



Enhancing Customer Relationship Management In The Banking Sector Using Machine Learning Approach: An Analytical Study Of Selected Private Banks In Bhubaneswar, Odisha"

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Abstract: The rapid evolution of technology presents numerous business opportunities, particularly with the advent of Machine Learning (ML), which has revolutionized the contemporary business landscape. ML tools offer marketing professionals unprecedented capabilities, streamlining business operations and prompting a paradigm shift in marketing strategies. Consequently, the significance of investing in and adopting AI technologies, integral to modern marketing tasks, becomes undeniable. This study focuses on elucidating the impact of customer retention and service quality leveraging a proposed Machine Learning Model. By examining these dynamics, we aim to underscore the significance of a highly integrated approach to innovation, discovery, creation, and customer retention, thereby advancing strategies for sustainable growth and competitiveness in the private sector banks. Customer acquisition remains pivotal for new entrants, while retention emerges as the cornerstone of success for established institutions, offering a cost-effective means of sustaining profitability. CRM practices empower Indian bankers to achieve business objectives by acquiring and retaining valuable customers, integrating them seamlessly into the entire business ecosystem. Yet, despite its criticality, customer retention often takes a back seat to acquisition in the priorities of banking. The Banking and Financial Sectors, now mature and robust, have embraced ML in various capacities within Customer Relationship Management (CRM) and marketing domains. These implementations yield profound impacts on customer loyalty, profitability, and Return on Investment (ROI). As the industry witnesses the emergence of specialized software tailored by IT firms to develop customized CRM solutions, the sector's dynamics, shaped by liberalization, privatization, and globalization (LPG), continue to diversify.

Keywords Banking Sector, Customer, CRM, ROI, Machine Learning.

I. INTRODUCTION

The Indian banking sector has undergone significant structural transformations propelled by advancements in information and communication technology (ICT). These changes have reshaped traditional banking activities. Today, the entire spectrum of banking operations has been revolutionized by the integration of information technology and communication networks. Furthermore, heightened competition among a diverse array of domestic and foreign institutions, particularly in product marketing, has become ubiquitous in the industry's landscape. To navigate the ever-evolving economic milieu, financial organizations have increasingly adopted customer-centric services across various domains. Customer Relationship Management (CRM) emerges as a pivotal tool in automating sales and customer service activities, profoundly impacting relationship marketing with its diverse principles. In this dynamic business environment, the convergence of information technology (IT) and Machine Learning (ML) assumes paramount importance, particularly in the financial sector. ML algorithms, tools, and mechanisms leverage new technologies to enhance the customer experience and refine CRM practices. ML's intervention enables a deeper understanding of customer

behavior and aids financial institutions in assessing customer sentiment towards their services. Customers today expect a myriad of offerings, including competitive pricing (such as interest rates), financial security, prompt service, convenience, favorable Return on Investment (ROI), low-cost loans, streamlined professional services, comprehensive analysis, easy accessibility, simplified procedures, and a personalized approach across a wide range of products. Consequently, the entire service sector is undergoing a paradigm shift towards becoming more customer-centric. Ultimately, effective CRM implementation not only amplifies profits but also capitalizes on an organization's competitive advantage, leading to sustained growth and success in the marketplace.

Statement of the problem

The customer relationship management and its changing dynamics over a period of time in Indian banking sector has assumed greater importance with the adoption of modern technology. However, the changing dynamics of customer relationship management is quite visible in post-digitalisation era. Now-a-days the customers rarely visit the bank branch for any regular banking transaction. Under such changing scenario, the importance of the shift from traditional CRM to machine learning ECRM need to be realised by the banking sector. The current banking institutions are facing threat not only from the fintech companies but also from the international banks. In addition to that, private banks and foreign banks are adopting a flexible approach in serving their customers by concentrating more on customer relationship management both physically and digitally. This renders a clear picture of the dependency of the banking institutions on machine learning ECRM that is technology driven to ensure customer satisfaction, loyalty and retention. The above stated aspects motivated the researchers to conduct the present study to examine customers' retention through machine learning CRM practices adopted by the selected private banks.

