



Barcode for Retail Store Operations- The Perfect Tool at Low Cost

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ABSTRACT: Barcodes are commonly used tool for retail store operations in India. Through literature review and questionnaire method, various parameters are identified to further study the reasons of adopting bar-coding in place of RFID and EDI. Bar-coding is economical and easy to use without much training to the employees and costly technological infrastructure is also not required for the implementation. The results of statistical analysis prove that use of bar-coding in retail store operations offers better services at low cost. It helps in management of inventory in the retail outlet.

Keywords: Bar-coding, EDI, Inventory Control, Retail, RFID, Store Management.

I. INTRODUCTION

Retail organizations are attracting the customers by providing the quality products at lesser cost. To achieve the economies of scale, these retailers are utilizing the technology benefits. In India most of the customers are price conscious and that is the reason the retailers are facing challenges to offer superior products at lesser cost. To reduce the cost of overall business operations, the retailers depend on technology. Lots of tools are available to run the business smoothly at lower cost. Electronic Data Interchange (EDI), Bar-coding and Radio Frequency Identification (RFID) are some technological inventions to reduce operating cost and ultimately cost reduction in product cost. Most of the researchers have the opinion that EDI was first launched in 1960s [4, 18] though it is not confirmed. In EDI, business information is exchanged through computer to computer among business associates [15]. Before EDI all the business communication were done through fax, mail and telephone etc. The objective was to improve the accurateness of information and cost reduction to achieve the competitive advantages [18]. Barcode was commercially introduced in US supermarkets in 1974 [9, 23], but its extensive utilization in the retail segment reduced EDI usage [1]. RFID technology possesses some advantages but has some major drawbacks also such as tag cost and quality of tags etc. [19]. All the tools have numerous advantages and disadvantages. In India all most all retailers are using bar-coding in their daily retail store operations because bar-coding is less costly in comparison to RFID and has many advantages over EDI. It is the views of researchers and managers that bar-coding have huge advantages over EDI and RFID. In the current paper, researcher has focused on the bar-coding because bar-coding is extensively used by Indian retailers in their store operations. Through literature review and interviews with store managers, many variables are identified which are affected by bar-coding which creates further scope to study. The present work aims to answer following research questions:

RQ1: How barcode is more advantageous in comparison to RFID and EDI?

RQ2: Does barcode fill the gap between RFID and EDI?
RQ3: Is barcode better choice in Indian context?

II. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Instant point of sale information cannot be conveyed through EDI without barcodes [7]. UPCs are used by retailers for inventory control which is the main focused area to reduce cost. A barcode consists of a sticker with a Universal Product Code (UPC) that can be traced by an optical scanner [7]. The UPC is alternative black and white lines with lot of information about the product such as manufacturer, package size, and style etc. Barcodes are introduced to increase the accurateness of information with transmission rate [12] and to persuade data sharing.

Bar-coding also improves savings through routine ordering, instant shelf allocation, better trade analysis, and immediate product tracking [25]. Internal and external theft is responsible for inventory mismatch [3]. Inventory mismatch refers to difference in information system inventory and physical inventory. Inaccurate incoming and outgoing deliveries are also responsible for inventory mismatch [17]. Hollinger and Davis (2001) [10] analyzed through survey method that theft, managerial faults and vendor scam costing to US retailers USD 33 billion in 2001 which was about 1.8 % of sales.

Inventory errors are the major problem now days in retail operations which lead to bullwhip effect. Reducing inventory errors any how is necessary to reduce bullwhip effect. Chen *et al.*, (2000) [5] conclude that data sharing on customer demand can be helpful in reducing the bullwhip effect. Inventory mismatch due to theft has major role on supply chain performance and removing stock errors reduces the cost of supply chain and also reduces the out-of-stock level [8]. RFID technology is not completely proven and that is the reason many retailers hesitating in implementing RFID technology and waiting for the better results [11, 16, 22, 24]. Wyld (2006) [26] explained that most of the researchers are only focusing on RFID uses in their research due to its publicity but they have forgotten about the reliability of bar-coding due to which bar-

coding is the most widely used technology in businesses with five billion barcodes scanned daily in the world.

