

Role of RFID on Store Operational Performances – A Prospect of Inventory Management Practice

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Abstract--- RFID is emerging tool used for tracking, identifying stocks, physical object. In competitive business world technologies play vital role towards bringing operational efficiency business unit. In this paper an attempt has been made to know the efficient RFID practices for improving operational performance of selected retail stores in India. Empirical relationship can be measured through different statistical tools i.e. Correlation, regression and factor analysis. Data have been collected from key officials of retail units i.e. Store manager, operations manager, purchase manager, etc. The study concludes that RFID is most efficient practices and it has significant impact on operational performance of retail store and also contribute to the existing body of knowledge as well as helping the management practitioners of retail industry.

Keywords--- RFID, Inventory Management Practices, Retail Industry, Operational Performance.

I INTRODUCTION

RFID is recognised as an energy efficient practices of inventory management. It consumes less energy as compared to other practices. It is frequently used as energy efficient techniques because it easily records the data as long as it is in its periphery or reader vicinity. This technique is widely used in supply chain management area [1]. Radio Frequencies Identification practices in inventory was considered to be the most effective mechanism for every commercial business. To cope with the rapid change of technology we should have control over assets tracking and warehouses management systems. By looking at above two control systems RFID is being adopted by retail outlets [2]. From the point of view of SML RFID (global leader for providing high performance RFID tech. solution for retail) explains RFID market continues to grow 30% year after year. By the use of RFID practices inventory accuracy improved by 98% and more as compared to other stock management techniques [3]. This report also gives importance on the popularity and wide acceptance of RFID practices in SCM. Subsequently it reduces time element for repetitious work. Report of IDTechEx. Reveals the value of RFID has been increased from 11.6 billion to 13 billion by the end of 2022. RFID includes tags, readers, labels software cum service, cards and other items of radio frequencies along with passive and active RFID [4]. This technique will be less costly as compared to printed codes [2].

1.1. RFID Assets Tracking Features

Assets tracking is important elements of RFID practices, which surrounded technical features

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- Unique facilities for asset identities towards faster retrieval
- Providing accurate information through automatic tracking
- Wireless connectivity for smooth work operations
- Use of multiple tags detections for upgrade assets optimisation.



Figure 1: Sources:[2]

RFID also use an effective technique to save the business from misplacement, shrinkage, in accuracy [5], [6], [7]. Towards tracking two fundamental principle being applied

- Providing product visibility to the manager to identify the items and access the information
- Helping the manager to restrict the business from misplacement and shrinkage [8], [9]

1.2. Problem Statement

RFID and Bar-Code are two accepted technologies for auto identifications products in stores. In recent times RFID practices is applied to increase the efficiency of operation. In warehouse management most used technology is RFID [10]. Indian diary and Medium scale retails firms widely used and it helps to compete with global market [11]. Still there is gap of understanding RFID Practices in the medium and large retail enterprise in India. The study tries to give importance on the present RFID (Automated inventory practices) adopted in the medium and large retail stores and how it contributes for store performances.

This paper is subsequently organized as follow sequences, 1st phase describe overview of RFID inventory practices and highlight previous research finding, followed by literature of review, relevant theory building, methodological foundation, next attention paid to data analysis, Result interpretation, conclusion and ended with scope of further research.

II Review of Literature

According to the previous studies RFID is one of the most important and common technology and become inseparable part of Industry as well as human life. Industry or Retails stores always try to use energy saving

mechanism or practices in their operation. RFID is an energy saving practices used in an industry bringing down different systems operational cost. If the operational cost reduces through energy efficiency then automatically brings return on investment [12]. In am manufacturing firms also using RFID practices for reduction of energy consumption and in turn it leads smooth process of loads profiles. It also helps to avoid peak load penalties [13]. In any kind of organization RFID practice is adopted with a motive in assistance in automatic record of physical products or units through use of radio waves [14] In the retail sector use of RFID technique used with the intension to foster the movement and tracking of transaction [15] ,[16] ,[17] ,[18], [19]. This technique developed as fastest growing techniques in the area wireless techniques, has a great impact on providing economy in operation [20]. Due to the use of tags for communication, RFID provide extra millage to retail industry in tracking of activity with highest accuracy [14].

