID.
The regression analysis of RFID Practices in benefits of RFID reveals the following major findings:

i. Work In Progress Management, Inventory Management, Logistics Management, Warehouse Management and In-Process Logistics Management are significant with regression coefficients +0.139, +0.211, +0.208, +0.332 and +0.382 respectively at 5% level of significance on Improved Operational Efficiency as a benefit of RFID technology; and the model can explain 93.1% of variations of Improved Operational Efficiency.

ii. Work In Progress Management, Inventory Management and Warehouse Management are significant with regression coefficients +0.307, +0.321 and +0.404 respectively at 5% level of significance on Improved Inventory Management Efficiency as a benefit of RFID technology; while Logistics Management and In-Process Logistics Management with a regression coefficient of +0.032 and +0.117 respectively are insignificant and the model can explain 88.4% of variations of Improved Inventory Management Efficiency.

iii. Work In Progress Management, Inventory Management, Logistics Management and Warehouse Management are significant with regression coefficients +0.352, +0.193, +0.208 and +0.429 respectively at 5% level of significance on Improved Information Sharing Efficiency as a benefit of RFID technology; while In-Process Logistics Management with a regression coefficient of -0.023 is insignificant and the model can explain 89.1% of variations of Improved Information Sharing Efficiency.

iv. Work In Progress Management, Inventory Management, Logistics Management, Warehouse Management and In-Process Logistics Management are significant with regression coefficients +0.185, +0.172, +0.369, +0.348 and +0.192 respectively at 5% level of significance on Improved Supply Chain Management Efficiency as a benefit of RFID technology; and the model can explain 92.6% of variations of Improved Supply Chain Management Efficiency.

v. Inventory Management, Logistics Management and Warehouse Management are significant with regression coefficients +0.391, +0.226 and +0.423 respectively at 5% level of significance on Improved Visibility Efficiency as a benefit of RFID technology; while Work In Progress Management and In-
Process Logistics Management with a regression coefficient of +0.108 and +0.001 are insignificant and the model can explain 85.8% of variations of Improved Visibility Efficiency.

vi. From the above regression analysis, it can be observed that any practice of RFID will lead to Improved Operational Efficiency and Improved Supply Chain Management Efficiency in organizations.

5.3 Discussion: Aims and Objectives

5.3.1 Objective 1: To explore and analyze the Drivers for RFID adoption in Organizations

After intense literature review, a total of 18 drivers were identified, which created an impact on adoption of RFID technology in manufacturing organizations. After using factor analysis as a data reduction tool, and reliability test of Cronbach’s Alpha, the data was reduced to 14 variables and four factors, namely, ‘Organizational Drivers’, ‘Technological Drivers’, ‘Competitive Drivers’ and ‘Environmental Drivers’. According to Literature Review, usually there are three types of drivers for adoption, based on the OTE Model, i.e.; Organizational Drivers, Technological Drivers and Environmental Drivers. Some studies show that there can be a fourth driver based on the industry and the competition in the industry. In this research, the fourth driver was identified as competitive driver, which was based on the variables of competitive pressure, status pressure and industry pressure. The rest of the drivers were more or less similar to the literature studies. While the most important variable for adoption was perceived benefits of RFID with the highest mean of 4.40 on the scale tested. While the drivers under environmental factor played the least role in adoption of the technology. So, the factors which create impact on the adoption of RFID technology are organizational, technological and competitive drivers.

