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**RFID TECHNOLOGY: PREDICTING CONSUMER BEHAVIOUR  
AND CUSTOMER SATISFATION IMPROVEMENT WITH RFID DATA IN RETAIL INDUSTRY**

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**ABSTRACT**

In the United States, Retail occupies the second place among the largest industries both in terms of the number of employees and in terms of the number of establishments countrywide. Worldwide it also occupies a prominent place among the biggest industries. Being a U.S. \$7 trillion sector, the retail industry generates more than \$3 trillion in retail sale annually and employs more than 22 million Americans. Wal-Mart is the world's largest retailer and as the world's largest employer with more than a million employees, Wal-Mart posted \$219 billion in sales for fiscal 2001 and displaced oil giant Exxon Mobil as world's largest company. Due its ability to leverage its size, market influence and efficiency to create market domination, globally Wal-Mart has reached the position of a retail brand, which enjoys the most success. In the Fortune magazine list of top 500 companies in world, Wal-Mart is the leader. In the Forbes Annual List of Billionaires, the largest number (45/497) of them are from the retail business.

***Key Words: Retailing, RFID, Customers, Supply Chain, Services***

**1. INTRODUCTION**

Data collection is possible by the use of technology aids. Data about consumers, their purchases the frequency of their buying and the typical basket size are collected. The customers who shops at his store frequently are distinguished by the retailer and are also rewarded. For example information gathered about a customer's preferences for certain brands may be revealed by the information collected. Regarding promotional offers etc this may be used for further communication with the customer. The data on purchase made is send to the credit card organization for billing the customer and for payment to the merchant establishment also. The unorganized retailers or kirana stores (mom-and-pop stores) that generally cater to the customers within their neighborhood give immense competition to the organized retailers. The

unorganized retail sector poses a serious hurdle for organized retailer since it constitutes over 94% of India's total retail sector. The 14 million kirana stores that offer personalized services such as free home delivery services, direct credit to customers, apart from the loyalty benefits, poses stiff competition to the organized retailers.

The traditional kirana stores adopted various measures to retain their customers, which directly affected organized retailers during the current economic slowdown. It has been observed generally that in kirana stores, customers stick to their needs because of the limited variety, however they shop impulsively and end up spending more than what they need at organized retail outlets. During a downturn, as is evident from the past few months' trend, shoppers are increasingly switching from organized retail stores to kiranas since many customers may not like to spend more. The importance of data leads to the importance of information technology. The information that aids decision making is nothing but data. The greatest tools in the hands of the retailer are the right data, in the right form to the right set of people at the right time. Information is always based on a particular time frame. At a department store let us take an example of a customer. The customer proceeds towards the billing counter after selecting some goods. Here each product is scanned at the POS (Point of sale) terminal the total number of items and the bill amount is added up by the billing clerk. He also checks if the customer is a member of the store's loyalty program. The customer confirms that and gives the billing clerk the store card for entry and exits the store with his purchases after making payment by way of credit card.

In the retail operations, by the appropriate use of technology, the headquarters will be able to know the summary of daily revenues across its outlets. It will also be able to know the sales analytics of products region wise and outlet wise. In case of a stock out of an item, a store could find out if that item is available at another location where it may be a slow moving item. To reinforce further its advertising practices, Flipkart acquired mobile advertising network Adiquity. In the ad space, Adiquity has an excellent expertise and a very good track record of innovations in mobility. Over the next two years through multiple business models Sbarro, the US-based Pizza chain plans a nearly three times increase in its number of stores from the current 17 to 50. Envisioning India as its largest market outside the country of United States, a war chest worth US\$ 5.2 billion is being planned by Amazon, the world's largest online retailer. In the forthcoming 12-16 years of timeline, 520 stores are forecasted to be established in India by Wal-Mart Stores Inc's wholly owned subsidiary, Wal-Mart India Private Ltd. Along with Tata group company Trent in an equal joint venture, around Rs 850 crore (US\$ 133.8 million) was invested by British retail major Tesco in multiple branded retail trading. Tesco in Trent Hypermarket Ltd (THL) to form the joint venture purchased 50 per cent stake, The Star Bazaar retail initiative in India is

operated by THL.