II. LITERATURE REVIEW

Several studies have highlighted how CRM systems powered by machine learning algorithms can significantly enhance the overall customer experience in the banking sector. By analysing vast amounts of customer data, these systems can provide personalized recommendations, anticipate customer needs, and offer tailored services, leading to higher levels of customer satisfaction and loyalty.

Machine Learning (ML) describes how various techniques and principles are applied in the financial sector today. It has been summarized in our development under the implications in terms of competition to elucidate the link between ML developments and the market competition they engender. ML, derived from Artificial Intelligence (AI), enables various software applications to utilize historical data and predict outcomes accurately without the need for explicit programming.

Burns (2020) confirmed that the utilization of ML across different enterprises has experienced significant growth over the years, with nearly every area of modern business being impacted by ML. He also elucidated that ML is specifically adept at processing vast amounts of data rapidly by identifying patterns within the data and predicting future outcomes based on these patterns.

Frankenfield (2020) explained that ML encompasses a broad category of techniques. The development of an interconnected network of Artificial Intelligence (AI) "nodes" has led to the emergence of Artificial Neural Networks (ANNs).

Kalaiarasi and Mugunthan (2019) conducted a study to examine the significance of CRM practises in the banking industry. The findings of the study revealed that banks could increase their competitiveness by winning over their customers' heart by implementing customer relationship management. The study suggested that the banking industry need to acquire enough resources and turn them into services in order to please customers.

Arsic et al. (2018) found the importance of reinforcing customer loyalty based on the basic principle in today's highly competitive market ecosystem and it gives the ability to reduce the risk of losing the best customer which is a key factor.

Optimove (2020) who described CRM as the collection of all marketing strategies and processes used to develop and manage customer relationships. CRM's primary goal is to improve and augment customer relationships so that businesses can achieve customer loyalty, revenue growth, and customer lifetime value through customer retention.

Cole (2019) defined CRM adoption in businesses are increasing because it is critical to residing in the current state with the newest trends in a highly competitive market.

Mahdavinejad et al. (2018) discovered that incorporating more data into ML algorithms improves the models' performance. ML is well-suited for contextualizing large volumes of data into information that humans can comprehend.

Syam & Sharma, (2018) stated that one of the most important roles of CRM in decision-making. Over time, technology has aided in the enhancement of business contact and data, but decision-making remains solely in the hands of human beings.

Fruhling&Siau (2007) described a person or a group of the community may recognize a set of ideas, practices, or objects which is innovative.

Buttle (2004) clarified in his research that Customer Relationship Management (CRM) is a specialized business tool that has evolved into a global concept of managing customer relationships, with the primary objectives being customer loyalty and enhancing company outcomes.

Machine learning techniques enable banks to segment their customer base more effectively, allowing for targeted marketing campaigns and personalized product offerings. By analyzing historical data and customer behavior patterns, banks can identify distinct customer segments and develop strategies to address their specific needs and preferences.

However, as technology advances, the procedure of making suitable and dependable decisions is interlinked to the machines.

III. Objectives of the study

Following are the main objectives of the present research work.

1. To examine the relationship between Machine Learning CRM and customer retention in selected private banks.
2. To examine service marketing strategies for customer retention through Machine Learning CRM in selected private banks.

Hypotheses for the study

1. H_01 There is no statistically significant relationship exists between service marketing and CRM practice in selected private banks.
2. H_02 There is no statistically significant relationship exists between CRM and customer retention in selected private banks.
3. H_03 There is no statistically significant impact of service marketing on customer retention in selected private banks.

Methods

The following methodology has been adopted for carrying out the present research work.