5.3.2 Objective 2: To explore and analyze the RFID Practices followed by Organizations

Literature review provided with many different practices of RFID applications in manufacturing organizations. After consulting few RFID vendors and middleware vendors, also some of organizations using RFID, a total of 30 practices were listed, which were being
used by organisations, depending on their requirement. Manufacturing organizations were asked to give their ratings on the basis of their experience for the practices they had adopted, regarding a positive change in their efficiency. Not all the 30 practices might be used in an particular organizations, so for the practices which they were not using, the respondents were asked to give their opinion regarding them affecting the efficiency, positively. Factor analysis was used as a data reduction method, to reduce the density of the variables related to practices. Later, to test the reliability of the variables, Cronbach’s alpha coefficient test was performed. The test reduced the data into 16 variables among five factors. Factors were ‘Work in Progress Management’, ‘Inventory Management’, ‘Logistics Management’, ‘Warehouse Management’ and ‘In process Logistics Management’. Among all the variables the highest agreeability was for improved tracking of inventory and improved inventory accuracy, which belong to the factor, inventory management practice; which show that the use of RFID is mainly satisfactory in inventory management.

5.3.3 **Objective 3: To explore and analyze the Benefits of using RFID in Organizational Practices**

The main objective of the study was to see if the operational efficiency of the organization is affected positively, after adopting RFID technology. This could be mapped from the operational level benefits achieved through adoption. For the same purpose, a total of 21 benefits were identified for RFID adoption in manufacturing organizations through literature review. Factor analysis was used as a data reduction method, to reduce the density of the variables related to benefits received. Later, to test the reliability of the variables, Cronbach’s alpha coefficient test was performed. The data was reduced to 16 variables from 21 variables under five factors, namely, ‘Improved Operational Efficiency’, ‘Improved Inventory Management’, ‘Improved Supply Chain Sharing’, ‘Improved Information Sharing’ and ‘Improved Visibility’. Results show that cost reduction is one a most satisfactory benefit for the organizations, while there is very little effect on the labour savings of the organization. Also the transportation efficiency has increased and overall inventory management has been affected positively. It can be interpreted that the using RFID does benefit organization to increase its operational efficiency and improve its inventory management. Also, the supply chain management and information sharing is also affected positively.
5.3.4 Objective 4: To analyse the impact of Drivers for RFID adoption on RFID Practices

The study comprised of identifying the drivers, practices, benefits and challenges for RFID adoption in a manufacturing organization. Also, it was required to understand the effect of them on each other. So, Multiple Regression Analysis was conducted to find the relation between the drivers of adoption to every practice of the Adoption. The study considered the factors derived for drivers and practices to test the relation. Four factors of drivers were considered, namely, ‘Organizational Drivers’, ‘Technological Drivers’, ‘Competitive Drivers’ and ‘Environmental Drivers’ and five factors of practices were considered, ‘Work in Progress Management’, ‘Inventory Management’, ‘Logistics Management’, ‘Warehouse Management’ and ‘In process Logistics Management’. Each practice was considered to be dependent variable, and the effect of all the drivers was tested on it.

For work in progress management, organizational drivers, technological drivers and competitive drivers showed an impact on it, while environmental drivers showed no impact. If there is any change in the external environment, it will not affect the work in management Process, so it should be taken into consideration while adopting the technology.

For inventory management and logistics management, also organizational drivers, technological drivers and competitive drivers showed an impact on it, while environmental drivers showed no impact.

While considering warehouse management as a practice, only organizational drivers and technological drivers showed an impact, while the other two drivers, namely competitive drivers and environmental drivers showed no impact.

For in process logistics management, technological drivers and competitive drivers showed an impact, while the other two showed no impact. For all the practices, competitive drivers showed an impact, while environmental driver showed no impact. It can be considered that, any change in the environmental drivers (professional & trade association
pressure, favourable transactional climate, and government support) will not affect RFID practices in organizations.

5.3.5 **Objective 5: To analyze the impact of RFID Practices on Benefits of using RFID**

Multiple Regression Analysis was conducted to find the relation between the practices of RFID to every benefit of the RFID. The study considered the factors derived for practices and benefits to test the relation. Five Factors of practices were considered, namely, ‘Work in Progress Management’, ‘Inventory Management’, ‘Logistics Management’, ‘Warehouse Management’ and ‘In process Logistics Management’ and five factors of benefits were considered, ‘Improved Operational Efficiency’, ‘Improved Inventory Management’, ‘Improved Supply Chain Sharing’, ‘Improved Information Sharing’ and ‘Improved Visibility’. Each benefit was considered to be dependent variable, and the effect of all the practices was tested on it.