Let us look at the information that the store has gathered from this transaction and how the information helps the retailer, while to the customer it is just a routine purchase. The personal shopper of the future is going to be RFID. Retailers can collect information about their customers' purchasing trends and offer rewards targeted to those interests by using RFID technology. RFID can help create a personalized shopping experience for the customers, enabling your customer relationship and customer service teams to recognize customers, analyze account histories, and render value-added services. To store information about each item in the store, such as fabric content, available sizes and colours, and suggested complementary items or accessories, a clothing retail company in New York is using RFID smart labels. So customers can view all the information, since the RFID readers in the trial rooms are connected to computer monitors and they could make decisions without ever having to leave the trial room. Advanced security technology enables the store IT staff to better protect all information and for each customer participation is optional.

## **2. LITERATURE REVIEW**

Alvi, S. S. (2012) argued that customers are seeking more information to make their choices. They increasingly seek convenience in shopping and want the shopping experience to be enjoyable. To keep the shopping more exciting and not as a mundane chore, retail business are early adopter of IT and various levels of usage are emerging such as data warehousing/mining, supply chain management, scanner data bar-coding, UPC, EDI & RIFD. Amine Ayad, (2008) examined the key factors within the purview of store managers for inventory optimization and store output in a big box retail environment. The study found that different stores within same organizations and different sections within same stores deliver different results mainly due to mental factors specifically, critical thinking, functional knowledge, and leadership. The study proposed a practical tools and ideas for inventory optimization and business output in big-box stores.

Anssens et al (2011) discussed that the RFID is a trend in the retail sector and made possible a quick inventory of a large stock, therefore it is expected to improve productivity. Currently the solutions are based on inventories, which record the input and the output of the goods and provide the stock situation. They develop another solution based on the real-time visibility of the items. With a sensor network, it is possible to detect all the items and locate them. It captured three data: the item identification, the place and the time. Chieu, et al (2010) discusses a framework for deployment of business analytics solutions on a cloud platform. The solutions are characterized by a need to process and manage large volumes of data, rapid on boarding of new retailers and CPs and an ability to plug in different analytical providers. The

framework provides a standardized mechanism to deploy solutions in the cloud. Dane, et al (2010) examines the impact of radio frequency identification (RFID) technology on the inventory control practices of a small to medium retailer. When integrating into a firm's business processes, the RFID technology allows "any tagged item to become a mobile, smart, communicative component of the organization's overall information management setup".

Ming Chih Tsai (2010) identified critical factors influencing industrial RFID implementation intention using statistical methods. Because of its inter-organizational nature, the study extrapolated the theory of diffusion of innovation and built an analytical model correlating relative benefit, complexity, organizational preparedness, and supply chain integration with adoption intention. The results indicated that the four constructs were all significant in favoring RFID adoption, and supply chain integration produced an effect similar to that of conventional innovation. An indirect effect of it on organizational preparedness was also found to be significant.

### **3. BACKGROUND OF THE STUDY**

It is a challenging task for the retailers to maintain the details of their fast increasing number of customers. It is always challenging to maintain data for the high visibility of customer profiles, services, communications, and analytics and it is also equally tough to analyse data using a single interface from multiple systems for promotions, communications, service and sales. Predicting product demand, buying behaviour and customer spending are tedious and are not accurate and it is also challenging to monitor request, complaints, queries, surveys and feedback from customers scattered over many geographies. Moreover the data for memberships, rules, accruals, customer profiling and market segmentation for activities carried out for product or service promotions are always available in a dispersed manner and without being aggregated or collected centrally. In the Retail sector customer engagement is made easy by CRM software with single window access to customer information and to manage all retail activities either in-store or outdoor through multiple sales, services, promotion, goods, customer loyalty and training options. Through price optimization, product bundling, satisfaction scoring and demand forecasting CRM improves sales and service operations of the retailers.