2.1 Theoretical Foundation

In this article we have used two theory for development of foundation. From past study it was observed that most of the time that use of technology advancement in any industry suggest how people are accepting the theory [21]. Two theories are used as Rogers and Business Information technology [22]. Energy model also explain to measure the energy consumption RFID techniques [23].

- a. Energy Model
- b. Rogers' theory of Diffusion of innovation.
- c. Theory of Business of Information technology.

1st Energy Model

To check the energy efficiency, we have to adopt the energy model, which is based on size of data used (recorded in bit), rate of recording (recorded in kbps), time consumed to send the data and lastly power supply.

$$T = \frac{ID}{rate}$$

if we use ID as per size of the tag needed in the product and rate is based on tag data rate., then energy can be computed by using bellow formula

$$E = (V \times I) \times T$$

Model can be explained as

E= Energy, V= Volt used in power supply

I= amperes for consumption of current at the time of scanning

In the prospects of energy consumption RFID has 3 modes of operation:

1. Scan
2. Idle
3. Sleep

Out of 3 modes 1st mode consume highest energy and last mode consumes least energy. Due to repetitions of work sleep mode is frequently used in an firms or industry [23].

2nd Rogers' Theory of Diffusion of Innovation

According to Rogers decision to adopt and use basically took place in between 5 interlinked stages.

- Knowledge
- Persuasion

- Decision
- Implementation
- Confirmation

These five stages of the decision making are inter linked and at the time of taking any kind of decision making it play an significant role in an organization. Though the theory has introduced by Rogers in 1995, but still today it creates it impact on Industry. Along with the 5 stages it has supported by five technological attributes, which helps an organization smooth adoption technological innovation. These are

- Relative Advantages
- Compatibility
- Complexity
- Observability
- Trialability

Among these five attributed most accepted attributed used in technology adoption as per researcher point of view are relative advantages, compatibility and complexity [24].

3rd Theory of Business of Information technology.

This theory is based on how IT creates its impact business performance on long term by the help of three dimension affect with three effect [25,26]. These 3 effects are

- Automational
- Informational
- Transformational

At the time of using RFID these above three dimension helps in these three ways

- Automation Contribution in RFID- Eliminate time consumption in any event of counting.
- Informational Contribution in RFID- Reduce number of errors in process of use.
- Transformational Contribution in RFID- Helps in stock replenishment from store to shop floor.

Table 1: Contribution of two theories

| Theories Used | Contribution to this Research Article |
|--|--|
| 1st Energy Model | Providing insight as energy efficient technological practices for firms with justify formula. As energy efficient tool it provide scope of improvement Return on Investment for retail stores. |
| 2nd 'Rogers' Theory of Diffusion of Innovation | Identifying the research problem in the light of dimension suggested. |
| 3rd Theory of Business of Information technology | Providing better understanding of different dimension RFID, which will impact on store performance. |

2.2 Energy Efficient RFID Practices in Retail Stores

Radio frequency practices provides extraordinary opportunity to enhancing shopping experiences to the customer as well as providing new ways to adopts different offering in single platform [27]. This facility with minimum effort of energy consumption may give extra millage to retailers.

Operational performance of stores improved through RFID (As an Energy Efficient Techniques)

Performances of the store improves if the following points need to be considered and adopted prior introduction of RFID practices. Below mentioned systems need to be installed in advance to RFID installed [27].

- RFID labelling station.
- RFID reader for inventorying the store.
- Overhead antennas for real-time inventory of the warehouse.
- RFID Point of Sale.
- RFID-enabled floor mat EAS.

