CHAPTER - IV

PROBLEMS AND CHALLENGES OF RETAILERS IN IMPLEMENTING TECHNOLOGY - DATA ANALYSIS DISCUSSIONS

4.1 INTRODUCTION

This study is mainly focused to study the impact of technology in the retail industry. The study is designed in two parts. The first part is designed to study the perception of the retailer on the technology use in retail store. The second part investigates the customer perspective of technology in retail industry. This chapter presents the data analysis of the first part of the study. The objective of this study is to study the application of the various technology innovations in the retail industry. The respondents are asked to rank the usage of the technology in the present situation and give their opinion on the importance of the technology use. There is a huge difference in the adoption of the technology among the retail stores. This study analyzes the problems and challenges faced by the retailers in adoption of technology. In addition, the benefits of using technology in retail industry are also analysed.

Technologies such as barcode and UPC have well penetrated in the retail sector. Even a small departmental store that is little larger than a convenience store have adopted barcode scanning. However, sophisticated technologies like RFID are yet to penetrate into the Indian retail sector inspite of the huge benefits in terms of store operations and supply chain operations. There are many factor like, cost of infrastructure, cost of the tag and applicability on certain products are still a challenge. The data analysis will reveal that awareness of the benefits and the problems faced by the retailers of the various categories and formats in adoption of RFID technology.

The collected data is processed and analysed using the following tools:

- Descriptive Statistics
- Validation of instrument
- Inferential Statistics

4.1.1 Descriptive Statistics

First, the descriptive statistics is presented. Descriptive statistics are used simply to describe the sample. They are used in the first instance to get a feel for the data, in the second for use in the statistical tests themselves. Typically, the data are reduced down to one or two descriptive summaries explaining the central tendency and the distribution. Usually the central tendency is analysed by calculating the mean and standard deviation. Frequency distributions are used to organise and present frequency counts in a summary form so that the information can be interpreted more easily. A frequency table is a simple way to display the number of occurrences of a particular value or characteristic.

4.1.2 Validation of Instrument

Validity of an assessment instrument is the degree to which it measures what it is supposed to measure. Reliability is the extent to which a measurement gives results that are consistent. Just because a measure is reliable, it is not necessarily valid (and vice-versa). Therefore, a measure has to be both valid and reliable. Validity is also dependent on the measurement measuring what it was designed to measure and not something else instead. There are many different types of validity. Content and Concurrent validity are explained in the methodology chapter. The construct validity is tested after the data collection. Construct validity. Construct validity refers to the extent to which operationalizations of a construct. Construct validity evidence involves the empirical and theoretical support for the interpretation of the construct. Such lines of evidence include statistical analyses of the internal structure of the test including the relationships between responses to different test items. They also include relationships between the test and measures of other constructs. The construct validity is tested by the factor analysis using principal component analysis

Principal Component Analysis (PCA) is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables. This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to (i.e., uncorrelated with) the preceding components. Principal components are guaranteed to be independent only if the data set is jointly normally distributed. PCA is sensitive to the relative scaling of the original variables. Depending on the field of application, it is also named the discrete Karhunen–Loève transform (KLT), the Hotelling transform or proper orthogonal decomposition (POD).

PCA was invented in 1901 by Karl Pearson. Now it is mostly used as a tool in exploratory data analysis and for making predictive models. PCA can be done by eigenvalue decomposition of a data covariance (or correlation) matrix or singular value decomposition of a data matrix, usually after mean centering (and normalizing or using Z-scores) the data matrix for each attribute. The results of a PCA are usually discussed in terms of component scores, sometimes called factor scores (the transformed variable values corresponding to a particular data point), and loadings (the weight by which each standardized original variable should be multiplied to get the component score). PCA is the simplest of the true eigenvector-based multivariate analyses. Often, its operation can be thought of as revealing the internal structure of the data in a way that best explains the variance in the data. If a multivariate dataset is visualised as a set of coordinates in a high-dimensional data space (1 axis per variable), PCA can supply the user with a lower-dimensional picture, a "shadow" of this object when viewed from it's (in some sense) most informative viewpoint. This is done by using only the first few principal components so that the dimensionality of the transformed data is reduced. PCA is closely related to factor analysis. Factor analysis typically incorporates more domain specific assumptions about the underlying structure and solves eigenvectors of a slightly different matrix.

4.1.3 Cronbach Reliability

Cronbach Alpha was developed by Lee Cronbach in 1951 to provide a measure of the internal consistency of a test or scale; it is expressed as a number between 0 and 1. Internal consistency describes the extent to which all the items in a test measure the same concept or construct and hence it is connected to the inter-relatedness of the items within the test. Internal consistency should be determined before a test can be employed for research or examination purposes. If the items in a test are correlated to each other, the value of alpha is increased. However, a high coefficient alpha does not always mean a high degree of internal consistency. This is because alpha is also affected by the length of the test. If the test length is too short, the value of alpha is reduced. Thus, to increase alpha, more related items testing the same concept should be added to the test. It is also important to note that alpha is a property of the scores on a test from a specific sample of tests. Therefore, investigators should not rely on published alpha estimates and should measure alpha each time the test is administered.

A “high” value of alpha is often used (along with substantive arguments and possibly other statistical measures) as evidence that the items measure an underlying (or latent) construct. However, a high alpha does not imply that the measure is unidimensional. If, in addition to measuring internal consistency, you wish to provide evidence that the scale in question is unidimensional, additional analyses can be performed. Exploratory factor analysis is one method of checking dimensionality. Technically speaking, Cronbach’s alpha is not a statistical test - it is a coefficient of reliability (or consistency). Cronbach’s alpha can be written as a function of the number of test items and the average inter-correlation among the items. Below, for conceptual purposes, we show the formula for the standardized Cronbach's alpha:

$$\alpha = \frac{N \cdot \bar{c}}{\bar{v} + (N-1) \cdot \bar{c}}$$

Here N is equal to the number of items, c-bar is the average inter-item covariance among the items and v-bar equals the average variance. One can see from this formula that if you increase the number of items, you increase Cronbach’s alpha. Additionally, if the average inter-item correlation is low, alpha will be low. As the average inter-item correlation increases, Cronbach’s alpha increases as well (holding the number of items constant).

4.1.4 Inferential Statistics

Inferential statistics is used to make claims about the populations that give rise to the data we collect. This requires that we go beyond the data available to us. Consequently, the claims we make about populations are always subject to error; hence the term “inferential statistics” and not deductive statistics. Inferential statistics encompasses a variety of procedures to ensure that the inferences are sound and rational, even though they may not always be correct. In short, inferential statistics enables us to make confident decisions in the face of uncertainty. Inferential statistics is the mathematics and logic of how this generalization from sample to population can be made. The fundamental question is: can we infer the population’s characteristics from the sample’s characteristics? Descriptive statistics remains local to the sample, describing its central tendency and variability, while inferential statistics focuses on making statements about the population.

Inferential statistics is concerned with making predictions or inferences about a population from observations and analyses of a sample. That is, we can take the results of an analysis using a sample and can generalize it to the larger population that the sample represents. In order to do this, however, it is imperative that the sample is representative of the group to which it is being generalized. To address this issue of generalization, we have tests of significance. A Chi-square or T-test, for example, can tell us the probability that the results of our analysis on the sample are representative of the population that the sample represents. In other words, these tests of significance tell us the probability that the results of the analysis could have occurred by chance when there is no relationship at all between the variables we studied in the population we studied.

Examples of inferential statistics include linear regression analyses, logistic regression analyses, ANOVA, correlation analyses, structural equation modeling, and survival analysis, to name a few. Linear regression attempts to model the relationship between two variables by fitting a linear equation to observed data. One variable is considered to be an explanatory variable, and the other is considered to be a dependent variable. For example, a modeler might want to relate the weights of individuals to their heights using a linear regression model. A classic statistical problem is to try to determine the relationship between a random variable Y. and an independent variable x. For example, we might consider height and weight of a sample of adults. Linear regression attempts to explain this relationship by fitting a curve to the data. The linear regression model postulates that

$$Y = b0 + b1\ x1 + \ldots + bnxn + e,$$

where the xi are independent variables and the “residual” e is a random variable with mean zero. In this applet, we consider the simplest example of fitting a straight line:

$$Y = a + bx + e.$$

The coefficients a and b are determined by the condition that the sum of the square residuals is as small as possible.

4.1.5 Chi Square

Chi-square is a statistical test commonly used to compare observed data with data we would expect to obtain according to a specific hypothesis. For example, if, according to Mendel's laws, you expected 10 of 20 offspring from a cross to be male and the actual observed number was 8 males, then you might want to know about the "goodness to fit" between the observed and expected. Were the deviations (differences between observed and expected) the result of chance, or were they due to other factors. How much deviation can occur before you, the investigator, must conclude that something other than chance is at work, causing the observed to differ from the expected? The chi-square test is always testing what scientists call the null hypothesis, which states that there is no significant difference between the expected and observed result.

