Role of FinTech in Enhancing Operational Efficiency and Financial Inclusion in the Indian Banking Sector

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2026 International Conference on Green Technologies and Sustainable Solutions (GTSS) | 979-8-3195-1778-4/26/$31.00 ©2026 IEEE | DOI: 10.1109/GTSS68743.2026.11679795

***Abstract* - The rise of the Financial Technology (FinTech) has transformed the way banks do business all around the world. As of the this, customer-focused models, digital innovating, and the automating have all been put into the place. FinTech has changed the game in an india, especially when it comes to the making of financial services easier for a everyone to the get, helping operations run more of a smoothly, and the making of clients happier with the banks. FinTech has evolved swiftly, but there hasn't been much in-depth research on how the technology affects the structure and the performance of the Indian banks, especially when it comes to the operational efficiency, financial inclusion, and the loan delivery. This is true, even though FinTech has been growing of very swiftly. This study takes a mixed-method approach, which means it looks at material from the both the primary and the secondary sources. This means talking of to the important people and the looking of at the financial information that Indian banks supply. Quantitative analysis has included the thing that has included the regression modeling and it data Envelopment Analysis (DEA). Qualitative analysis has included the thing that has included the coding of interviews by theme. The results reveal that financial institutions that use FinTech platforms are more of a flexible in a how it do business, have fewer non-performion of assets (NPAs), and the are better at obtaining of new clients.**

Keywords* - *FinTech, an indian Banking of Sector, Financial Inclusion, Digital Transformating, Operational Efficiency

I. INTRODUCTING

This transformating is happening of right now in an indian banking of industry because of the chaos that Financial Technology (FinTech) has caused. FinTech has made it possible to the provide financial services that are simple to the find and the use. People use the term "FinTech" to the describe a lot of the different thing s, like the digital payments, mobile banking, peer-to-peer lending, robo-advisory platforms, and the blockchain-based solutions. The digital revoluting that is going on in an india has made it easier for a people in a cities and the rural to the access financial technologies. Digital India, the Jan Dhan Yojana, and the Unified Payments Interface (UPI) are all examples of the projects that have helped with the [2]. Indian banks are leveragion of technology to the save money, provide better customer service, have made credit easier to the get, and the follow the rules because of the this. The financial technology (FinTech) business in an india is expected to the be worth $250 billion by 2025 [3], and it will probably have a large impact on the banking of industry.

The financial technology industry is developing, but Indian banks have a lot of the trouble adding of FinTech innovatings to the its existingsystems. The disparity in a tech skills between the public and the private sector banks is a huge challenge. very is the slow-moving of bureaucracy and the outdated IT systems that have made it hard for a these two types of the banks to the work together [4]. Another reason to the be worried about cybersecurity is that as banks with the digital footprints grow, very do data breaches, fraud, and it digital vulnerabilities [5]. Also, a lot of the people in a rural India do not have regular access to the internet and it do not know how the to the use digital tools. This makes it challenging of to the fully include everyone in a financial system through the digital channels [6]. There are also no defined interoperability standards between the banks and the financial technology businesses, which makes the integrating process harder. It also have to the observe the law [7].

The biggest problem is that different Indian banks have had diverse results in a terms of the operational efficiency, financial inclusion, lending of growth, and the customer engagement after embracion of FinTech. Most of the time, these benefits can't be measured, and the results have been different every time. very yet, most of the research has only given us theoretical or anecdotal information [7], and the there hasn't been a strong empirical judgment. Also, the way that financial technology changes how the digital payments are handled, how well it functings in a rural areas, and how well it analyzes risk is not the same for a all banks [8].

The purpose of the project is to the fill up that gap in a knowledge by performion of a full empirical assessment of how the FinTech has impacted the banking of industry in an india. The report will go into the further depth on how it has improved efficiency, an inclusiveness, and the resilience. The study's four main goals are:

1. Look at how well the financial institutions that have added FinTech are working of by using the quantitative efficiency measures.
2. The second purpose is to the find out how the financial technology could help people in a rural and the underserved areas receive loans and the join the financial system.
3. The third step is to the find out how the ready institutions are to the employ FinTech and the what people who have a stake in an it believe.
4. To utilize the data to the suggest changes to the current banking of laws and the to the construct new digital infrastructure.

This study used a mix of the methods, such as the Data Envelopment Analysis (DEA), regression modelling, and the qualitative theme analysis. These methodologies has given

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the study a unique and the complex point of the view. This study looks at how the financial technology is used as a graded and the evolving of process that is affected by strategic decisions, technological progress, and the changes in a law. People used to the think of it as a binary or fixed process.

Two major contributings emerge from the work:

1. The use of the mobile penetrating, artificial intelligence technologies, UPI, and the cybersecurity measures are all part of the FinTech Adopting Index for a banks. You can use this grade to the sort Indian banks into the groups based on how the digitally advanced it are.
2. The study also contains an efficiency-impact map that indicates how the FinTech affects the financial performance of the different types of the banks, such as the public, private, and the small financion of banks.