As per Gary Lynch FCILT(CEO GS1 UK) RFID was evolved as multi solution provider in the area of inventory management in retail sector. These areas are improved IM, improving performance of sales, delivery to omni channel processes [28].

III Research Gap, Research Questions, Objectives, Hypothesis

3.1 Research Gap

From extant literature it has been identified that RFID both play significant role in medium and large-scale Retail Enterprises. But in recent times large retail industry heavily depends upon the RFID practices. Lots of paper working on the energy efficiency of RFID technology and many paper also on the use of RFID as on the component of Inventory management techniques But the relationship of Energy efficient RFID practice with retail store operational performance has not been studied in Indian context. So, we have conducted the study to know the impact of Energy efficient RFID as an inventory practices towards store performance in Indian Retail Industry.

3.2 Research Questions

By analyzing potential effect of RFID on operational performance of retail store the following questions are develop.

RQ 1: What is the impact of Energy Efficient RFID inventory practices on Retail store performance in India?

3.3 Research Objective

RFID practices is considered to be in its infancy stage but it has its positive impact on Automated Inventory management practices. So, this paper an attempt has been made to check the impact RFID practices towards increasing operational performance of retails stores..

3.4 Hypothesis of the Study.

H1 = RFID have significant impact on Retail Store Performance

IV Methodological Foundation

Study adopt PCA analysis to confirm principal items majorly contributed towards latent variable RFID and improved Store operational performance. After that we have use descriptive statistics, correlation and regression analysis to measure the relation between RFID with store performance. Data has been collected through out PAN India from 6 retails store namely Vishal mega mart, Khimji K. D & Sons Pvt. Ltd., Shopper Stop, Big Bazzar (Future Group), Hafele India, Raymond, by using purposive sampling techniques from 180 responded but out of 150 response are complete and correct for the analysis. Pilot test were conducted to measure the validity and

reliability of the data. Cronbach's alpha values was higher than 0.81 which indicate variables found highly reliable for the study [29]. The respondent are key officials of the Retail Stores i.e. Store manager, operations manager, purchase manager, warehouse manager etc. A Five-point Likert scale (where 1-Not at all Effective, 2- Not Effective, 3- Somewhat at, 4-Effective, 5- Very Effective) is used in the instrument to collect the data. Operational performance measured through 5-point Likert scale [30].

V Results and Analysis

5.1 Principle Component Analysis

In the step of this analysis we have applied PCA to confirms major items (questions) and reduce the items whose eigenvalues is less than 1 and value under RFID practices, and Improved store performance. After principal component analysis with rotation of varimax of 30 items, 21 have selected based on criteria of minimum threshold limit of KMO value is 0.60 and above, Communalities value 0.50 value and lastly also checked minimum fulfilling criteria Measures of Sampling Adequacy (MSA) which is above than KMO value of anti-image matrices of 0.60. By applying above three threshold limits we have selected 7 items of RFID out of 10 items, 4 items are selected out of 10 items and lastly entire 10 items are select from improved retail store performance.

Table 2: Factor Analysis by using (Principal Component Analysis) of RFID, SP.

| Rotated Component Matrix^a | | |
|---|------------------|----------|
| Items under Energy Efficient RFID and Store operational performances | Component | |
| | 1 | 2 |
| ERFIP 8 - Improved warehouse distribution systems | .949 | |
| ERFIP 4 -Facilitates in distribution channels partners for meeting target customer demand | .943 | |
| ERFIP 6 -Easy tracking of Replaced / return items in store | .915 | |
| ERFIP 5 - Generating revenue through quick movement of store sales activity with lees energy consumption | .761 | |
| ERFIP 1 -Inventory Practices helps to avoid stock out condition in retail outlet | .757 | |
| ERFIP 3 - Multiple in-house store operation activities | | .933 |
| ERFIP 9 -Brings competitive advantages | | .871 |
| SOP 9 - Brings Accuracy, Energy efficiency in store operation | .923 | |
| SOP 7 - Security check towards theft / fraud and other illegal activities | .910 | |
| SOP 1 -Reduction of errors in inventory management records in retails stores | .909 | |
| SOP 10 -Enhancing performance through IT | .877 | |
| SOP 6 - Missing sales have checked though automated inventory practices | .859 | |
| SOP 8 -Reduced overall cost of store operation through energy efficiency | .847 | |
| SOP 2 -Improved inventory management | .814 | |
| SOP 4 -Operational performance improved through proper Inventory visibility in sleep mode | .801 | |
| SOP 5 -Fewer damages recorded in godown | .800 | |
| SOP 3 -Due to accuracy in information decision making | .714 | |