The formula for calculating chi-square (2) is:

2= (o-e) 2/e

That is, chi-square is the sum of the squared difference between observed (o) and the expected (e) data (or the deviation, d), divided by the expected data in all possible categories.

4.1.6 ANOVA

An ANOVA is an analysis of the variation present in an experiment. It is a test of the hypothesis that the variation in an experiment is no greater than that due to normal variation of individuals' characteristics and error in their measurement. To get a grasp of statistics, the researcher must realize that statistics is based on philosophy and the testing of hypothesis. Too often the researcher reverts back to his schoolroom daze, when old Mr Westerkamp leaning over him was ready to pour down verbal abuse when the student did not immediately grasp the concept of decimals points. The researcher no longer needs to fear Mr. Westerkamp, although some reviewers with Westerkampian tendancies still exist. Instead the researcher should know that there really is no WRONG analysis.

The basis for every statistical test is to phrase the question in terms of a null hypothesis, essentially that everything is equal, and then to test whether that can be accepted within a certain probability. If the null hypothesis is rejected that allows the researcher to say that “significant differences were found in with a probability <0.05”. The tests in an ANOVA are based on the F-ratio: the variation due to an experimental treatment or effect divided by the variation due to experimental error. The null hypothesis is this ratio equals 1.0, or the treatment effect is the same as the experimental error. This hypothesis is rejected if the F-ratio is significantly large enough that the possibility of it equaling 1.0 is smaller than some pre-assigned criteria such as 0.05 (one in twenty).

4.1.7 Discriminant Analysis

Discriminant analysis builds a predictive model for group membership. The model is composed of a discriminant function (or, for more than two groups, a set of discriminant functions) based on linear combinations of the predictor variables that provide the best discrimination between the groups. The functions are generated from a sample of cases for which group membership is known; the functions can then be applied to new cases that have measurements for the predictor variables but have unknown group membership. Given a set of independent variables, discriminant analysis attempts to find linear combinations of those variables that best separate the groups of cases. These combinations are called discriminant functions and can be written in form of an equation.

4.2 CASE SUMMARIES

Table 4.1: Case summaries on respondent's demography

Demography	Types	Frequency	Percent
Type of ownership	Independent	73	54.5
	Chain store	61	45.5
	Total	**134**	**100.0**
Decision Structure	Independent	73	54.5
	Decentralised	25	18.7
	Centralised	22	16.4
	Both	14	10.4
	Total	**134**	**100.0**
Product category	Food/Grocery	17	12.7
	Gold	5	3.7
	House Hold Durables	22	16.4
	Apparel	47	35.1
	Electronic	16	11.9
	Footwear	14	10.4
	Others	13	9.7
	Total	**134**	**100.0**
Store format	Department Store	20	14.9
	Hyper mart / Super Market	12	9.0
	Category Killer	29	21.6
	Discount Store	14	10.4
	Specialty Store	39	29.1
	Warehouse Store	13	9.7
	Malls	7	5.2
	Total	**134**	**100.0**

The Table 4.1 shows the demography of the respondents. Responses were received from 134 stores across the metropolitan cities of South India. Among them 73 stores was an independent store, which makes 54.5% of the total respondents. 61 stores representing 45.5% of the total respondents were chain stores. On the decision structure of the store, the operational and procurement decisions were independently taken by 73 stores (54.5%) of the total respondent stores. This would mostly include the independently owned stores. Nearly 18.7% of the respondents have a decentralised decision-making, 16.4% had centralised decision-making. Nearly 10.4% stores had a mix of Centralised and decentralised decision-making.

Responses were collected from stores operating on various product categories. 12.7% of the stores were food and grocery Stores. 3.7 % of responses were received from golden Jewellery stores. 16.4 % of the respondents were Household Durable stores. 35.1% of respondents were from Apparel stores. 11.9 % of the responses were received from Electronic stores. Nearly 10.4 % were Footwear stores and the rest 9.7 % were of other types not included in the above types. This reveals that the organised retail stores are mainly apparel stores and followed by household durables. Food/ Grocery, Electronic and Footwear stores have moderate presence. Gold Jewellery stores are limited.

The responses were group on the store format and the results reveal that most of the stores (29.1%) were speciality stores dealing with one range of product. Nearly 21.6% of respondents were category killers that had a deep and wide collection of the product category. 14.9% of the respondents were department stores, 10.4% were discount stores, 9.7% were warehouse stores and around 5.2% respondents were malls.

Table 4.2: Case summary on Opinion on Retail Sector

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std. Deviation
Important contributor to Economy	4 (2.99)	10 (7.46)	36 (26.9)	51 (38.06)	33 (24.63)	3.74	1.217
Has a high potential for growth	3 (2.24)	5 (3.73)	34 (25.4)	50 (37.3)	42 (31. 3)	3.92	1.320
Technology is par with foreign retailers	9 (6.72)	18 (13.4)	39 (29.1)	38 (28.4)	30 (22.4)	3.46	1.155
Foreign retailers will not be a competition	21 (15.7)	26 (19.4)	40 (29.9)	30 (22.4)	17 (12.7)	2.97	1.250
Government should protect	12 (9.0)	30 (22.4)	41 (30.6)	31 (23.1)	20 (14.9)	3.13	1.185
Foreign retailers can bring better technology and supply chain	13 (9.7)	32 (23.9)	39 (29.1)	32 (23.9)	18 (13.4)	3.38	1.187
Suppliers and farmers will be better benefitted by foreign retailers	12 (9.0)	35 (26.1)	37 (27.6)	32 (23.9)	18 (13.4)	3.07	1.184
Sustain even in competition	4 (2.99)	7 (5.23)	35 (26.1)	50 (37.3)	38 (28.4)	3.83	1.157
Changing fast	3 (2.24)	6 (4.48)	36 (26.9)	52 (38.81)	37 (27.62)	3.85	1.169

* Values in the bracket are in percentage

To analyse the contribution of technology in retail industry towards Indian economy, the respondents were asked to give their opinion on the Indian retail sector, Use of technology and about the entry of foreign retail stores into India. The distribution of respondents on the agreeableness scale is presented in the Table 4.2. Interpreting the mean value, the data reveal that the retail stores have an opinion that the Indian retail sector has high growth potential (3.92 on a scale of 1 to 5). They feel that the retail scape in India is fast changing (Mean = 3.85), and that they can sustain the competition from the foreign retailers (Mean = 3.83). They perceive that the contribution of retail store to Indian economy is substantial (Mean = 3.74). Indian Retailers feel that the Suppliers and farmers will not benefit by foreign retailers (Mean = 3.07) and foreign retailers will not be a competition (Mean =2.97). These items have the lowest mean values. However, Indian retailers are moderate on opinion that foreign retailers can bring better technology and supply chain (Mean = 3.38) and the technology in Indian retailers are par with foreign retailers (Mean = 3.46). The respondents are neutral in saying that the government should protect Indian retailers (Mean = 3.13).

Overall, it can be inferred that the technology use in Indian retail is par with foreign retailers and the organised retail will be an important contributor to the Indian Economy. Though the Indian retailers are confident on sustaining the competition, they feel that the government should protect the Indian retail business.

Table 4.3 : Case summary on Attitude on Technology

	Not at all important	Not very important	No Opinion	Somewhat Important	Extremely Important	Mean	Std. Deviation
Bar Code Scanning and UPC Codes	1 (.7)	19 (14.2)	31 (23.1)	52 (38.8)	31 (23.1)	3.69	1.005
Customer Relationship Management (CRM) Software	9 (6.7)	27 (20.1)	38 (28.4)	41 (30.6)	19 (14.2)	3.25	1.135
Electronic Data Interchange (EDI)	10 (7.5)	27 (20.1)	40 (29.9)	34 (25.4)	23 (17.2)	3.25	1.179
Electronic Point of Sale (EPOS)	10 (7.5)	28 (20.9)	33 (24.6)	42 (31.3)	21 (15.7)	3.27	1.177
In-Store Digital Signage	13 (9.7)	21 (15.7)	43 (32.1)	32 (23.9)	25 (18.7)	3.26	1.214
Inventory Control Software	4 (3.0)	17 (12.7)	48 (35.8)	27 (20.1)	38 (28.4)	3.58	1.119
Kiosk Technology	10 (7.5)	23 (17.2)	45 (33.6)	38 (28.4)	18 (13.4)	3.23	1.117
Plan-o-gram	8 (6.0)	26 (19.4)	33 (24.6)	47 (35.1)	20 (14.9)	3.34	1.130
Portable Data Terminals (PDT) and Hand Held Computers	12 (9.0)	31 (23.1)	40 (29.9)	31 (23.1)	20 (14.9)	3.12	1.189
Retail Accounting Software	6 (4.5)	18 (13.4)	20 (14.9)	53 (39.6)	37 (27.6)	3.72	1.14
RFID	4 (3.0)	20 (14.9)	33 (24.6)	36 (26.9)	41 (30.6)	3.67	1.149
Store Traffic Counters	11 (8.2)	26 (19.4)	46 (34.3)	23 (17.2)	28 (20.9)	3.23	1.22
Surveillance & Security	6 (4.5)	31 (23.1)	37 (27.6)	36 (26.9)	24 (17.9)	3.31	1.145
Websites & Shopping Carts	14 (10.4)	22 (16.4)	43 (32.1)	36 (26.9)	19 (14.2)	3.18	1.182