Data Collection: The data for the present study have been obtained mainly from the primary source i.e. through a structured questionnaire. Moreover, the face validity, criterion validity and content validity relating to the questionnaire were done with appropriate techniques to make the data fit for analysis and interpretation.

Period of the study: The period of the study covered from 8 to months during 2021 and 2022. Further, the researchers made a pilot study by taking 50 samples to examine the validity of the questionnaire as well as ensuring that the data is useful for analysis and fit for the research objectives.

Sampling frame and size: In this research work, the private sector banks located in Bhubaneswar city of Odisha is the sampling frame. From this sampling frame the sample respondents have been picked up for collection of primary data. In this study, 700 bank customers were approached for the survey from 6 private banks namely Axis Bank, HDFC Bank, ICICI Bank, Kotak Mahindra Bank, YES Bank and IDBI Bank. An attempt was made to achieve a greater number of valid responses for the research work. Finally, the sample size for the present study is 564 customer respondents.

Tools and Techniques used for the study: In this study, Structural equation modelling and multiple regression analysis have been mainly used for data analysis. To test the hypotheses, χ^2 test has been used in this study.

Development of the conceptual model

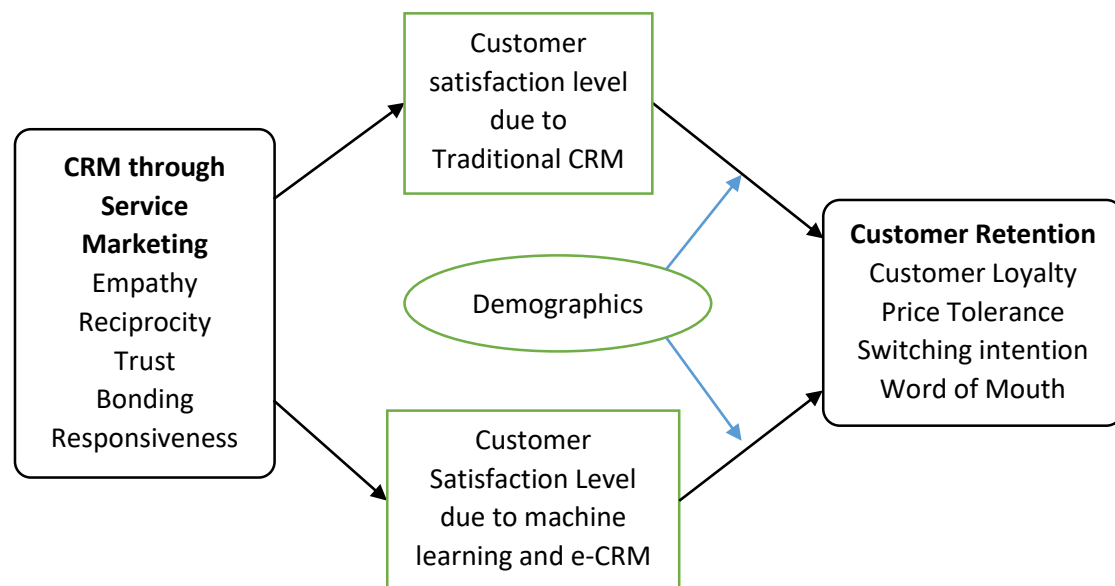


Fig.1: Conceptual model framework

The above fig.-1 shows a preliminary structural model where relationships are established among the test variables. It was assumed that in the modern banking system both the ECRM practices and the traditional CRM practices are responsible for better customer retention. Besides, better CRM practices were assumed to be ensured by the quality services provided by the banks. Since, service quality is one of the crucial elements in the banking sector, therefore, CRM practices also supposed to be greatly influenced by the service quality parameters. The present research only used major key aspects that are directly representing the better customer relationship building features of the banking sector.