Rotation converged in 3 iterations. Source: Author's Computation, 2020

5.2 Descriptive Statistics

This section states that data have been collected from 150 respondent by using Likert 5-point scale, where we got mean value of RFDI practices are varies from 3.25 to 3.259 and standard deviation is highest value of 1.299 against item RFID 9 which deals with providing competitive advantages retails store. For Improved store performance mean score varies from 3.09 to 3.52 and Highest score of S.D. is 1.344. Due to accuracy in information decision making is quite easier on the part of manager and official in the retail outlets. As per standard skewness less than -1 / greater than 1 is highly skewed all the 21 items under three heads RFID, Barcode and Improved Store performance are fall under the categories of Highly skewed which shows data are normally distributed. Acceptance criteria for kurtosis is -2 to 2, accordingly here it also the data are under acceptable range. It represents data are evenly distributed. It shows that this distribution's propensity to represent outliers [31]. (Table 3)

Table 3: Descriptive Statistics of RFID Inventory Practice and Store Performance

| Descriptive Statistics | | | | |
|------------------------|-----------|----------------|-----------|-----------|
| | Mean | Std. Deviation | Skewness | Kurtosis |
| | Statistic | Statistic | Statistic | Statistic |
| RFIP 1 | 3.25 | 1.207 | -.123 | -1.189 |
| RFIP 4 | 3.26 | 1.268 | -.154 | -1.328 |
| RFIP 5 | 3.51 | .854 | -.389 | -.136 |
| RFIP 6 | 3.30 | 1.208 | -.155 | -1.241 |
| RFIP 8 | 3.26 | 1.224 | -.154 | -1.262 |
| RFIP 3 | 3.59 | 1.244 | -.343 | -1.354 |
| RFIP 9 | 3.32 | 1.299 | -.051 | -1.526 |
| SOP 1 | 3.35 | 1.044 | -.293 | -.650 |
| SOP 2 | 3.52 | 1.056 | -.501 | -.600 |
| SOP 3 | 3.25 | 1.344 | -.039 | -1.500 |
| SOP 4 | 3.23 | 1.246 | -.153 | -1.224 |
| SOP 5 | 3.09 | 1.282 | -.013 | -1.346 |
| SOP 6 | 3.39 | 1.050 | -.311 | -.593 |
| SOP 7 | 3.19 | 1.223 | -.067 | -1.224 |
| SOP 8 | 3.48 | 1.107 | -.305 | -.573 |
| SOP 9 | 3.28 | 1.190 | -.166 | -1.214 |
| SOP 10 | 3.44 | 1.071 | -.356 | -.633 |

Source: Author's Computation, 2020

5.3 Correlation Analysis

H1 = RFID have significant impact on Retail Store Performance - 0.911

This section states that correlation between the latent variables i.e RFID with Store operational performance. This analysis reveals that the sub component of RFID have significant and positive relationship with store operational performance. This study justifies the statement with correlation value of 0.911(RFID) with store operational performance. The output is not deviate from previous studies [32], [33] (Table 4) :

Table 4 Pearson's correlations in between RFID with Store performance with store performance.