* Values in the bracket are in percentage

The respondents were asked about the importance of various technologies in the retail store environment of India. Various technologies were listed and were asked to give their opinion on a 5-point scale of importance from ‘not at all important’ to ‘extremely important’. The distributions of the responses are presented in the Table 4.3. The mean values and standard devotions are also presented. Analysing the mean values, it can be inferred that Retail accounting software (Mean = 3.72) and the barcode scanning (Mean = 3.62) are the most important technology for the retail business. RFID (Mean =3.67) and Inventory software (Mean = 3.58) are felt equally important. Hand held Devices (Mean =3.12) and Websites (Mean = 3.18) were felt moderately important, but least compared to other technologies. Other technologies were also felt somewhat important (Mean values are above the mid value of 3, on a scale of 1 to 5). The standard deviations of the responses are less than 1.3 indicating that there is not much of spread of the opinion.

To analyse the current use of the various technologies, the respondents were asked to sort 14 technologies based on their application in their retail store. Ratio method was use to analyse the data. The Ratio Method is simple way of calculating weights for a number of critical factors. The respondent should first rank all the items according to their importance. The next step is giving weight to each item based on its rank. The lowest ranked item will be given a weight of 10. The weight of the rest of the items should be assigned as multiples of 10. The last step is normalizing these raw weights (Weber and Borcherding 1993). The normalised weights are presented in the Table 4.4.

Table 4.4 : Normalised Weightage for the Rank Scores

Rank	Weightage	Normalised Weightage
1.0	140.0	13.5
2.0	130.0	12.5
3.0	120.0	11.5
4.0	110.0	10.5
5.0	100.0	9.5
6.0	90.0	8.5
7.0	80.0	7.5
8.0	70.0	6.5
9.0	60.0	5.5
10.0	50.0	4.5
11.0	40.0	4
12.0	30.0	3
13.0	20.0	2
14.0	10.0	1
	Total	**100**

For each item, the product of their frequency of ranks and their respective normalised weights are obtained and aggregated. Table 4.5 presents the calculations.

Table 4.5 : Cumulative weightage of the rank scores of each item

	Rank	Frequency (F)	Weightage (W)	F * W
Bar Code Scanning and UPC Codes	1	77	13.5	1039.5
	2	37	12.5	462.5
	3	19	11.5	218.5
	4	1	10.5	10.5
	Total	**134**	**Cumulative weightage**	**1731.0**
Plan-o-gram	2	1	12.5	12.5
	4	1	10.5	10.5
	5	2	9.5	19.0
	6	8	8.5	68.0
	7	9	7.5	67.5
	8	5	6.5	32.5
	9	40	5.5	220.0
	10	27	4.5	121.5
	11	40	4	160.0
	12	1	3	3.0
	Total	**134**	**Cumulative weightage**	**714.5**
Electronic Data Interchange (EDI)	3	2	11.5	23.0
	4	1	10.5	10.5
	5	5	9.5	47.5
	6	34	8.5	289.0
	7	51	7.5	382.5
	8	36	6.5	234.0
	9	4	5.5	22.0
	10	1	4.5	4.5
	Total	**134**	**Cumulative weight-age**	**1013.0**

Table 4.5 : Contd…

	Rank	Frequency (F)	Weightage (W)	F * W
Electronic Point of Sale (EPOS)	1	40	13.5	540.0
	2	47	12.5	587.5
	3	33	11.5	379.5
	4	12	10.5	126.0
	5	2	9.5	19.0
	Total	**134**	**Cumulative weightage**	**1652.0**
Portable Data Terminals (PDT) and Hand Held Computers	5	1	9.5	9.5
	7	2	7.5	15.0
	8	1	6.5	6.5
	9	3	5.5	16.5
	10	48	4.5	216.0
	11	45	4	180.0
	12	28	3	84.0
	13	4	2	8.0
	14	2	1	2.0
	Total	**134**	**Cumulative weightage**	**537.5**
Inventory Control Software	3	1	11.5	11.5
	4	25	10.5	262.5
	5	64	9.5	608.0
	6	43	8.5	365.5
	7	1	7.5	7.5
	Total	**134**	**Cumulative weightage**	**1255.0**
In-Store Digital Signage	9	14	5.5	77.0
	10	10	4.5	45.0
	11	17	4	68.0
	12	27	3	81.0
	13	30	2	60.0
	14	36	1	36.0
	Total	**134**	**Cumulative weightage**	**367.0**

Table 4.5 : Contd…

	Rank	Frequency (F)	Weightage (W)	F * W
Websites & Shopping Carts	5	1	9.5	9.5
	6	3	8.5	25.5
	7	43	7.5	322.5
	8	49	6.5	318.5
	9	31	5.5	170.5
	10	2	4.5	9.0
	12	1	3	3.0
	13	2	2	4.0
	14	2	1	2.0
	Total	**134**	**Cumulative weightage**	**864.5**
Customer Relationship Management (CRM) Software	8	35	6.5	227.5
	9	35	5.5	192.5
	10	38	4.5	171.0
	11	4	4	16.0
	12	14	3	42.0
	13	2	2	4.0
	14	6	1	6.0
	Total	**134**	**Cumulative weightage**	**659.0**
Retail Accounting Software	1	1	13.5	13.5
	3	32	11.5	368.0
	4	67	10.5	703.5
	5	28	9.5	266.0
	6	5	8.5	42.5
	7	1	7.5	7.5
	Total	**134**	**Cumulative weightage**	**1401.0**

Table 4.5 : Contd…

	Rank	Frequency (F)	Weightage (W)	F * W
RFID	4	6	10.5	63.0
	5	31	9.5	294.5
	6	40	8.5	340.0
	7	27	7.5	202.5
	8	8	6.5	52.0
	9	7	5.5	38.5
	10	5	4.5	22.5
	11	9	4	36.0
	14	1	1	1.0
	Total	**134**	**Cumulative weightage**	**1050.0**
Kiosk Technology	10	3	4.5	13.5
	11	17	4	68.0
	12	31	3	93.0
	13	58	2	116.0
	14	25	1	25.0
	Total	**134**	**Cumulative weightage**	**315.5**
Surveillance & Security	1	16	13.5	216.0
	2	49	12.5	612.5
	3	47	11.5	540.5
	4	21	10.5	220.5
	6	1	8.5	8.5
	Total	**134**	**Cumulative weightage**	**1598.0**
Store Traffic Counters	11	2	4	8.0
	12	32	3	96.0
	13	38	2	76.0
	14	62	1	62.0
	Total	**134**	**Cumulative weightage**	**242.0**

The cumulative weightage of each item are then tabulated and sorted based on their descending values. The items are then ranked based on their sorted order. Table 4.6 presents the final ranking of the current usage of technologies in retail store.

Table 4.6 : Ranking based on Cumulative weightage each item

Technology	Cumulative weightage	Rank
Bar Code Scanning and UPC Codes	1731	1
Electronic Point of Sale (EPOS)	1652	2
Surveillance & Security	1598	3
Retail Accounting Software	1401	4
Inventory Control Software	1255	5
RFID	1055	6
Electronic Data Interchange (EDI)	1013	7
Websites & Shopping Carts	865	8
Plan-o-gram	715	9
Customer Relationship Management (CRM) Software	659	10
Portable Data Terminals (PDT) and Hand Held Computers	538	11
In-Store Digital Signage	367	12
Kiosk Technology	316	13
Store Traffic Counters	242	14

The table above shows that the barcode scanning ranks first in the application, followed by electronic POS, Surveillance and security. Store Traffic Counter and Kiosk Technology have the least application. The use of RFID is found to rank at sixth position.