IV. Analysis and Interpretation of data

To investigate the retention of customers in selected private banks, service marketing strategies as well as CRM practices are used as important factors in the present study. To analyse the data, structural equation modelling has been applied taking into account four constructs such as Customer Retention (CR), Electronic Customer Relationship Management (ECRM), Traditional Customer Relationship Management (TCRM) and Service Marketing (SM). Before proceeding for Structural equation modelling, factor analysis has been applied to the above mentioned constructs.

Factors analysis

The Exploratory Factor Analysis (EFA) has been conducted using principal component analysis and varimax rotation method for all four constructs (Customer Retention, ECRM, TCRM and Service Marketing) separately for better refinement of these factors. The EFA outcomes are useful in taking decision to include or remove any item(s) from the construct. All items loaded on a single dimension with factor loadings and communalities value of more than 0.50 were retained in the construct. The following sections discuss the primary refinement of all the constructs.

Customer retention

The first factor verified using exploratory factor analysis is the customer retention. There are five statements which were asked to the respondents to collect data and measure the construct. All the statements were adopted from prior research studies. All the statements were taken to test which variable to be included and which one to be dropped. The following table-1 presents the initial results for the communalities and the total variance explained. It can be seen from the table that the communality value of the variables CR2 and CR3 are low i.e. 0.350 and 0.423 respectively and are less than 0.5. Therefore, these two variables need to be dropped and again to test whether the total variance explained by the construct is improved or not. After dropping the variables, the communalities of the variables have improved above 0.5 and the total variance explained has also improved from 65.75% to 90.31%.

Table-1a: Initial results of communalities for CR

	Initial	Extraction
CR1	1.000	.835
CR2	1.000	.350
CR3	1.000	.423
CR4	1.000	.850
CR5	1.000	.830

Extraction Method: Principal Component Analysis.

Table-1b: Total variance explained for the variable CR

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.288	65.750	65.750	3.288	65.750	65.750
2	.860	17.191	82.942			
3	.618	12.352	95.293			
4	.199	3.973	99.266			
5	.037	.734	100.000			

Extraction Method: Principal Component Analysis.

The factor analysis outcome for CR construct with three items shows improved results given in the Table-1c. The KMO score of 0.713 (significant) indicated enough correlation and exhibited a significant Bartlett's test for sphericity. The total variance explained by the single factor is 90.31%. All the items were loaded on a single dimension with factor loadings whose values are more than 0.60.

Table-1c: Exploratory factor analysis final result for CR

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.713
Bartlett's Test of Sphericity:	
Approx. Chi-Square	2055.906
Df	3
Sig.	0.000
Initial Eigenvalue	2.710
% Of Total Variance Explained	90.319
Rotated component matrix:	
Variables	Component
CR4	0.974
CR5	0.968
CR1	0.908

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

The Confirmatory Factor Analysis (CFA) result for the customer retention shows acceptable model fit indices: $\chi^2/df = 1.613$, RMR= 0.024, GFI= 0.911, AGFI= 0.813, NFI= 0.941, CFI= 0.942 and RMSEA = 0.057. The result demonstrates that there has been no need for further modification of the model.

Table-1d: Model fit indices for customer retention

Indices	Value
CMIN/DF	1.613
RMR	0.024
GFI	0.911
AGFI	0.813
NFI	0.941
CFI	0.942
RMSEA	0.057
AVE	0.561
CR	0.856

V. Machine Learning & ECRM

The second factor verified using EFA is the Machine Learning E-CRM practices of selected private banks. There are six statements which were asked to the respondents to collect data and measure the construct. The following table-2 a & b presents the initial results for the communalities and the total variance explained. It can be seen that the communality value of the variables that ECRM1 and ECRM5 values are low i.e. 0.461 and 0.353 respectively and are less than 0.5. Hence, these two variables need to be dropped and again to test whether the total variance explained by the construct is improved or not. After dropping these variables, the communalities of the variables have improved above 0.5 and the total variance explained has also improved to 69.43% from 47.93%.