| Correlations | | | | | | | | | | |
|----------------|---------------------|-----|--------|--------|--------|---------|--------|--------|--------|--------|
| | | R F | STP | RFIP 1 | RFIP 3 | RFI P 4 | RFIP 5 | RFIP 6 | RFIP 8 | RFIP 9 |
| RFID Practices | Pearson Correlation | 1 | .911** | .855** | .527** | .812** | .920** | .841** | .866** | .749** |

| | | | | | | | | | | |
|---|---------------------|--|----------|----------|----------|----------|----------|----------|----------|----------|
| Store Performance | Pearson Correlation | | 1 | .857** | .405** | .681** | .854** | .762** | .768** | .752** |
| RFIP 1 | Pearson Correlation | | | 1 | .327** | .669** | .843** | .683** | .693** | .574** |
| RFIP 3 | Pearson Correlation | | | | 1 | .075 | .466** | .162 | .162 | .717** |
| RFIP 4 | Pearson Correlation | | | | | 1 | .722** | .816** | .906** | .338** |
| RFIP 5 | Pearson Correlation | | | | | | 1 | .713** | .748** | .680** |
| RFIP 6 | Pearson Correlation | | | | | | | 1 | .895** | .412** |
| RFIP 8 | Pearson Correlation | | | | | | | | 1 | .420** |
| RFIP 9 | Pearson Correlation | | | | | | | | | 1 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | | | | | | | |

Source: Author's Computation, 2020

5.4 Regression Analysis

Interpretation of the result will be based R square and R. where R square represent the amount of variation in DV (Dependent variable – store operational performance) on the IV (Independent variable – RFID in model series. The value of the R square is 0.904, it shows store performance have 90% dependencies on automated techniques i.e RFID. R stand to explain correlation coefficient in between DV and IV which is 90.1%. according to D-W values near to 2 indicates non-autocorrelation so according to this condition analysis says D-W 1.76 which implies that there is non-autocorrelation in the regression model. (Table 5).

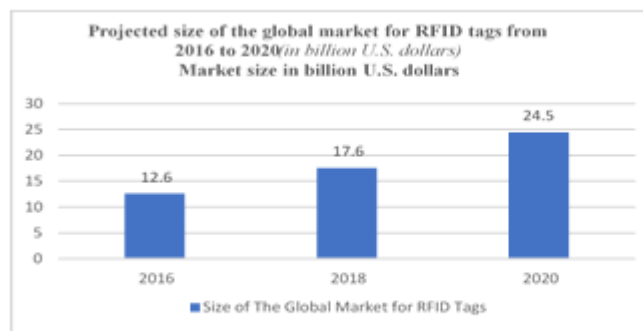
Table 5: Model Summary Regression between Two Automation Inventory Practices (RFID) Vs Store Performance.

| Model Summary | | | | | | | | | | |
|---|-------------------------|-------------|-------------------|----------------------------|-------------------|----------------|----------|------------|---------------|-----------------|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | | Durbin - Watson |
| | | | | | R Square Change | F Change | df 1 | df2 | Sig. F Change | |
| 1 | .951^a | .904 | .897 | .314 | .904 | 137.074 | 7 | 102 | .000 | 1.653 |
| a. Predictors: (Constant), Barcode Practices, Radio Frequencies Practices | | | | | | | | | | |
| b. Dependent Variable: Store Performance | | | | | | | | | | |