To study the factors influencing the technology innovation in retail industry, the awareness of the benefits and challenges in adopting technology are measured. The frequency distribution, the mean and standard deviation of the responses on awareness of the benefits of adopting technology specifically the RFID are presented in the Table 4.7

Table 4.7 : Case summary on Benefits of Technology adoption

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std. Deviation
Allows real time Asset Tracking	11 (8.2)	18 (13.4)	44 (32.8)	33 (24.6)	28 (20.9)	3.37	1.192
Provides Better Inventory Visibility	11 (8.2)	19 (14.2)	34 (25.4)	42 (31.3)	28 (20.9)	3.43	1.204
Provides Better Store Sales and Shelf Inventory	5 (3.7)	28 (20.9)	44 (32.8)	35 (26.1)	22 (16.4)	3.31	1.092
Provides Better Supply Chain Visibility	9 (6.7)	17 (12.7)	43 (32.1)	34 (25.4)	31 (23.1)	3.46	1.174
Helps in Compliance with regulators	16 (11.9)	26 (19.4)	47 (35.1)	31 (23.1)	14 (10.4)	3.01	1.154
Provides Real-time Business Intelligence	11 (8.2)	27 (20.1)	39 (29.1)	37 (27.6)	20 (14.9)	3.21	1.170
Reduces operational cost	12 (9.0)	32 (23.9)	39 (29.1)	31 (23.1)	20 (14.9)	3.11	1.193
Helps in reduction of inventory levels	8 (6.0)	18 (13.4)	35 (26.1)	50 (37.3)	23 (17.2)	3.46	1.108
Improves the labour efficiency	5 (3.7)	18 (13.4)	46 (34.3)	34 (25.4)	31 (23.1)	3.51	1.102

Table 4.7 : Contd…

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std. Deviation
Increases operational efficiency	5 (3.7)	21 (15.7)	40 (29.9)	30 (22.4)	38 (28.4)	3.56	1.167
The use of technology will Free up staffs for other operations	20 (14.9)	22 (16.4)	41 (30.6)	35 (26.1)	16 (11.9)	3.04	1.229
Lower the cost of goods	11 (8.2)	35 (26.1)	41 (30.6)	31 (23.1)	16 (11.9)	3.045	1.143
Supports implementation of better return program (Claims)	21 (15.7)	28 (20.9)	29 (21.6)	41 (30.6)	15 (11.2)	3.01	1.266
Reduces Out of stock situations	4 (3.0)	13 (9.7)	40 (29.9)	61 (45.5)	16 (11.9)	3.54	.931
Provides Quicker Check-out	7 (5.2)	13 (9.7)	24 (17.9)	47 (35.1)	43 (32.1)	3.79	1.151
Helps Protection against Counterfeiting	7 (5.2)	20 (14.9)	44 (32.8)	36 (26.9)	27 (20.1)	3.42	1.126
Prevent product tampering	25 (18.7)	26 (19.4)	27 (20.1)	34 (25.4)	22 (16.4)	3.02	1.365
Will reduce or Eliminate Theft	3 (2.2)	16 (11.9)	40 (29.9)	41 (30.6)	34 (25.4)	3.65	1.057
Will reduce data entry errors	8 (6.0)	12 (9.0)	33 (24.6)	38 (28.4)	43 (32.1)	3.72	1.180

* Values in the bracket are in percentage

The analysis of the data in the Table 4.7 shows that the mean of all the benefits of RFID are all above the mid value of 3 measured on a scale of 1 to 5. This shows that the Indian retail stores are aware of the benefits of adopting technologies in the retail store. The respondents view that the RFID technology can provide more benefits such as quicker checkout (Mean = 3.79), reduce data entry errors (Mean= 3.65) and will eliminate theft of the products (Mean = 3.65). However, the respondents feel that the RFID technology does not lower the cost of the goods (Mean=3.045), free up staffs for other operations (Mean=3.04), prevent product tampering (Mean=3.02), supports implementation of better return program (Mean= 3.01) and helps in Compliance with regulators (Mean=3.01). These benefits are perceived to be the lowest. The standard deviations of the responses are less than 1.4 indicating that there is not much of spread of the opinion. The awareness on challenges of RFID adoption of the respondents are measured and the frequency, mean and standard deviation are presented in the Table 4.8.

Table 4.8 : Case summary on Challenges of Technology adoption

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Mean**	**Std. Deviation**
There is a lack of visible benefits	21 (15.7)	36 (26.9)	41 (30.6)	26 (19.4)	10 (7.5)	2.76	1.158
Does not help in controlling the operating costs	11 (8.21)	15 (11.2)	39 (29.1)	36 (26.9)	33 (24.6)	3.49	1.115
There is a lack of understanding among the stakeholders	14 (10.4)	33 (24.6)	44 (32.8)	31 (23.1)	12 (9.0)	2.96	1.123
Will not be able to Quantify Key Performance Indicators	14 (10.4)	34 (25.4)	39 (29.1)	28 (20.9)	19 (14.2)	3.03	1.207
It is difficult to allocate adequate fund	15 (11.2)	39 (29.1)	34 (25.4)	25 (18.7)	21 (15.7)	2.99	1.251

Table 4.8 : Contd….

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std. Deviation
Cost of technology is high (Hardware & Software)	9 (6.7)	25 (18.7)	36 (26.9)	38 (28.4)	26 (19.4)	3.35	1.184
Increases of cost of product because of tagging	6 (4.5)	14 (10.4)	38 (28.4)	34 (25.4)	42 (31.3)	3.69	1.153
There is interference in the store that does not allow use of RFID (Electronic noise, Magnetic field, Temperature etc.)	17 (12.7)	32 (23.9)	32 (23.9)	38 (28.4)	15 (11.2)	3.015	1.220
There is a lack of proper standards	12 (9.0)	33 (24.6)	40 (29.9)	31 (23.1)	18 (13.4)	3.08	1.174
There is a lack of Integration with other process and software	7 (5.22)	17 (12.7)	40 (29.9)	38 (28.4)	32 (23.9)	3.53	1.151
It is not suitable for type of products sold	10 (7.46)	21 (15.7)	40 (29.9)	34 (25.4)	29 (21.6)	3.38	1.237
There is a lack of Customer acceptance (Privacy problems)	16 (11.9)	31 (23.1)	43 (32.1)	32 (23.9)	12 (9.0)	2.95	1.146
Suppliers do not have the capacity to adopt technology	13 (9.7)	31 23.1)	23 (17.2)	41 (30.6)	26 (19.4)	3.27	1.281
Availability of trained staff in using technology	15 (11.2)	38 (28.4)	33 (24.6)	33 (24.6)	15 (11.2)	2.96	1.198

* Values in the bracket are in percentage

The analysis of the mean value shows that the respondents perceived certain challenges to be high and some as low. This is evident from the mean values being below the mid value of 3 on a scale of 1 to 5. The challenges such as Increases of cost of product because of tagging (Mean = 3.69), lack of Integration with other process and software (Mean = 3.53), does not help in controlling the operating costs (Mean = 3.49), being not suitable for type of products sold (Mean = 3.38) are seen as the major challenges. However, the respondents does not feel the challenges from lack of visible benefits (Mean = 2.76), lack of Customer acceptance (Mean = 2.95), lack of understanding among the stakeholders (Mean = 2.96), availability of trained staff (Mean = 2.96) and difficulty to allocate adequate fund (Mean = 2.99). In addition, the standard deviations are less than 1.3 indicating a consistent opinion among the respondents. To analyse the depth of usage of the RFID in the various areas of retail operations, respondents were asked to indicate the percentage of use of RFID in product receipt and processing, pallet level store check-in, store checkout, item level replenishment and home applications. The results are presented in the Table 4.8.

Table 4.9 : Usage of RFID in Retail Operations

	Percentage of usage				
	< 10	**10 to 19**	**20 to 29**	**30 to 39**	**40 to 49**
Product receipt and Processing	35 (26.1)	55 (41.0)	39 (29.1)	5 (3.7)	0
Check-in and store replenishment (Pallet level)	33 (24.6)	57 (42.5)	43 (32.1)	1 (.7)	0
In-Store customer marketing (Information & Check-out)	0	59 (44.0)	52 (38.8)	21 (15.7)	2 (1.5)
In-Store initiated replenishment & Order filling (Case level & Item Level)	65 (48.5)	65 (48.5)	4 (3.0)	0	0
Embedding RFID for Customer utility in home base application	130 (97.0)	4 (3.0)	0	0	0

* Values in the bracket are in percentage

The results show that 3.7% of the respondents have a usage of RFID in 30 to 39% of product receipt and processing. However, majority (41%) of respondents have RFID use in 10 to 19% of their product receipt and processing operation. Pallet level check in of store replenishment is only to a maximum range of 30 to 39% with only one respondent use to that extend. However, majority (42.5%) of respondents have RFID use in the range of 10 to 19% for pallet level replenishment. In store checkout, RFID is used to a maximum extend of 40 to 49% by at least 2 respondents. There is at least 10 to 19% use of RFID in checkout applications of 44% respondent stores. Item level in-store replenishment of the product is used to a maximum extend of 20 to 29% in at least 4 stores. However, equal number of respondents (48.5%) use in the range of up to 10% and from 10 to 19%. The application of RFID in home appliances is found to be very less. The majority of the stores (97%) have an application of less than 10% of embedding RFID in home applications.