Lots of issues are associated with RFID implementation such as technical issues and hardware related problems and also cost of tags, information infrastructure and privacy concerns are the major issues. Radio waves are affected by moisture, metal, noise and fluorescent lights [14]. Due to uncertain return on investments and technology standards related issues, RFID is not matured enough to be implemented in warehouse operations [2]. In addition to this, RFID has some other limitations also such as privacy and security related limitations. Customer transaction information which is kept in RFID tag may be accessed and misused without permission. Barcode technology implementation has improved the operational efficiency within the organization in the form of data accuracy, inventory control, and product management [6]. Barcodes are reliable and more accurate in comparison to manual techniques and also affordable with ease of uses [13]. Bar-coding is well established in business operations and it is not easy for RFID technology to replace barcodes because of cost issues [20]. Bar-coding is tremendously accepted because of its feature of saving time and money with reduced errors [21]. Available literatures on uses of bar-coding in retail clearly indicate that bar-coding is economical with lots of benefits. Literature review and interviews with store managers has helped in identification of areas where bar-coding is useful when used in retail store operation. The identified areas are protection from theft, faster and improved customer service, reducing inventory errors, easy accessibility in showroom, time saving, improved efficiency, reduce cost, fast inventory status in store, faster information dissemination and tracking & tracing the material. These areas are considered as part of efficient store management. For the purpose of testing and statistical analysis following hypothesis is proposed. H: Barcode affects the overall store management / service availability to provide better services and management.

III. METHODOLOGY

Data Collection: The respondents for the present research are store managers of organized retail stores which are successfully operating in India. These store managers are responsible for smooth functioning of their respective retail outlets. The researcher contacted around 250 store managers through email and provided them the link to the online questionnaire. The researcher selected only those managers who belong to top line. The email is open by 85 store managers within 25 days. Again request based reminder mail sent to those managers who did not open the link. Finally the researcher received total hundred responses which were complete in all respect within 40 days. Respondents were asked about the usefulness of bar-coding in identified areas of research.

Selection of Industry: Barcodes are extensively used in all areas of business. Even the small retailers are using barcodes in their daily business activities. The organized retail stores were selected because of several reasons. First, it is the fastest growing sector in India. In addition to this, several literatures explored the use of barcode, EDI and RFID in organized retail sector as discussed in literature review section. Finally organized

retail sector suits best to examine the usefulness of barcodes in Indian context.

Measurement: The questionnaire was developed from valid areas taken from previous literature and interview with stores managers. Responses are collected on five point Likert scales, ranging from "not effective" to "highly effective". Data coding is done and SPSS is used for statistical analysis.

IV. DATA ANALYSIS

H: Barcode affects the overall store management/ service availability to provide better services and management.

All the variables are highly correlated with one another (See Table 1). Due to this high correlation, researcher conducted a factor analysis in which researcher entered all variables which are affected by bar-coding. Factor analysis was carried out using principal component extraction with varimax and Kaiser Normalization. The suitability of factor analysis was checked by the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy & Bartlett's test of Sphericity reveals adequate values for derivation of the used technique. Kaiser (1974) has recommended the range between 0.5 to 0.8 for KMO value. Here the KMO value is 0.606 (Table 2), therefore can be accepted.

For Technological support, all the parameter of store management/service availability when based on barcode technology effect then most of all values of store management/service are positive values i.e. more than 1 or 0. Tracking and tracing the material having good Eigen value shows that this parameter has same significant impact in comparison to others when bar coding technology is being used. Overall the changes brought down by all values seem to be influenced by bar-coding towards the positive.

The outcome of the Table 4 is interpreted as follows:

- Two factors (components) have been saved. The study assumes that 10 original variables can be reduced to five underlying factors.
- The five components describe 68% of variance in the data. It means when it is assumed that there are five components, we can forecast 68% of the information in all the 10 variables.
- The first component explains more of the variance as compared to second component (29% versus 16%).

The rotated component matrix is the main outcome of principal components analysis. It is also referred as loadings. It shows correlations between each of the variables and the estimated components.

- There are moderate-to-strong correlations between four store management / service availability and component 1.
- The correlations between the parameter and the first component are high. Thus, the first component seems to determine tendency to all parameters.
- There are moderate-to-strong correlations among most of all services & managerial feature.

Thus reducing inventory errors, easy accessibility in showroom, time saving and improved efficiency are coming in 1st component mean that the primarily benefited services due to bar-coding and other variable are contributing in explaining the variance at 2nd, 3rd, 4th and 5th component.

Hence null hypothesis is rejected that implies that Barcode affects the overall store management/service availability to provide better services and management.

Table 1: Correlation Matrix.

