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TO STUDY THE IMPACT OF RFID APPLICATIONS ON INFORMATION SHARING

Diljeetkaur G. Makhija
Assistant Professor, Institute of Management,
Nirma University, Ahmedabad, Gujarat, India
*Corresponding Author E-mail: diljeet.makhija@gmail.com

ABSTRACT

In this era of information technology, the advancement in technology is so high that every other day, there is a new technology coming up in the market. Some prove efficient and are absorbed in the market, adapted globally, making the world a better place to live. Since a few decades, the world was busy using barcode technology everywhere, from manufacturing to libraries to retails; and then came Radio Frequency Identification (RFID) technology, which has changed the way we look at world. A technology which does not require line of sight to communicate, i.e., it can read the product from a specific distance. This paper focuses on the various applications of RFID technology and the impact it creates on the organization's improved information sharing in manufacturing organizations.

Keywords: RFID, visibility, information sharing.

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1. INTRODUCTION

With the rapid growth in the information technology, it comes up with a new technology every time which can change the scenario of human lives. Technology has gifted us with Telecommunication making the world smaller by bringing revolution in the way people communicate. Internet made the world even smaller as things now can be accessed at the click of your finger. Lost are the days where a letter used to take seven days to reach the other end, with emails coming in, the letter now reaches to the other party in a few seconds just at a click. Quick and accurate information sharing has become the need of the hour. The technology which can help organizations with this is the one which can make it efficient and effective. One of such technology is Radio Frequency Identification (RFID) technology, which offers greater visibility to all stakeholders in the supply chain. This visibility provides real-time and accurate information about products, allowing organizations to use this information to increase efficiency.

2. LITERATURE REVIEW

Radio Frequency Identification (RFID) is one of the Automatic Identification and Data Capture (AIDC) techniques which can be used to track objects in a manner similar to using barcode based systems but RFID also combines additional advantages not available in these technologies (Ishikawa et al., 2003).

An RFID system primarily consists of RFID tags (transponders) and RFID readers, but can be extended to include antennas, radio characteristics and the computer network used to connect RFID readers (Finkenzeller, 2003). RFID readers contain radio frequency modules that emit pulses of radio energy that are detected by tags and responded to with information, such as the tag's serial number. RFID tags are the labels that are attached to the object to be identified. RFID tags consist of an antenna, a small silicon chip that contains a radio receiver, a radio modulator, control logic, memory and a power system (Garfinkel & Rosenberg, 2005). RFID transmits information through radio waves between RFID tags (or transponders) and readers (Interrogators). The collected information is passed on to RFID middleware for processing, for use in various business applications. Each tag consists of unique identification information about the item to which it is attached, e.g. item ID, date of production, batch number, shipping detail, expiry date, etc. depending on the intended uses. The associated benefits of RFID are well-perceived by industries such as retail, logistics, manufacturing, the military, healthcare, pharmaceuticals and the service sector. A substantial range of RFID applications have been implemented; each industry has a unique interest in the technology benefits for their business. These benefits include enhanced stock/inventory visibility and traceability at any stage in the supply chain, automated inventory counts, improved status monitoring, increased data accuracy and sharing, increased operational efficiency, and reduced shrinkages.

An RFID system is composed of three basic components: a tag, a reader, and a host computer.

RFID tags contain tiny semiconductor chips and miniaturized antennas inside some form of packaging. They can be uniquely identified by the reader/host pair and, when applied or fastened to an object or a person, that object or person can be tracked and identified wirelessly. RFID tags come in many forms. For example, some look like paper labels and are applied to boxes and packaging; others are incorporated into the walls of injection molded plastic containers; and still others are built into wristbands and worn by people. A reader is an antenna which reads the data fed in the data fed in the tag (details of the item) and transfers the same to host computer in the form of information which can be further processed.

A typical example of RFID technology being used is supply chain management. In supply chain management, in order to know the movements of products easily, an RFID tag is attached to a product. If the product with an RFID tag moves or stays near the detection region, RFID readers will detect RFID tags and the detected information will be generated in the form of (tag identifier, location, time). As the flow of the product is detected easily by RFID technology, it is observed that RFID can be used to revolutionize supply chain management. The RFID data generated in each region (i.e., (tag identifier, location, time)) are sent to the central server. Then, the data are transformed into stay records in the form of (tag identifier, location, start time, end time). While raw RFID data have many duplicates, the transformed data (i.e., stay records) do not have duplicates. We can represent how long a tag stays at a location by the start time and end time of stay records. The stay records for each tag compose a trace record that gives us movement history with time information for the tag.