4.3 Validity and reliability tests

To validate the instrument and its constructs, the principal component analysis using varimax rotation was done on multiple item constructs. First, the benefit variables were analysed. The un rotated principal component extraction is presented in the Table 4.9 and the varimax rotated matrix is presented in Table 4.10. The Kaiser-Meyer-Olkin value was found to be 0.966 indicating the Sampling Adequacy. The Bartlett's Test of Sphericity is also found to significant at 0.000, this indicates that the factors are adequately explained by items. This can be interpreted that the convergent validity (Items reflecting the construct and does not cross load) and discriminant validity (The extracted constructs are different from other constructs) of the instrument is found to be good.

Table 4.10 : Principal Component Analysis for Benefit Variables

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.966
Bartlett's Test of Sphericity	Approx. Chi-Square	3605.879
	df	171
	Sig.	.000

Component Matrix[a]

	Communa-lities	**Component**			
	Extraction	**1**	**2**	**3**	**4**
Provides Better Supply Chain Visibility	.887	.931	-.084	.027	-.117
Allows real time Asset Tracking	.888	.929	-.061	.016	-.142
Helps Protection against Counterfeiting	.832	.926	.092	.066	-.024
Increases operational efficiency	.888	.924	-.038	.038	.173
Provides Better Inventory Visibility	.765	.923	-.083	-.007	-.174
Helps in reduction of inventory levels	.855	.922	-.032	-.062	.188
Improves the labour efficiency	.764	.920	-.062	-.072	.188
Will reduce or Eliminate Theft	.890	.897	.083	-.365	-.088
Prevent product tampering	.891	.896	.125	.057	-.094
Provides Real-time Business Intelligence	.887	.886	-.141	.165	.150
Supports implementation of better return program (Claims)	.779	.885	-.100	.121	.000
Provides Better Store Sales and Shelf Inventory	.855	.880	-.204	.034	-.125
Provides Quicker Check-out	.809	.860	.378	.160	.024
Will reduce data entry errors	.911	.859	.124	-.432	-.125
The use of technology will Free up staffs for other operations	.909	.858	-.140	.150	-.012
Reduces operational cost	.870	.837	.015	.065	-.244
Helps in Compliance with regulators	.830	.836	-.254	.044	-.023
Reduces Out of stock situations	.953	.824	.447	.169	.054
Lower the cost of goods	.956	.809	-.032	-.173	.412
Eigenvalues		7.563	2.356	1.926	1.369
% of Variance		39.81	12.40	10.13	7.205
Cumulative %		39.81	52.21	62.34	69.55

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

The 19-items indicating the benefits of RFID were extracted. The components with eigen value above one are considered. There were four components with eigen value above one. The factors were further rotated by varimax technique to clearly identify the factors (Table 4.10). Four items loaded on the first component and accounted for 22.42% of the variability in all the 19 items. . Five items loaded on the second component and accounted for 19.4% of the variability in all the 19. Four components loaded on the third component and accounted for 17.04% of the variability in all the 19 items. The other six items loaded to the fourth component and accounted for 10.7% of the variability in all the 19 items. Together all the four factors accounted for 69.555 of variability if the items. To identify the factors, the items of each component are analysed. The factors need to be labelled. The first component had 'Better Store Sales and Shelf Inventory', 'Helps in Compliance with regulators', 'Provides Real-time Business Intelligence' and 'lower the cost of goods'. The close analyses of the items show that they are about the cost, sales and business intelligence. Therefore, the construct can be labelled as strategic benefits. The items loading on the second component are analysed. The construct is reflected by Inventory Visibility, stock situations, inventory levels, Supply Chain Visibility and Asset Tracking. Therefore, the factor is labelled as Inventory and Supply chain benefits. The third component is reflected by return program, counterfeiting, product tampering and theft. This factor can be named as control benefits. The fourth component is reflected by staffs for operations, operational cost, Check-out, operational and labour efficiency, and data entry errors. Therefore, the factor is labelled as operational benefits.

Table 4.11 : Rotated Component Matrix for Benefit Variables

	Component			
	1	**2**	**3**	**4**
Provides Better Store Sales and Shelf Inventory	**.731**	.265	.326	.348
Helps in Compliance with regulators	**.696**	.209	.401	.277
Provides Real-time Business Intelligence	**.695**	.363	.287	.437
Lower the cost of goods	**.691**	.380	.334	.394
Provides Better Inventory Visibility	.392	**.682**	.309	.415
Reduces Out of stock situations	.352	**.680**	.381	.216
Helps in reduction of inventory levels	.385	**.659**	.401	.254
Provides Better Supply Chain Visibility	.372	**.640**	.530	.160
Allows real time Asset Tracking	.428	**.640**	.157	.384
Supports implementation of better return program (Claims)	.305	.286	**.753**	.336
Helps Protection against Counterfeiting	.516	.354	**.602**	.371
Prevent product tampering	.504	.383	**.595**	.369
Will reduce or Eliminate Theft	.551	.419	**.568**	.291
The use of technology will Free up staffs for other operations	.310	.306	.267	**.806**
Reduces operational cost	.381	.311	.287	**.765**
Provides Quicker Check-out	.365	.324	.330	**.780**
Increases operational efficiency	.422	.337	.375	**.722**
Improves the labour efficiency	.532	.371	.359	**.566**
Will reduce data entry errors	.540	.292	.383	**.553**
Eigenvalues	4.259	3.685	3.238	2.032
% of Variance	22.42	19.40	17.04	10.70
Cumulative %	22.42	41.81	58.85	69.55
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				
a. Rotation converged in 8 iterations.				

The principal component analysis using varimax rotation was done on multiple item constructs of the challenges variable. The unrotated principal component extraction is presented in the Table 4.11 and the varimax rotated matrix is presented in Table 4.12. The Kaiser-Meyer-Olkin value was found to be 0.959 indicating the Sampling Adequacy. The Bartlett's Test of Sphericity is also found to significant at 0.000, this indicates that the factors are adequately explained by items. This can be interpreted that the convergent validity (Items reflecting the construct and does not cross load) and discriminant validity (The extracted constructs are different from other constructs) of the instrument is found to be good.

Table 4.12: Principal Component Analysis for Challenges Variables

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.959
Bartlett's Test of Sphericity	Approx. Chi-Square	1919.184
	df	91
	Sig.	.000

Component Matrix[a]				
	Communa-lities	**Component**		
	Extraction	**1**	**2**	**3**
It is difficult to allocate adequate fund	.848	.900	-.065	-.271
Increases of cost of product because of tagging	.784	.893	-.043	-.314
Cost of technology is high (Hardware & Software)	.709	.892	-.170	-.253
There is a lack of visible benefits	.764	.890	-.046	-.233
Does not help in controlling the operating costs	.887	.864	-.192	.008
There is a lack of Customer acceptance (Privacy problems)	.889	.862	.009	.088
There is a lack of proper standards	.897	.860	.073	.158
There is a lack of Integration with other process and software	.790	.859	.041	.111

Table 4.12: Contd…

	Communa-lities	Component		
	Extraction	1	2	3
Availability of trained staff in using technology	.771	.855	.022	.124
Suppliers do not have the capacity to adopt technology	.752	.852	.206	.116
There is interference in the store that does not allow use of RFID (Electronic noise, Magnetic field, Temperature etc.)	.943	.832	.053	.307
Will not be able to Quantify Key Performance Indicators	.751	.814	-.155	.277
There is a lack of understanding among the stakeholders	.781	.808	-.235	.024
It is not suitable for type of products sold	.747	.533	.803	-.117
Eigenvalues		7.912	1.851	1.349
% of Variance		56.514	13.221	9.636
Cumulative %		56.51	69.74	79.37
Extraction Method: Principal Component Analysis.				
a. 3 components extracted.				

The 14-items indicating the challenges of RFID were extracted. The components with eigen value above one are considered. There were three components with eigen value above one. The factors were further rotated by varimax technique to clearly identify the factors (Table 4.12). Five items loaded on the first component and accounted for 35.128% of the variability in all the 14 items. Four items loaded on the second component and accounted for 32.893% of the variability in all the 14 items. Another five components loaded on the third component and accounted for 11.35% of the variability in all the 14 items. Together all the three factors accounted for 79.37% of the variability.