Table-2a: Communalities for the variable Machine Learning ECRM

	Initial	Extraction
ECRM1	1.000	.461
ECRM2	1.000	.498
ECRM3	1.000	.477
ECRM4	1.000	.477
ECRM5	1.000	.353
ECRM6	1.000	.511

Extraction Method: Principal Component Analysis.

Table-2b: Total variance explained for the variable ECRM

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.876	47.933	47.933	2.876	47.933	47.933
2	.683	11.383	59.315			
3	.660	11.004	70.319			
4	.633	10.550	80.870			
5	.601	10.016	90.885			
6	.547	9.115	100.000			

Extraction Method: Principal Component Analysis.

The factor analysis outcome for ECRM construct with four items shows improved results as shown in the Table-2c. The KMO score of 0.827 (significant) indicated enough correlation and exhibited a significant Bartlett's test for sphericity. The total variance explained by the single factor is 69.43%. All the items were loaded on a single dimension with factor loadings whose values are more than 0.60.

Table-2c: Exploratory factor analysis final result for ECRM

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.827
Bartlett's Test of Sphericity:	
Approx. Chi-Square	401.473
Df	6
Sig.	0.000
Initial Eigenvalue	2.170
% Of Total Variance Explained	69.439
Rotated component matrix:	
Variables	Component
ECRM6	0.762
ECRM2	0.738
ECRM3	0.728
ECRM4	0.717

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

The CFA model result for the ECRM shows acceptable model fit indices: $\chi^2 / df = 1.209$, RMR= 0.026, GFI= 0.998, AGFI= 0.989, NFI= 0.994, CFI= 0.999 and RMSEA = 0.019. The result demonstrates that there has been no need for further modification of the model.

Table-2d: Model fit indices for ECRM

Indices	Value
CMIN/DF	1.209
RMR	0.026
GFI	0.998
AGFI	0.989
NFI	0.994
CFI	0.999
RMSEA	0.019
AVE	0.539
CR	0.816

VI. TCRM

The third factor generally in practice in the banking sector is the Traditional Customer Relationship Management (TCRM). It is verified by using EFA. There are six statements which were asked to the respondents to collect information regarding CRM practices in physical mode. The following table-3a presents the initial results for the communalities and the total variance explained. It can be seen that the communality values of all the variables under TCRM are high i.e. more than 0.5. So, there is no need of dropping any variable since the values of communalities of the variables are good enough for retention in the construct. Moreover, the total variance explained is 91.44%.

Table-3a: Communalities for the variable TCRM

	Initial	Extraction
TCRM1	1.000	.917
TCRM2	1.000	.914
TCRM3	1.000	.916
TCRM4	1.000	.912
TCRM5	1.000	.912
TCRM6	1.000	.915

Extraction Method: Principal Component Analysis.

Table-3b: KMO and Bartlett's Test for TCRM

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.952
Bartlett's Test of Sphericity	Approx. Chi-Square	5437.348
	Df	15
	Sig.	.000

Table-3c: Total variance explained for the variable TCRM

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.486	91.440	91.440	5.486	91.440	91.440
2	.119	1.980	93.419			
3	.111	1.846	95.265			
4	.103	1.713	96.978			
5	.094	1.566	98.544			
6	.087	1.456	100.000			

Extraction Method: Principal Component Analysis.

Table-3d: Component Matrix^a for the variable TCRM

	Component1
TCRM1	.959
TCRM3	.957
TCRM6	.957
TCRM2	.956
TCRM5	.955
TCRM4	.954

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

The CFA result for the TCRM shows acceptable model fit indices: $\chi^2/df = 1.799$, RMR= 0.009, GFI= 0.991, AGFI= 0.978, NFI= 0.997, CFI= 0.993 and RMSEA = 0.018. The result demonstrates that there has been no need for further modification of the model.