In the field of manufacturing RFID has found a wide range of uses through improvements in data quality. A number of these include inventory management (Cachon and Fisher 2000, Mills-Harris et al. 2005), manufacturing asset tracking and maintenance (Strassner and Chang

2003, Lampe et al. 2006), process tracking (Huang et al. 2007), and dynamic improvements in production planning (Brewer and Sloan 1999, Li et al. 2006). Hozak and Hill (2008) showed how ideal frequencies of production rescheduling may be concluded through the use of timely information provided by RFID technology. Wang (2008) integrated RFID technology, mobile devices, and web portals to help enhance the effectiveness and flexibility of information flow in material test management. Green et al. (2009) theorized that RFID utilization would both directly and indirectly (through supply chain productivity) impact the financial performance of the organization. They surveyed large US manufacturers and assessed an RFID performance model that includes RFID utilization, supply chain productivity, and financial performance of the organization as constructs. Vijayaraman and Osyk (2006) study found the top sources of RFID cost savings included reduction in out-of-stock, minimized inventory losses, and reduced labor costs due to less material handling.

Reyes et al. (2007) report on realized improvements, such as accuracy and availability of information, levels of process automation, level of customer service, and labor cost. Other firms have begun to adopt RFID technology with the expectations that such adoption will lead to improved supply chain productivity and financial performance (Green et al., 2007).

Firms, such as Boeing and Airbus, see RFID as a value-added technology with great potential to improve their supply chain operations (Reyes and Frazier, 2007). From supply chain level operations to shop floor level manufacturing execution, deploying radio frequency identification (RFID) technologies can help facilitate information sharing and provide visibility in the processes (Brewer et al., 1999; Lee et al., 2004; Michael and McCathie, 2005).

Many pioneer organizations and companies, such as Wal-Mart, Tesco and the United States Department of Defense, have invested in RFID technology. The potential benefits arise from an increase in supply chain visibility, an increase in efficiency and a decrease in total costs.

RFID as an emerging technology has generated an enormous amount of interest in the supply chain as stated by Lee et al. (2005). Inventory accuracy is significantly affected when RFID technology is not employed. Without this accuracy, the supply chain has incorrect information which in turn affects the whole network. Inventory cost also has a great impact on the supply chain inventory. The sharing of inventory information between suppliers and retailers not only improves the supply chain fill rate but also reduces inventory levels. The RFID technology enhanced the information system of the inventory to be tracked more accurately in real-time. More considerably, the complete integration of inventory data throughout the whole supply chain drivers, from the manufacturer's shop-floor to warehouses to retail stores, brings prospects for improvement in reducing processing time and labor cost. Zhen and Ying (2009) adopted RFID technology to design an electronic toll collection system in expressway. Wamba et al. (2006) applied RFID in B-to-B eCommerce supply chain management to improve the supply chain's end-to-end visibility. RFID technology can be used by an organization in various aspects. One of the practice of RFID technology is to increase the information sharing in organization by increasing visibility through real time sharing of data.

3. RESEARCH OBJECTIVE

The primary objective of this research is to understand the impact of RFID technology on Information Sharing in organizations.

4. RESEARCH METHODOLOGY

Various practices of RFID technology were identified through literature review and interviewing the vendors of this technology, and the research was designed to understand the impact that it creates on the information sharing in an organization. In total 52 manufacturing organization using RFID technology were studied by interviewing their top and middle level managers who were aware about the use of technology in their organization, through a structure questionnaire.

5. DATA ANALYSIS AND INTERPRETATION

Multiple regression analysis was performed to understand the impact of RFID practices on information sharing of the organizations. "Multiple regression analysis is a multivariate statistical technique used to examine the relationship between a single dependent variable and several independent variables" (Hair et. al, 2009). For performing the multiple regression analysis, following values of independent variables were considered, Regression Co-efficient, Coefficient of Determination (R^2) (Malhotra and Dash, 2010), Adjusted R^2 (Malhotra and Dash, 2010), ANOVA (F-test) (Malhotra and Dash, 2010), multicollinearity (Malhotra and Dash, 2010). multicollinearity occurs when any single independent variable is highly correlated with a set of other independent variables (Hair et. al, 2009). The simplest and most obvious means of identifying collinearity is an examination of the correlation matrix of independent variables. The presence of high correlations (generally .70 or more) is an indication of substantial collinearity (Hair et. al, 2009). A formal method of detecting the presence of multicollinearity is Variance Inflation Factors (VIF). The larger values for VIF signal the presence of multicollinearity. The common rule of thumb for a large value of VIF is 10 as described is (Keith, 2006). If the VIF value is nearer to 10 (Keith, 2006) or more than 10 (Kutner, et. al, 2005), then it signifies high level of multicollinearity among independent factors. While performing the regression analysis, all the above statistics were considered.