To identify the factors, the items of each component are analysed. The first component was reflected by Interference, suitable for type of products, standards, trained staff and integration with other process and software. The items indicate the technical aspects of the RFID technology. Therefore, the component is labelled as technical challenges. The second component is reflected by items such as cost of product because of tagging, cost of technology, allocate adequate fund and controlling the operating costs. The items are identified to be related with cost and finance. Therefore, the component is labelled as financial challenges. The third component is reflected by Quantify Key Performance Indicators, visible benefits, customer acceptance and supplier capacity. Since the items indicate the stakeholders, benefits and performance the component can be labelled as strategic challenges.

Table 4.13 : Rotated Component Matrix for Challenges Variables

Rotated Component Matrix[a]			
	Component		
	1	2	3
There is interference in the store that does not allow use of RFID (Electronic noise, Magnetic field, Temperature etc.)	**.784**	.328	.260
It is not suitable for type of products sold	**.773**	.403	.062
There is a lack of proper standards	**.694**	.441	.308
Availability of trained staff in using technology	**.671**	.476	.263
There is a lack of Integration with other process and software	**.662**	.482	.285
Increases of cost of product because of tagging	.388	**.818**	.278
Cost of technology is high (Hardware & Software)	.445	**.808**	.149
It is difficult to allocate adequate fund	.426	**.701**	.253
Does not help in controlling the operating costs	.617	**.630**	.082
Will not be able to Quantify Key Performance Indicators	.192	.176	**.836**
There is a lack of visible benefits	.444	.262	**.763**
There is a lack of Customer acceptance (Privacy problems)	.259	.510	**.651**

Table 4.13 : Contd…

Suppliers do not have the capacity to adopt technology	.437	.421	**.642**
There is a lack of understanding among the stakeholders	.022	.395	**.595**
Eigenvalues	4.918	4.605	1.589
% of Variance	35.128	32.893	11.35
Cumulative %	35.13	68.02	79.37
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 5 iterations.			

The reliability of the instrument and the multi item constructs were analysed by calculating the cronbach alpha. The values are presented in the Table 4.14.

Table 4.14 : Reliability Statistics

Constructs	No of Items	Cronbach's Alpha
Opinion	9	.928
Inventory and Supply chain Benefits	5	.927
Strategic Benefits	4	.910
Operational Benefits	6	.925
Control Benefits	4	.920
Benefit (Overall)	19	.914
Cost Challenges	4	.925
Strategic Challenges	5	.918
Technical Challenges	5	.890
Challenge (Overall)	14	.937

The cronbach alpha values of all the constructs are above minimum acceptable value of 0.7. Except for technical challenges, all the other constructs had an alpha value above 0.9 showing a very high internal consistency. However, the cronbach alpha value of technical challenges (0.89) is close to 0.9, which can be understood to have a good internal consistency. Therefore, the instrument is considered reliable.

4.4 Inferential Statistics

4.4.1 Regression analysis to find the influence of perceived RFID benefits and challenges on Attitude on Technology

To study the factors influencing technology innovation in retail industry, a regression analysis is done. To test the influence of perceived RFID benefits and challenges on Attitude on Technology, the following null hypotheses are framed.

Ho1 : Perceived RFID benefits and Perceived RFID challenges will not influence the Attitude on Technology.

Ha1 : Perceived RFID benefits and Perceived RFID challenges will influence the Attitude on Technology.

A multivariate linear regression with Attitude on technology as dependent variable and perceived RFID benefits and Perceived RFID challenges are entered as the predictors. The regression model is found to be significant with $F = 47.658$ and $P < 0.000$. The R Square value is found to be 0.421. This indicates that the perceived RFID benefits and challenges have an influence on attitude on technology to an extent of 42% where the rest of 58% variability will be caused by unknown variables or variables not taken for the study. Analysing the regression coefficients, RFID benefits have a positive and significant influence on the attitude ($B= 0.236$, $P < 0.000$). This can be interpreted that when on unit of benefit is perceived, there will be an increase of 0.236 units of positive attitude on technology. The regression coefficient of perceived RFID challenges is found to be $B= - 418$, $p=0.028$. This means that perceived RFID challenges will have negative and significant influence on the attitude on technology. The effect can inferred that when the perceived RFID challenges increases by one unit, the attitude on technology becomes negative by 0.418 units. Comparing the effect of perceived benefits and challenges, the challenges have more influence in changing the attitude. From the results, the null hypothesis that the perceived RFID benefits and Perceived RFID challenges will not influence the Attitude on Technology is rejected. The alternate hypothesis that the perceived RFID benefits and Perceived RFID challenges will influence the Attitude on Technology is thus accepted.

Table 4.15 : Regression on Technology Attitude

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.649[a]	.421	.412	.76659794

a. Predictors: (Constant), RFID Challenges, RFID Benefits
b. Dependent Variable: Technology Attitude

ANOVA[b]

	Sum of Squares	df	Mean Square	F	Sig.
Regression	56.015	2	28.007	47.658	.000[a]
Residual	76.985	131	.588		
Total	133.000	133			

Coefficients[a]

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-3.853E-16	.066		.000	1.000
RFID Benefits	.236	.253	.236	3.769	.000
RFID Challenges	-.418	.253	-.418	-2.224	.028

4.4.2 Regression analysis for predicating influence of attitude on technology on the RFID usage

To study how the factors influencing technology innovation in retail industry will then influence the usage of the technology such as RFID, another regression analysis is done. To test the influence of attitude on technology on the RFID usage, the following null hypotheses are framed.

Ho2: Attitude on technology will not influence the usage of RFID.

Ha2 : Attitude on technology will influence the usage of RFID.

A bivariate linear regression with Attitude on technology as predictor and Usgae of RFID as the dependent variable is done. The regression model is found to be significant with F =73.631 and P < 0.000. The R Square value is found to be 0.358. This indicates that the attitude on technology will have an influence on the RFID usage to an extent of 35.8 %. The rest of 64.2% of the variability will be caused by unknown variables or variables not taken for the study. Analysing the regression coefficients, attitude on technology have a positive and significant influence on the RFID Usage (B= 0.598, P < 0.000). This can be interpreted that when one unit of Attitude on technology becomes positive, there will be an increase of 0598 units of usage of RFID. From the results, the null hypothesis that the Attitude on technology will not influence the usage of RFID is rejected. The alternate hypothesis that the Attitude on technology will influence the usage of RFID is thus accepted.

Table 4.16 : Regression for RFID Usage

Model Summary			
R	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
.598[a]	.358	.353	.80423166

a. Predictors: (Constant), Technology Attitude
b. Dependent Variable: RFID USAGE

ANOVA[b]					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Regression	47.624	1	47.624	73.631	.000[a]
Residual	85.376	132	.647		
Total	133.000	133			

Coefficients[a]					
	Unstandardized Coefficients		**Standardized Coefficients**	**t**	**Sig.**
	B	**Std. Error**	**Beta**		
(Constant)	1.453E-16	.069		.000	1.000
Technology Attitude	.598	.070	.598	8.581	.000

4.4.3 ANOVA on opinion on retail sector among the independent and chain stores.

The opinion on the retail sector can be different among the retailers. To test the difference ANOVA is performed on groups of retail ownership, product area and store formats

The following null hypothesis is framed.

Ho3: Opinion on retail sector does not vary with the ownership type.

. Table 4.16 presents the results of ANOVA on opinion on retail sector among the independent and chain stores.

The independent and chain stores significantly differ on opinion that use of technology in par with foreign retailers (F = 8.389, P= 0.004), Entry of foreign retailers will not be a competition (F = 5.645, P= 0.019) and that they have capacity to sustain even in competition (F = 7.351, P= 0.007). Independent and chain store do not differ in their opinion on other factors.

From the results, the null hypothesis is rejected and it is concluded that the opinion on retail sector varies with the ownership type.