		Protection from theft	Faster and improved customer service	Reducing inventory errors	Easy accessibility in showroom	Time saving	Improved efficiency	Reduce Cost	Fast inventory status in store	Faster information dissemination	Tracking and tracing the material
Correlation	Protection from theft	1.000	.186	.186	.138	-.050	.064	.119	-.019	.140	-.185
	Faster and improved customer service	.186	1.000	.130	.215	.015	.052	.175	.049	-.038	.138
	Reducing inventory errors	.186	.130	1.000	.064	.345	.097	.038	.246	.036	.076
	Easy accessibility in showroom	.138	.215	.064	1.000	.347	.110	-.028	.166	-.047	.000
	Time saving	-.050	.015	.345	.347	1.000	.289	.048	-.037	.004	-.052
	Improved efficiency	.064	.052	.097	.110	.289	1.000	-.270	-.231	.080	.029
	Reduce Cost	.119	.175	.038	-.028	.048	-.270	1.000	-.095	.051	-.052
	Fast inventory status in store	-.019	.049	.246	.166	-.037	-.231	-.095	1.000	.084	.056
	Faster information dissemination	.140	-.038	.036	-.047	.004	.080	.051	.084	1.000	-.243
	Tracking and tracing the material	-.185	.138	.076	.000	-.052	.029	-.052	.056	-.243	1.000
Sig. (1-tailed)	Protection from theft		.032	.032	.086	.309	.263	.120	.427	.083	.033
	Faster and improved customer service	.032		.100	.016	.441	.303	.041	.315	.354	.086
	Reducing inventory errors	.032	.100		.263	.000	.169	.354	.007	.362	.225
	Easy accessibility in showroom	.086	.016	.263		.000	.137	.390	.050	.321	.500
	Time saving	.309	.441	.000	.000		.002	.319	.357	.486	.303
	Improved efficiency	.263	.303	.169	.137	.002		.003	.010	.215	.388
	Reduce Cost	.120	.041	.354	.390	.319	.003		.175	.308	.304
	Fast inventory status in store	.427	.315	.007	.050	.357	.010	.175		.204	.289
	Faster information dissemination	.083	.354	.362	.321	.486	.215	.308	.204		.007
	Tracking and tracing the material	.033	.086	.225	.500	.303	.388	.304	.289	.007	

Table 2: KMO and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.606
Bartlett's Test of Sphericity	Approx. Chi-Square	107.729
	Df	45
	Sig.	.000

Table 3: Communalities.

	Initial	Extraction
Protection from theft	1.000	.676
Faster and improved customer service	1.000	.697
Reducing inventory errors	1.000	.524
Easy accessibility in showroom	1.000	.414
Time saving	1.000	.864
Improved efficiency	1.000	.776
Reduce Cost	1.000	.842
Fast inventory status in store	1.000	.850
Faster information dissemination	1.000	.555
Tracking and tracing the material	1.000	.621

Extraction Method: Principal Component Analysis.

Table 4: Total Variance Explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.785	17.849	17.849	1.785	17.849	17.849	1.617	16.169	16.169
2	1.434	14.344	32.193	1.434	14.344	32.193	1.376	13.757	29.926
3	1.380	13.797	45.990	1.380	13.797	45.990	1.305	13.048	42.975
4	1.198	11.980	57.969	1.198	11.980	57.969	1.274	12.738	55.712
5	1.021	10.211	68.180	1.021	10.211	68.180	1.247	12.468	68.180
6	.965	9.650	77.830						
7	.809	8.094	85.924						
8	.616	6.163	92.087						
9	.442	4.421	96.508						
10	.349	3.492	100.000						

Extraction Method: Principal Component Analysis.

Table 5: Rotated Component Matrix^a.

	Component				
	1	2	3	4	5
Protection from theft		.420			
Faster and improved customer service			.773		
Reducing inventory errors	.609			.362	
Easy accessibility in showroom	.537				
Time saving	.896				
Improved efficiency	.347				
Reduce Cost					.879
Fast inventory status in store				.914	
Faster information dissemination		.726			
Tracking and tracing the material		.762			

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.
 a. Rotation converged in 7 iterations.

V. CONCLUSION AND FUTURE RECOMMENDATIONS

As the results clearly show the importance of bar-coding in several dimensions of store operations, we can conclude that bar-coding is much better technology in comparison to RFID and EDI. Bar-coding is economical to apply and easy to use without any privacy concerns with lot of benefits and that is why it is mostly used by Indian retailers. Bar-coding is still leader in retail operations which is not only serving in a better way but also helpful in reducing bullwhip effect at lower cost. The results of the study give the clear picture of bar-code efficiency in different areas of store functions which are considered for study. Further empirical research with other statistical tool is also recommended to strengthen the efficiency of bar-code in retail

operations. Much more other areas can also be identified for further investigation of bar-code efficiency.

Conflict of Interest. No conflict of interest.

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