Multichannel retailing is the enabling the customers to do their transaction through many channels. The various retail channels available are retail stores, mobile stores, online stores, m-commerce apps, telephonic sales. It also includes any other method that the customer could interact with a store. The customer activities include browsing, purchasing, returning goods and before and after sale service. Only consumers are responsible for the growth of multi-channel though recent technologies support the growth. As per Shop.org and other

researches, nearly 36 per cent of customers today use minimum three channels while purchasing and spend almost 10 times more, to churn out 25 to 50% more profitability and show higher loyalty than their single-channel counterparts. The major drivers for multichannel strategy are customer demand and minimizing costs by the way of operational effectiveness and store efficiency. In addition to poor customer relationships, managing channels not in an integrated fashion will also lead to higher costs due to separate order-management and customer service operations, multiple warehouses customers and retailer shave to duplicate the cost and effort across the different channels.

Since it is driven by flow of goods across the supply chain, the retail business has its own way of running. The rapid movement of goods, the requirements of high availability of goods and the overheads of handling uncertainty in needs are aggravated by the fast decaying properties of many of the products flowing across the supply chain. The lack of supply chain efficiencies is further worsened since like other industries late fulfilment of orders or lack of accuracies is not percolated into the supply chain. The retailer's capability to run the business and customer service levels are affected by this. The sales analytics and decision-making on inventory levels and merchandise planning is based on the sales data from the store, which should be used as a forecast by the manufacturer to reduce lead times. This strategy is especially useful for shorter life cycle products like fashion goods. The information collected in this approach could provide insights about the buying trends of the younger generation like the style and colour choices of clothing like Jean or Tee shirts. To service this section of the audience the seller should plan for faster reordering or reduced lead times to cater to this segment of the buyers. Sales trends could be analysed with technology, which helps in data acquisition and transmission which in turn will help avoid no stock situations by better stock turnover and also offer appropriate product markdowns.

The various types of information that is collected with the help of technology are customer information, their buying patterns and intervals and the quantity of goods purchased. This information will enable the retailer to have better customer relationship and complement them who purchases often from the store. The data collected about customer's preferences could be used for marketing promotion of the preferred brands. The purchase information is also sent to the banker for payment processing in case of credit or debit card purchases. (Sree Rama Rao, 2010)

#### **4. METHODOLOGY**

Fundamentally, the study is designed as descriptive research. The phenomenon of study are not controlled or modified. They are just measured and reported to highlight the facts. As

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descriptive research mainly uses interview or survey technique to collect the data, it is proposed to use a self administered questionnaire. Before research instrument is developed, a thorough review of literature and series of interview was conducted among the subject experts and possible respondents to find the items that need to be measured. Multi item constructs that measures phenomenon are framed. Proper scales such as five point agreeableness likert scales, importance scale and satisfaction scales are used. The sources of data include both primary and secondary. The primary source includes opinions of top management of the respondent retail stores and the opinion of customers visiting retail stores. The secondary source includes reports, standard textbooks, journals, magazines, web sites, newspapers etc. The population consists of retail outlets, which are operating in India. For convenience the sample framework was created limiting samples to the major cities in south India, Bangalore, Chennai, and Coimbatore. Though Indian retail sector has majority of retail stores in unorganized sector, the application of technology was found relevant in the organized retailing. Therefore, sampling framework restricted to retails stores of various product categories of modern format. 300 stores were randomly selected for collecting data. However, only 268 stores responded the survey.

## **5. ANALYSIS AND DISCUSSIONS**

### **5.1. REGRESSION ANALYSIS FOR PREDICTING CHARACTERISTICS OF THE PEOPLE WHO GET SATISFIED FROM THE USE OF RFID.**

A regression model was developed with the demography variables as the independent and the satisfaction on RFID as the dependent variable to investigate the characteristics of the people who get satisfied from the use of RFID.