Source: Author's Computation, 2020

VI RFID Growth Prospect – Predictive Statistics

6.1. Global trend of RFID from 2014-2020



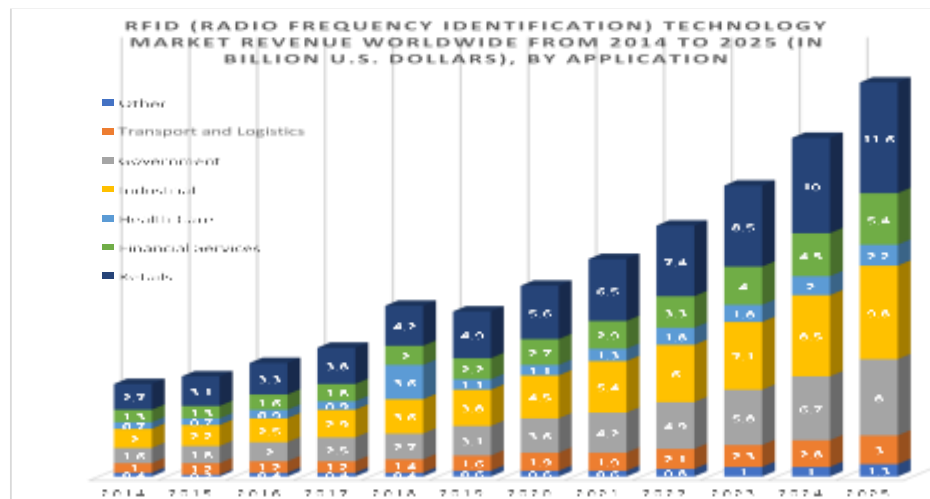
In 2020, the global market for RFID tags is projected to be sized at around 24.5 billion U.S. dollars. Retail applications are expected to account for the largest share of the market.

Figure 2: (Global trend of RFID)

(Sources: <https://www.statista.com/statistics/299966/size-of-the-global-rfid-market>)

In the above figure 2, it has clearly observed that Due to Energy Efficiency and Cost-Effectiveness, Demand is in increasing trend as well as growth of RFID from 4 to 5 years and forecasted that it will increase significantly.

6.2 Analysis RFID (Radio Frequency Identification) technology market revenue worldwide from 2014 to 2025 (in billion U.S. dollars)



The statistic shows the RFID (Radio Frequency Identification) technology market revenue worldwide from 2014 to 2025, broken down by application. In 2017, the retail sector of the RFID technology market is forecast to generate some 3.8 billion U.S. dollars.

Figure 3: (RFID (Radio Frequency Identification) technology market revenue worldwide from 2014 to 2025)

(Sources: <https://www.statista.com/statistics/781314/global-rfid-technology-market-revenue-by-application/>)

The both forecasting on RFID growth and demand in coming times shows Indian retail sector are blending towards adoption of Inventory practices through latest technologies like RFID Practices. Technology survey report suggest that highest use of RFID practices in retail as compared other six sector.

VII Conclusion and Scope for further Research

This study focuses on the impact of efficient RFID practices at retail store operational performance. RFID practices is majorly affected towards store operational performance in the area i.e. Facilitates in distribution channels partners for meeting target customer demand, Improved warehouse distribution systems, Easy tracking of Replaced / return items in store, Inventory Practices helps to avoid stock out condition in retail outlets. The study not only draw a conclusion on the basis of relationship but also it gives valuable inputs to the officials of retail outlets regarding adoption automated technology of inventory management. It will easily track the missing items and also restrict the inhouse theft and miss utilization / mis handling of items through proper tracking system. By the passage of time store must bring upgradation in its operation, which will create a greater number of satisfy customer along with investment made on inventory can be control. Huge amount of monetary resources not blocked in the goodown in the form of stocks. Contribution of this study is to the society as well ss to the retail industry is to by the use of these techniques time , money and effort can be saved and resources are optimally utilize and lastly being a service provider industry must know as per the size of the organization, whether retail outlet adopt centralized systems or decentralized system in store operations. In retail store RFID practices brings economy in operation due to the adoption of energy efficiency of the technique.

Further this paper can be extended and applied with larger sample size and cover wider area as well as sample outlets more than 15-20 companies will give us better result. Subjective evaluation may increase measurement error due to relatively low reliability. Objective measurement will give more accurate information for better analysis. It was observed that Knowledge of inventory Automation practices may fill the gap in between concept and practical. So, the further may extended in this area.

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