For improved operational efficiency, all the five Practices showed a positive relation. showing that any of the practice adopted, will have an impact on improved operational efficiency.

For improved inventory management efficiency, work in progress management, inventory management, warehouse management showed an impact, while logistics management and in process logistics management showed no impact. It shows that if RFID is used for work in progress/inventory/warehouse management, it will show positive effect on improved inventory management efficiency.

While considering Improved Information Sharing Efficiency, four practices, namely, ‘Work in Progress Management’, ‘Inventory Management’, ‘Logistics Management’, ‘Warehouse Management’ showed an impact; while In process Logistics Management showed no impact. It shows that in process logistics management does not affect the information sharing efficiency of an organization.
For improved supply chain management efficiency, all the five practices; ‘Work in Progress Management’, ‘Inventory Management’, ‘Logistics Management’, ‘Warehouse Management’ and ‘In process Logistics Management’; showed an impact; which means that adopting any of the practices will lead to improved supply chain operations of an organization.

For improved visibility, three practices; ‘Inventory Management’, ‘Logistics Management’ and ‘Warehouse Management’ showed an impact, while work in progress management and in process logistics management showed no impact.

It can be considered that any of the practice adopted, will lead to improvement in operational efficiency and supply chain management of an organization.

5.4 Suggestions/Implications

There are no standards set for adoption of RFID technology. Organizations do not have awareness towards EPC global standards and thus it is required to create an awareness so that there is no lack of standards in the adoption of technology and thus it does not become a barrier to adoption of the technology.

The biggest drawback of RFID technology is the cost associated with it, and the uncertain ROI. The cost of the tag has decreased a lot since the inception cost, but it is still required to be reduced. With the development of the Electronics and Communication industry, it won’t be much difficult to reduce the cost of the tag in future, making it more easily accessible to the customers.

There is no registration of the firms using RFID technology as the frequency of the radio waves is quite low, but still there should be comprehensive data available about the organizations using the technology, so that other organizations may get motivated to adopt the technology.
Adopting any practice of RFID technology can lead to improved operational efficiency; hence adoption of this technology, can be recommended to organizations which are looking forward to improve their efficiency irrespective of the high initial cost included.

5.5 Original Contribution to Knowledge

RFID technology is being used by several organizations across Globe. Research on its drivers for adoption, benefits and challenges have been done for several sectors, including Manufacturing, Retail, and Service. Also, research in this usually has been on case study method, to completely understand the adoption and working procedure for the technology and the organization; and then the benefits are derived accordingly. This research focuses on manufacturing organizations, the reason for adoption, practices followed and benefits received for RFID Adoption in Manufacturing Organizations. Also, this research tries to develop relation between adoption and practices of RFID and a relation between practices and benefits received. This research provides an understanding of which drivers lead to which practices and which practices lead to which benefits, and hence illustrates the practice to be adopted seeking for the kind of benefit required by the organization.

5.6 Further Research

RFID has many drivers for adoption, many practices, and several benefits. This research has considered a limited number of drivers, practices and benefits, considering the literature review. Also, the research is limited to Gujarat State, and four different industries, namely Cement/Ceramic, Boilers, Textile and Tubes & Pipes. The research can be further carried out in a different State (Geographical Location) and also for different Industries. This research has not considered Employee Management as a practice for RFID Adoption, because of its limitation in Manufacturing Organizations. Several researches show Employee Management it to be one of the important applications for RFID technology. Future research can be conducted in Service Sector and Employee Management can be considered as one of the
practices of RFID technology. So, more research can be done in different sector with
different applications and in a different state, and hence it has a wide scope in the future.

5.7 Chapter Summary

The chapter covers the objectives and the result obtained through the data analysis carried out
for the research and the major findings and suggestions for the industry. It also covers the
original contribution to research and the future research which can be carried out further.