#### **5.1.1. Hypothesis**

For regression analysis, the following null hypothesis is framed.

Ho1: There is no influence of the demographic characteristics of the retail customers on the satisfaction on RFID.

Below is the alternate hypothesis that is framed.

Ha1: There is significant influence of the demographic characteristics of the retail customers on the satisfaction on RFID.

The demography variables such as age, gender, education, marital status, occupation and frequency of visit are entered into regression test. The results presented in the table 4.27. From the outcome of the results, a prediction model can be framed. The regression model is found to

be significant with  $F = 3.472$  and  $P < 0.011$ . This rejects the null hypothesis that there is no influence of the demographic characteristics of the retail customers on the satisfaction on RFID. The alternate hypothesis that there is significant influence of the demographic characteristics of the retail customers on the satisfaction on RFID is thus accepted.

The R Square value is found to be 0.223. This indicates that the model can predict the 22.3 of the variability of the satisfaction on RFID from the demography variables, where the rest of 77.7 % variability will be caused by unknown variables or variables not taken for the study.

Analyzing the regression coefficients, education ( $t = -1.055$ ) and occupation ( $t = -0.341$ ) were found to insignificant. All other variables had a positive and significant impact on satisfaction on RFID. Gender had an impact of 0.284, marital status had an impact of 0.172, and age had impact of 0.129 and frequency of visit of 0.171. The prediction model can thus be framed as:

$$\text{Satisfaction on RFID} = 0.174 + 0.129 * \text{Age} + 0.172 * \text{Marital status} + 0.284 * \text{Gender} + 0.171 * \text{Visiting Periodicity.}$$

The equation can be substituted with following values for prediction:

Gender is equal to 1 for men and 2 for women. Age is equal to 1 when Less than 20 Years, 2 when Between 21 and 30 Years, 3 when Between 31 and 40 Years, 4 when Between 41 and 50 Years and 5 when Above 50 Years. Marital status is equal to 1 for married 2 for unmarried. Gender is equal to 1 for men and 2 for women. Visiting Periodicity is equal to 1 for Less than once a week, 2 for Once or twice a week, 3 for Three or Four times a week, 4 for Five times a week or more.

**TABLE 5.1 : REGRESSION PREDICTING SATISFACTION ON RFID FROM DEMOGRAPHY**

SUMMARY OF THE MODEL					
R	R Square	R Square (Adjusted)	Estimate Std. Error		
.473 <sup>a</sup>	.223	.221	.984945789		
a. Predictors: (Constant), Frequency of Visit, Occupation, Marital Status, Education, Age, Gender					
b. Dependent Variable: Satisfaction on RFID					
ANOVA <sup>b</sup>					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	20.152	6	3.368	3.472	.011 <sup>a</sup>
Residual	458.874	484	.984		
Total	479.015	485			
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.174	.315		3.162	.005
Gender	.284	.124	.198	2.362	.032
Marital Status	.172	.113	.142	3.105	.009
Education	-.053	.054	-.061	-1.063	.302
Occupation	-.025	.045	-.023	-.356	.745
Age	.129	.056	.115	2.755	.023
Frequency of Visit	.171	.045	.195	4.056	.005

**5.2. REGRESSION ANALYSIS FOR PREDICTING INFLUENCE OF STORE FEATURES ON CUSTOMER SATISFACTION ON RFID.**

A regression analysis is conducted to study the store features that influence the customer satisfaction on RFID.

**5.2.1. Hypothesis**

The following null hypothesis is framed for regression analysis.

Ho2: There is no influence of the store features on the satisfaction on RFID.



Below is the alternate hypothesis that is framed.

Ha2: There is significant influence of the store features on the satisfaction on RFID.