Table 4.17 : Opinion on retail sector among Independent and chain stores

ANOVA						
BY Type		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Important contributor to Indian Economy	Between Groups	.168	1	.168	.113	.737
	Within Groups	196.764	132	1.491		
	Total	196.933	133			
Has a high potential for growth	Between Groups	.042	1	.042	.024	.878
	Within Groups	231.839	132	1.756		
	Total	231.881	133			
Use of technology in par with foreign retailers	Between Groups	10.325	1	10.325	8.389	.004
	Within Groups	162.459	132	1.23075		
	Total	172.784	133			

Table 4.17 : Contd…

BY Type		Sum of Squares	df	Mean Square	F	Sig.
Entry of foreign retailers will not be a competition	Between Groups	8.526	1	8.526	5.645	.019
	Within Groups	199.355	132	1.510265		
	Total	207.881	133			
Government should protect Indian retail sector	Between Groups	1.367	1	1.367	.973	.326
	Within Groups	185.477	132	1.405		
	Total	186.843	133			
Foreign retailers can bring better technology and supply chain	Between Groups	.928	1	.928	.657	.419
	Within Groups	186.326	132	1.412		
	Total	187.254	133			
Suppliers and farmers will be better benefitted by foreign retailers	Between Groups	.289	1	.289	.205	.652
	Within Groups	186.107	132	1.410		
	Total	186.396	133			
Have capacity to sustain even in competition	Between Groups	9.395	1	9.395	7.351	.007
	Within Groups	168.702	132	1.278045		
	Total	178.097	133			
Retail scape is changing fast	Between Groups	.042	1	.042	.030	.862
	Within Groups	181.839	132	1.378		
	Total	181.881	133			

4.4.4 ANOVA on opinion on the retail sector among the stores dealing with different product area

The difference on opinion on the retail sector among the stores dealing with different product area is tested using ANOVA.

The following null hypothesis is framed for the study.

Ho4: Opinion on retail sector does not vary among the stores in different product area.

The results of ANOVA test are presented in the table 4.17. The table reveals that the stores grouped on product area significantly differ in their opinion that Use of technology in Indian retailing is par with foreign retailers (F= 2.575, P= 0.022), that government should protect Indian retail sector (F= 2.274, P= 0.041) and Foreign retailers can bring better technology and supply chain (F= 4.810, P= 0.000). However, they do not differ on the other factors. From the results, the null hypothesis can be rejected and it can be concluded that opinion on retail sector will vary among the stores in different product area.

Table 4.18 : Opinion on retail sector among retails stores of different product area

ANOVA						
BY Area		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Retail sector is an important contributor to Indian Economy	Between Groups	10.149	6	1.692	1.150	.337
	Within Groups	186.783	127	1.471		
	Total	196.933	133			
Indian retail sectors has a high potential for growth	Between Groups	12.663	6	2.110	1.223	.299
	Within Groups	219.218	127	1.726		
	Total	231.881	133			
Use of technology in Indian retailing is par with foreign retailers	Between Groups	19.256	6	3.209	2.575	0.022
	Within Groups	158.266	127	1.246		
	Total	177.522	133			
Entry of foreign retailers will not be a competition to Indian Retailers	Between Groups	9.399	6	1.566	1.002	0.427
	Within Groups	198.482	127	1.563		
	Total	207.881	133			
Government should protect Indian retail sector	Between Groups	18.123	6	3.021	2.274	0.041
	Within Groups	168.720	127	1.329		
	Total	186.843	133			
Foreign retailers can bring better technology and supply chain	Between Groups	34.673	6	5.779	4.810	0.000
	Within Groups	152.581	127	1.201		
	Total	187.254	133			
Suppliers and farmers will be better benefitted by foreign retailers	Between Groups	11.532	6	1.922	1.396	0.221
	Within Groups	174.863	127	1.377		
	Total	186.396	133			
Indian retails have capacity to sustain even in competition	Between Groups	8.075	6	1.346	1.005	0.425
	Within Groups	170.022	127	1.339		
	Total	178.097	133			
Indian retail scape is changing fast	Between Groups	5.224	6	0.871	0.626	0.709
	Within Groups	176.656	127	1.391		
	Total	181.881	133			

4.4.5 ANOVA on opinion on the retail sector among the different store formats.

The difference on opinion on the retail sector among the stores of different formats is tested using ANOVA.

The following null hypothesis is framed for the study.

Ho5: Opinion on retail sector does not vary among the different store formats.

The results of ANOVA test are presented in the table 4.18. The table reveals that the stores grouped on store format significantly differ in their opinion that entry of foreign retailers will not be a competition to Indian Retailers (F = 2.706, P= 0.017), that government should protect Indian retail sector (F = 2.241, P= 0.043), that foreign retailers can bring better technology and supply chain (F = 2.483, P= 0.026), that suppliers and farmers will be better benefitted by foreign retailers (F = 4.857, P= 0.000), and that they have capacity to sustain even in competition (F = 3.577, P= 0.003). However, they do not differ on the other factors. From the results, the null hypothesis can be rejected and it can be concluded that opinion on retail sector will vary among different store formats.

Table 4.19 : Opinion on retail sector among various store formats

ANOVA						
BY Format		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Retail sector is an important contributor to Indian Economy	Between Groups	6.559	6	1.093	.729	.627
	Within Groups	190.374	127	1.499		
	Total	**196.933**	**133**			

Table 4.19 :Contd…

BY Format		Sum of Squares	df	Mean Square	F	Sig.
Indian retail sectors has a high potential for growth	Between Groups	7.106	6	1.184	.669	.675
	Within Groups	224.775	127	1.770		
	Total	231.881	133			
Use of technology in Indian retailing is par with foreign retailers	Between Groups	9.234	6	1.539	1.161	.331
	Within Groups	168.288	127	1.325		
	Total	177.522	133			
Entry of foreign retailers will not be a competition to Indian Retailers	Between Groups	23.567	6	3.928	2.706	0.017
	Within Groups	184.314	127	1.451		
	Total	207.881	133			
Government should protect Indian retail sector	Between Groups	17.890	6	2.982	2.241	0.043
	Within Groups	168.953	127	1.330		
	Total	**186.843**	**133**			
Foreign retailers can bring better technology and supply chain	Between Groups	19.657	6	3.276	2.483	0.026
	Within Groups	167.597	127	1.320		
	Total	187.254	133			
Suppliers and farmers will be better benefitted by foreign retailers	Between Groups	34.789	6	5.798	4.857	0.000
	Within Groups	151.607	127	1.194		
	Total	186.396	133			
Indian retails have capacity to sustain even in competition	Between Groups	25.747	6	4.291	3.577	0.003
	Within Groups	152.35	127	1.200		
	Total	178.097	133			
Indian retail scape is changing fast	Between Groups	9.027	6	1.505	1.105	.363
	Within Groups	172.853	127	1.361		
	Total	181.881	133			

4.4.6 ANOVA on importance of technology among the different store formats.

To investigate the difference on importance of technology among the various store formats, ANOVA is tested. The following null hypothesis is framed for the study.

Ho6: Importance of technology among the different store formats does not vary.

The results are presented in the table 4.19. The table reveal that the importance of Customer Relationship Management (CRM) Software (F=3.560, P=0.003), Electronic Data Interchange (EDI) (F=2.624, P=0.020), Kiosk Technology(F=2.868, P=0.012), Plan-o-gram (F=2.282, P=0.04), Portable Data Terminals (PDT) and Hand Held Computers (F=2.800, P=0.014), RFID (F=2.398, P=.0315), Store Traffic Counters (F=2.423, P=0.030) and Websites & Shopping Carts (F=3.018, P=0.009) differ among the different store formats.

However, the importance of Bar Code Scanning and UPC Codes (P= 0.736), Electronic Point of Sale (EPOS) (P=0.651), In-Store Digital Signage (P=0.413), Inventory Control Software (P=0.264), Retail Accounting Software (P=0.225) and Surveillance & Security (P=0.501) are all similar among the different store formats. From the results, the null hypothesis can be rejected and it can be concluded that the importance of technology among the different store formats does vary.

Table 4.20 : Importance of Technology among various store formats

ANOVA						
BY Format		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Bar Code Scanning and UPC Codes	Between Groups	3.659	6	0.61	0.592	0.736
	Within Groups	130.796	127	1.03		
	Total	134.455	133			
Customer Relationship Management (CRM) Software	Between Groups	24.673	6	4.112	3.560	0.003
	Within Groups	146.7	127	1.155		
	Total	**171.373**	**133**			
Electronic Data Interchange (EDI)	Between Groups	20.391	6	3.3985	2.624	0.020
	Within Groups	164.482	127	1.29513 39		
	Total	184.873	133			
Electronic Point of Sale (EPOS)	Between Groups	5.893	6	0.982	0.699	0.651
	Within Groups	178.435	127	1.405		
	Total	**184.328**	**133**			
In-Store Digital Signage	Between Groups	9.029	6	1.505	1.023	0.413
	Within Groups	186.829	127	1.471		
	Total	**195.858**	**133**			
Inventory Control Software	Between Groups	9.614	6	1.602	1.296	0.264
	Within Groups	156.983	127	1.236		
	Total	166.597	133			
Kiosk Technology	Between Groups	19.789	6	3.298	2.868	0.012
	Within Groups	146.039	127	1.150		
	Total	**165.828**	**133**			
Plan-o-gram	Between Groups	16.532	6	2.755	2.282	0.04
	Within Groups	153.356	127	1.208		
	Total	**169.888**	**133**			

Table 4.20 : Contd…

BY Format		Sum of Squares	df	Mean Square	F	Sig.
Portable Data Terminals (PDT) and Hand Held Computers	Between Groups	21.977	6	3.663	2.800	0.014
	Within Groups	166.113	127	1.308		
	Total	**188.09**	**133**			
Retail Accounting Software	Between Groups	10.614	6	1.769	1.385	0.225
	Within Groups	162.169	127	1.277		
	Total	**172.784**	**133**			
RFID	Between Groups	17.865	6	2.978	2.398	0.0315
	Within Groups	157.687	127	1.242		
	Total	**175.552**	**133**			
Store Traffic Counters	Between Groups	20.32	6	3.387	2.423	0.030
	Within Groups	177.508	127	1.398		
	Total	**197.828**	**133**			
Surveillance & Security	Between Groups	7.075	6	1.179	0.895	0.501
	Within Groups	167.38	127	1.318		
	Total	**174.455**	**133**			
Websites & Shopping Carts	Between Groups	23.173	6	3.862	3.018	0.009
	Within Groups	162.528	127	1.280		
	Total	**185.701**	**133**			

4.4.7 ANOVA on importance of technology among the stores of different product area.

To investigate the difference on importance of technology among the stores of different product area, ANOVA is tested. . The following null hypothesis is framed for the study.