5.1. Hypothesis

The RFID applications create significant improvement in Information Sharing of the organization. The applications of RFID technology investigated are Work in Process Management, Inventory Management, Logistics Management, Warehouse Management and In bound Logistics Management.

The following are hypothesis have been formed:

- H1: Work in Process Management application of RFID technology shows a significant improvement on Information Sharing.
- H2: Inventory Management application of RFID technology shows a significant improvement on Information Sharing.
- H3: Logistics Management application of RFID technology shows a significant improvement on Information Sharing.
- H4: Warehouse Management application of RFID technology shows a significant improvement on Information Sharing.
- H5: In bound Logistics Management application of RFID technology shows a significant improvement on Information Sharing.

The regression co-efficient of the independent variables with their respective direction, values and significance level are given in the table 1 below:

Table 1: Regression coefficients of RFID Practices on Improved Inventory Management Efficiency

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-.276	.206		-1.338	.187		
Work in Process	.353	.067	.352	5.303	.000	.486	2.056
Inventory	.160	.052	.193	3.074	.004	.543	1.842
Logistics	.218	.070	.208	3.135	.003	.489	2.045
Warehouse	.348	.051	.429	6.841	.000	.547	1.829
In bound logistics	-.011	.030	-.023	-.373	.711	.571	1.750

As seen in the table, work in process management, inventory management, logistics management and warehouse management have a positive relationship with improved information sharing, with significance level below 0.05 and regression coefficients as + 0.352, + 0.193, + 0.208 and + 0.429 respectively rejecting the null hypothesis and accepting the alternate hypothesis H1, H2, H3 and H4, which means using RFID technology for these four applications can improve the information sharing in an organization. While in bound logistics management has a negative relationship with improved information sharing with a significance value of 0.711 which is statistically insignificant, which means use of RFID technology in-bound logistics management will not bring about a significant increase in RFID usage in improved information sharing.

Table 2: Model Summary[b]

R	R Square	Adjusted R Square	Std. Error of Estimate	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Change
.949[a]	.901	.891	.10620	.901	84.025	5	46	.000

Table 3: Variance Analysis of RFID Applications on Improved Information Sharing

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	4.738	5	.948	84.025	.000a
Residual	.519	46	.011		
Total	5.257	51			

The variance analysis given in table 3 above shows F = 84.025 at a significance level of 0.000 with df (5, 51), which indicates that all regression co-efficients will be non zero.

The emerging Multiple Regression Equation is as under:

PDF = - 0.276 + 0.352 (Work in process management) + 0.193 (Inventory Management) + 0.208 (Logistics Management) + 0.429 (Warehouse Management) - 0.023 (Inbound Logistics Management)

The adjusted R^2, i.e. the co-efficient of determination stands at 0.891 indicating that the equation can explain 89.1% variations in RFID usage in improved information sharing. For remaining variations, i.e. unexplained variations, some other variables are responsible.

Table 4 Correlation Coefficient

		Work in Process	Inventory	Logistics	Warehouse	In bound logistics
Pearson Correlation	**Work in Process**	1.000	.566	.590	.529	.505
	Inventory	.566	1.000	.388	.579	.406
	Logistics	.590	.388	1.000	.478	.592
	Warehouse	.529	.579	.478	1.000	.253
	In bound logistics	.505	.406	.592	.253	1.000

The co-efficients of correlation amongst all variables are depicted in the table 4 above. It is revealed that none of the five independent variables (work in process management, inventory management, logistics management, warehouse management and in-bound logistics management) has the co-efficient of correlation coefficient larger than $\pm$ 0.7. The VIF statistics, in table 1, of all the independent variables are very much far from cut off rate of 10. Hence, there is no cause of concern from viewpoint of multicollinearity among the independent variables.

The applications related to inventory, work in process management, inventory management, logistics management and warehouse management create an impact on the improved information sharing benefit of RFID technology, while in bound logistics management does not create an impact on improved information sharing.

6. CONCLUSION

With this research it can be concluded that RFID technology has a wide scope for application in manufacturing industry and has potential benefit of better information sharing in an organization making it efficient and effective.

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