Table-4.15e: Model fit indices for TCRM

Indices	Value
CMIN/DF	1.799
RMR	0.009
GFI	0.991
AGFI	0.978
NFI	0.997
CFI	0.993
RMSEA	0.018
AVE	0.676
CR	0.893

Service marketing

The Fourth factor responsible for the effectiveness of customer retention in the banking sector is service marketing elements. There are five statements which were asked to the respondents to collect information regarding service marketing practices in the private banks. All the statements were taken to test which variables to be included and which one to be dropped. In the following table-4 a & b, the initial results for the communalities and the total variance have been presented. It can be seen that the communality value of the all the variables under service marketing are high i.e. more than 0.5. Thus, there is no need for dropping any variable since the values of communalities of the variables are good enough for retention in the construct. Moreover, the total variance explained is 67.49%.

Table-4a: Communalities for the variable SM

	Initial	Extraction
SM1	1.000	.664
SM2	1.000	.682
SM3	1.000	.684
SM4	1.000	.690
SM5	1.000	.654

Extraction Method: Principal Component Analysis.

Table-4b: KMO and Bartlett's Test for the variable SM

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.884
Bartlett's Test of Sphericity	Approx. Chi-Square
	1341.445
	Df
	10
	Sig.
	.000

Table-4c: Total variance explained for the variable SM

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.375	67.498	67.498	3.375	67.498	67.498
2	.445	8.905	76.402			
3	.406	8.128	84.530			
4	.390	7.808	92.339			
5	.383	7.661	100.000			

Extraction Method: Principal Component Analysis.

Table-4d: Component Matrix^a for the variable SM

	Component 1
SM4	.830
SM3	.827
SM2	.826
SM1	.815
SM5	.809

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

The EFA outcome for SM construct with all the five items intact shows better quality results given in the above tables. The KMO score of 0.884 (significant) indicated enough correlation and exhibited a significant Bartlett's test for sphericity. The total variance explained by the single factor is 67.49%. All the items were loaded on a single dimension with factor loadings more than 0.60.

The CFA results for the service marketing shows acceptable model fit indices: $\chi^2/df = 3.396$, RMR= 0.019, GFI= 0.991, AGFI= 0.986, NFI= 0.988, CFI= 0.979 and RMSEA = 0.013. The result demonstrated that there has been no need for further modification of the model.

Table-4e: Model fit indices for service marketing

Indices	Value
CMIN/DF	3.396
RMR	0.019
GFI	0.991
AGFI	0.986
NFI	0.988
CFI	0.979
RMSEA	0.013
AVE	0.655
CR	0.801

After doing the refinement of the constructs through EFA and CFA, the next step is to test the structural model after obtaining the regression weights of all the latent variables. Dependence relationships have been considered between exogenous and endogenous constructs. The structural model has been prepared by using AMOS 20.0 and the results are given in the following tables. The result shows information relating to the regression model, the model fit, intercept, variances, etc. The structural equation modelling results with path coefficients of unstandardized is given in Fig.2 below.

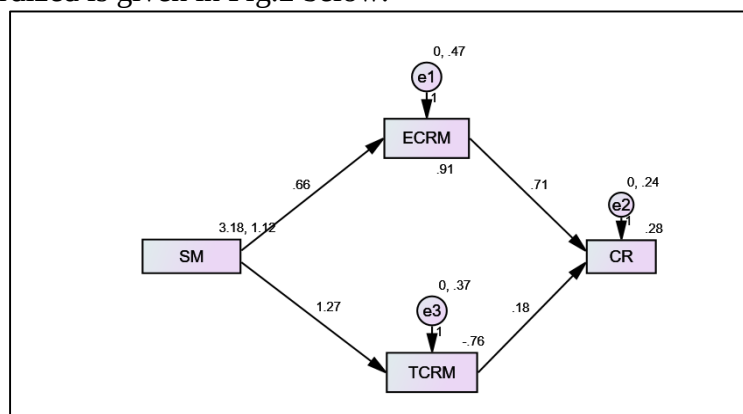


Fig.-2: Structural model showing unstandardised estimates

The above figure presents the unstandardised regression coefficients for the relationship between the endogenous and exogenous variables. It can be seen that there are four variables used in the structural model. Service marketing is the independent variable predicting the implication and practices of ECRM and TCRM on customer retention in selected private banks. The two categories of CRM practices are used to test customer retention. The unstandardised coefficients between service marketing explaining ECRM is 0.66