Ho7: Importance of technology among the stores of different product area does not vary.

The results are presented in the table 4.20. The table reveal that the importance of Customer Relationship Management (CRM) Software (F=3.560, P=0.003), Electronic Data Interchange (EDI) (F=2.520, P=0.024), Kiosk Technology (F=3.720, P=0.002), Plan-o-gram (F=4.473, P=0.000), Portable Data Terminals (PDT) and Hand Held Computers (F=2.504, P=0.025), Retail Accounting Software (F=2.703, P=0.017) and RFID (F=3.290, P=0.005) differ among the stores of different product area.

However, the importance of Bar Code Scanning and UPC Codes (P=0.433), Customer Relationship Management (CRM) Software (P=0.548), Electronic Point of Sale (EPOS) (P=0.500), In-Store Digital Signage (P=0.523), Inventory Control Software (P=0.294), Store Traffic Counters (P=0.848), Surveillance & Security (P=0.509) and Websites & Shopping Carts (P=0.535) are all similar among the stores of different product area. From the results, the null hypothesis can be rejected and it can be concluded that the importance of technology among the stores of different product area does vary.

Table 4.21 : Use of Technology among retails stores of different product area

ANOVA						
BY Area		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Bar Code Scanning and UPC Codes	Between Groups	6.028	6	1.005	0.993	0.433
	Within Groups	128.428	127	1.011		
	Total	134.455	133			
Customer Relationship Management (CRM) Software	Between Groups	6.479	6	1.080	0.832	0.548
	Within Groups	164.894	127	1.298		
	Total	171.373	133			

Table 4.21 :Contd…

BY Area		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Electronic Data Interchange (EDI)	Between Groups	19.670	6	3.278	2.520	0.024
	Within Groups	165.203	127	1.301		
	Total	184.873	133			
Electronic Point of Sale (EPOS)	Between Groups	7.481	6	1.247	0.895	0.500
	Within Groups	176.847	127	1.392		
	Total	184.328	133			
In-Store Digital Signage	Between Groups	7.687	6	1.281	0.865	0.523
	Within Groups	188.171	127	1.482		
	Total	195.858	133			
Inventory Control Software	Between Groups	9.169	6	1.528	1.233	0.294
	Within Groups	157.428	127	1.240		
	Total	166.597	133			
Kiosk Technology	Between Groups	24.785	6	4.131	3.720	0.002
	Within Groups	141.043	127	1.111		
	Total	165.828	133			
Plan-o-gram	Between Groups	29.636	6	4.939	4.473	0.000
	Within Groups	140.252	127	1.104		
	Total	169.888	133			
Portable Data Terminals (PDT) and Hand Held Computers	Between Groups	19.900	6	3.317	2.504	0.025
	Within Groups	168.190	127	1.324		
	Total	188.090	133			

Table 4.21 : Contd…

BY Area		Sum of Squares	df	Mean Square	F	Sig.
Retail Accounting Software	Between Groups	19.567	6	3.261	2.703	0.017
	Within Groups	153.217	127	1.206		
	Total	172.784	133			
RFID	Between Groups	23.617	6	3.936	3.290	0.005
	Within Groups	151.935	127	1.196		
	Total	175.552	133			
Store Traffic Counters	Between Groups	4.066	6	0.678	0.444	0.848
	Within Groups	193.763	127	1.526		
	Total	197.828	133			
Surveillance & Security	Between Groups	6.992	6	1.165	0.884	0.509
	Within Groups	167.464	127	1.319		
	Total	174.455	133			
Websites & Shopping Carts	Between Groups	7.155	6	1.193	0.848	0.535
	Within Groups	178.546	127	1.406		
	Total	185.701	133			

4.4.8 ANOVA on use of RFID among the stores of different product area.

ANOVA is tested to investigate the difference in use of RFID among the stores of different product area. The following null hypothesis is framed for the study.

Ho8: There is no difference in use of RFID among the stores of different product area.

The results are presented in the table 4.21. The table reveal that the Use of RFID in product receipt and processing, Pallet level store check in, In-Store Check-out, Item level replenishment are different among the different store formats. However, the activity of embedding RFID for Customer utility in home base application (P=0.541), is similar among the stores of different product area. From the results, the null hypothesis can be rejected and it can be concluded that the there is difference in use of RFID among the stores of different product area.

Table 4.22 : Use of RFID among retails stores of different product area

ANOVA						
BY Area		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Product receipt and Processing	Between Groups	979.854	6	163.309	2.572	0.022
	Within Groups	8062.959	127	63.488		
	Total	**9042.813**	**133**			
Check-in and store replenishment (Pallet level)	Between Groups	1098.890	6	183.148	4.393	0.000
	Within Groups	5294.192	127	41.687		
	Total	**6393.082**	**133**			
In-Store customer marketing (Information & Check-out)	Between Groups	989.123	6	164.854	2.437	0.029
	Within Groups	8592.467	127	67.657		
	Total	**9581.590**	**133**			

Table 4.22 : Contd..

BY Area		Sum of Squares	df	Mean Square	F	Sig.
In-Store initiated replenishment & Order filling (Case level & Item Level)	Between Groups	1287.670	6	214.612	11.721	0.000
	Within Groups	2325.382	127	18.310		
	Total	**3613.052**	**133**			
Embedding RFID for Customer utility in home base application	Between Groups	27.581	6	4.597	.840	.541
	Within Groups	695.173	127	5.474		
	Total	**722.754**	**133**			

4.4.9 ANOVA on use of RFID among the different store format.

ANOVA is tested to investigate the difference in use of RFID among various store formats. The following null hypothesis is framed for the study.

Ho9: There is no difference in use of RFID among the stores of different formats.

The results are presented in the table 4.22. The table reveal that the Use of RFID in product receipt and processing, Pallet level store check in, In-Store Check-out, Item level replenishment are different among the different store formats. However, the activity of embedding RFID for Customer utility in home base application (P=0.452), is similar among the different store formats. From the results, the null hypothesis can be rejected and it can be concluded that the there is difference in use of RFID among the stores of different formats.

Table 4.23 : Use of RFID among various store formats

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Product receipt and Processing	Between Groups	1380.506	6	230.084	3.814	0.002
	Within Groups	7662.307	127	60.333		
	Total	**9042.813**	**133**			
Check-in and store replenishment (Pallet level)	Between Groups	1136.282	6	189.380	4.575	0.000
	Within Groups	5256.800	127	41.392		
	Total	**6393.082**	**133**			
In-Store customer marketing (Information & Check-out)	Between Groups	1600.170	6	266.695	4.244	0.001
	Within Groups	7981.420	127	62.846		
	Total	**9581.590**	**133**			
In-Store initiated replenishment & Order filling (Case level & Item Level)	Between Groups	421.090	6	70.182	2.792	0.014
	Within Groups	3191.962	127	25.134		
	Total	**3613.052**	**133**			
Embedding RFID for Customer utility in home base application	Between Groups	31.482	6	5.247	.964	.452
	Within Groups	691.272	127	5.443		
	Total	**722.754**	**133**			

4.5 CONCLUSION

This chapter presented the results of the data analysis of the responses collected from the retail store on their awareness of the benefits and challenges of the adoption of RFID. The extent of usage of RFID and other technologies are also measured. The descriptive statistics first presented the frequency distribution and the central tendency of the measures. The validity of the information collected is done by reliability test and factor analysis. The inferential statistics tested the hypotheses by regression and ANOVA tests.