With the parameters identified from the factor analysis such as Factors of marketing, External factors of store, Service level of Retail, Internal factors of store, Environment of Retailing and Relationship with customers are entered as independent variable and satisfaction on RFID as dependent variable, a multivariate linear regression was done.

The regression model is found to be significant with  $F = 125.223$  and  $P < 0.009$ . The R Square value is found to be 0.374. This indicates that the factors of store features have an influence on satisfaction on RFID. This rejects the null hypothesis that there is no influence of the store on the satisfaction on RFID. The alternate hypothesis that there is influence of the store features on the satisfaction on RFID is thus accepted.

The R Square value indicated that the store features have an influence on satisfaction on RFID to an extent of 37.4 %, where the rest of 62.6% variability will be caused by unknown variables or variables not taken for the study. Analyzing the regression coefficients, all the factors had a positive and significant influence. The regression equation formed as:

$$\text{Satisfaction on RFID} = 0.05 + 0.123 * \text{Factors of Marketing} + 0.111 * \text{External factors of store} + 0.263 * \text{Service level of Retail} + 0.123 * \text{Internal factors of store} + 0.196 * \text{Environment of Retailing} + 0.225 * \text{Relationship with Customers.}$$

**TABLE 5.2: REGRESSION PREDICTING SATISFACTION ON RFID FROM STORE FEATURES**

SUMMARY OF THE MODEL					
R	R Square	R Square (Adjusted)	Estimate Std. Error		
.611 <sup>a</sup>	.374	.374	.341188296		
a. Predictors: (Constant), Customer Relations, Store External , Marketing Mix, Retail Experience, Retail Service, Store Internal					
b. Dependent Variable: Opinion on RFID					
ANOVA <sup>b</sup>					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	293.954	6	48.99144	125.2231	.009 <sup>a</sup>
Residual	185.063	485	0.391356		
<b>Total</b>	<b>479.011</b>	<b>483</b>			

Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.05	.023		2.156	.044
Factors of Marketing	.123	.058	.126	2.423	.025
External factors of Store	.111	.044	.113	2.783	.009
Internal factors of store	.123	.071	.119	2.925	.005
Service level of Retail	.263	.065	.269	4.596	.000
Environment of Retailing	.196	.055	.195	3.863	.000
Relationship with Customers	.225	.063	.225	3.874	.000

## 6. CONCLUSION

In 2009, Wal-Mart picked Bangalore-based Infosys Technologies, based in Bengaluru and Cognizant, based in India were selected by Wal-Mart among the 3 IT solution providers for a 600 million USD contract spanning multiple years. Infosys was an early adapter of For Wal-Mart's adoption of radio-frequency identification (RFID) tags, Infosys was a key enabler that made inexpensive inventory tracking possible. Kosmix, an innovative search engine founded by Venky Harinarayan and Anand Rajaraman of Indian origin, was bought by Wal-Mart for the technology of text mining of data from social media like twitter, which would enable new channels of customer interaction. Tesco banks on the Bangalore based IT company called the "Hindustan Service Centre" a Bengaluru based IT firm is relied upon by Tesco for their IT support. To enable retail players recognize, focus and service customers in a way they deserve, Bengaluru based Manthan Systems, is a world leader in business intelligence software for the retail sector. The talent in India is not recognized by the retail units here in spite of the western players are hugely benefitted by it. From this study, we are able to comprehend the impact of RFID on the consumer behavior. To improve the buying experience of the consumer, retail players could make use of Video Analytics that are innovative and smart, shopping carts with integrated sensors and point of-sales terminals. The spending by consumers will be increased by the Speed of buying, availability of merchandise and pricing of goods and rebates available. Retail players need to appreciate the fact that a strategy that works for a particular region of the country and set of people may not work for others since India is a diverse country with multi-lingual, cross cultural population spread across different geographical regions, rural population volume and urban

population that is affluent. They should be careful with the concept of 'one size does not fit all', while dealing with the application of technology also.

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