whereas service marketing explaining TCRM is 1.27. similarly, the coefficient between ECRM and CR is 0.71 and between TCRM and CR is 0.18. However, the value of coefficient between SM and TCRM is high as compared to SM and ECRM.

The following table-5 reveals the regression coefficients, standard errors and composite reliability and p-value of the relationship between different constructs. It can be observed that all the relationships in the model are statistically significant. The relationship between SM and ECRM is showing a beta estimate of 0.661 with standard error 0.027 and CR as 24.208 that is statistically significant at p-value less than 0.001. The relationship between SM and TCRM is showing a beta estimate of 1.266 with standard error 0.024 and CR as 52.427 is statistically significant at p-value less than 0.001. These observations lead to the rejection of the null hypothesis (H_01) which says there is no statistically significant relationship between service marketing and CRM practices in select private banks.

Further, the relationship between ECRM and customer retention is showing a beta estimate of 0.710 with standard error 0.028 and CR as 25.672 which is statistically significant at p-value less than 0.001. Again, the relationship between TCRM and customer retention is showing a beta estimate of 0.180 with standard error 0.018 and CR as 9.769 is statistically significant at p-value less than 0.001. These observations lead to the rejection of the null hypothesis (H_02) which says there is no statistically significant relationship between CRM practices and customer retention in select private banks. On the basis of the regression coefficients arrived at the final structural model (unstandardized), it can be inferred that the impact of service marketing on customer retention through CRM practices is statistically significant and hence, the null hypothesis (H_03) which says there is no statistically significant impact of service marketing on customer retention through CRM practices in select private banks is rejected. Further, it is pertinent to mention that the impact of service marketing on customer retention through ECRM practices is more effective than the TCRM on the basis of beta coefficients.

Table-5: Regression weights (Unstandardized) of the final SEM

			Estimate	S.E.	C.R.	P	Label
ECRM	<---	SM	.661	.027	24.208	***	Significant
TCRM	<---	SM	1.266	.024	52.427	***	Significant
CR	<---	ECRM	.710	.028	25.672	***	Significant
CR	<---	TCRM	.180	.018	9.769	***	Significant

From the foregoing discussion, it can be inferred that the structural model is quite acceptable on the basis of model fit indices as shown in table-6. Further, from the above test results, it can be concluded that the structural model showing the impact of service marketing on customer retention through CRM practices of select private banks is acceptable.

Table-6: Model fit indices for structural model

Indices	Value
CMIN/DF	3.221
NFI	0.972
CFI	0.973
RMSEA	0.057
TLI	0.919
AIC	88.422
BIC	88.637
ECVI	0.147
HOELTER	53 at .05, 81 at .01
PRATIO	0.333

VII. Results and conclusion

It is revealed from the analysis that the relationship between service marketing and TCRM is significantly high with a beta value of 1.27 whereas the relationship between service marketing and Machine Learning ECRM is no doubt, significant but the beta coefficient is comparatively low i.e., 0.66. In other words, service marketing has a significant association with both traditional and digital practices relating to managing customer relationship in the private banks. It is also observed that the present service marketing practices are not that efficient and effective in virtual banking operations through Machine Learning ECRM practices. Therefore, banks need to focus on this aspect so that Machine Learning ECRM practices could be improved further. Further, with regard to the link between CRM and CR, it is found that both Machine Learning ECRM and TCRM are significantly associated with customer retention in the private banks. On the whole, the

magnitude of impact of Machine Learning ECRM practice is high on the customer retention as compared to TCRM practices.

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