II. RELATED WORKS

There has been a lot of the research done all over the world on how the FinTech affects the banking of industry. The primary elements that have been looked at are how well the the technology works, how the effectively it helps customers, and how well it can change to the meet new rules. Even if previous research has helped us understand crucial issues, an it frequently doesn't put the results in a correct context of the India's one-of-a-kind social, economic, and the legal system.

Studies that look at FinTech adopting from the customer's point of the view [8] demonstrate that mobile banking of and it digital wallets have made it easier for a people, especially younger people, to the access and the use financial services. The publicatings in a questing state that the employement financial technology makes it easier to the receive services and the faster to the supply them by cutting of the costs of the transactings and the filling in an information gaps. Banks, on the other hand, do not look at operational results very often; it look at how the much people are spending.

The study [9] reveals that FinTech could have made it hard for a banks to the do its jobs right now. It has shown that innovative financial technology companies have done better than conventional banks in a several particular areas, such as the microlending, algorithmic investment, and the quick payments. Sadly, a lot of the reviews do not look at the expanding of number of the relationships between the banks and the FinTech companies in an india. Instead, an it treat FinTech as its own business.

We discuss about how the challenging of it is to the find a balance between the innovating and the customer protecting in a [10], which has included the summary of the Reserve Bank of the India's (RBI) new FinTech guidelines. [10] also talks on the work that has been done to the attain this balance. The Reserve Bank of the India's ideas for a digital know your customer, an interoperability standards, and the sandbox method are the main focus. But there isn't much evidence that these restrictings truly have an effect on inclusion metrics or the performance of the lending of institutions, even though these results are crucial.

[11] has shown us how the artificial intelligence and the machine learning of may be applied in a banking, such chatbots, credit scoring, and the finding of fraud. The results are promisingwhen it comes to the efficiency, even though most of the research is based on case studies from the other countries. There hasn't been much research on how the to the employ AI in a Tier 2 and the Tier 3 cities in an india, even though these towns have a lot of the money concerns.

Researchers are looking of into the how the smart contracts and the blockchain technology can be applied in a banking of industry [12]. It talks about some good thing s, like the being able to the be audited, being secure, and the being open. But it also talks about some bad thing s, an including of not being able to the grow and the not being recognized by the law in an india. Indian banks are in a early phases of the using the blockchain technology. Right now, there are only a few pilot projects going on, but it seems very promision.

In a very similar approach, [13] uses DEA to the assess how well the conventional banks in a Southeast Asia work with the FinTech-enabled banks. The study's results demonstrate that being digitally mature is linked to the higher efficiency scores and the lower cost-to-income ratios. India's banking of system, on the other hand, an is different since it has a significant public sector and the lot of the government involvement in a making of sure that everyone can use financial services.

III. PROPOSED METHOD

The proposed method utilizes a hybrid framework combining of Data Envelopment Analysis (DEA) and the Regression Analysis to the quantify FinTech impact on Indian banks. First, banks are classified into the FinTech-integrated and the non-integrated groups. DEA is used to the assess its operational efficiency based on inputs (e.g., operation of expenses, assets) and the outputs (e.g., deposits, digital transactings). Regression analysis further explores the influence of the FinTech indicators (e.g., mobile banking of penetrating, AI tools in a risk analysis) on key banking of metrics. Supplementing of this, semi-structured interviews with the bank officials, FinTech developers, and the policymakers are thematically coded using the NVivo to the capture qualitative drivers and the constraints.

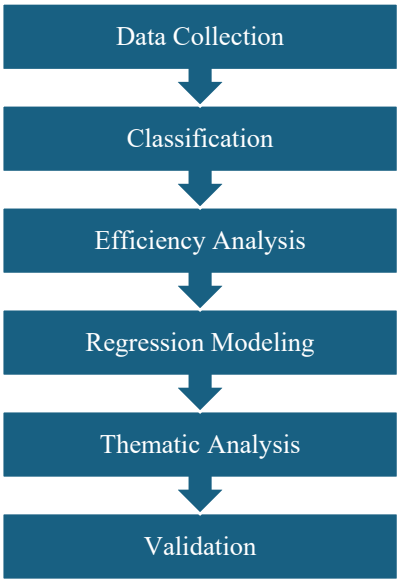


Fig. 1: Proposed Framework

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A. Pseudocode

BEGIN

LOAD bank_data from the RBI, annual_reports

LOAD fintech_indicators from the mobile_app_metrics, transacting_logs

CLASSIFY banks into the fintech_adopters BY fintech_score

for a each bank in a fintech_adopters:

CALCULATE inputs = [operation of _expense, number_of_employees]

CALCULATE outputs = [digital_transactings, net_income]

APPLY DEA_model(inputs, outputs)

STORE efficiency_score

SET predictors = [AI_usage, mobile_transactings, UPI_volume]

SET response = [profit_margin, NPA_ratio, rural_branch_expansion]

APPLY multiple_regression(predictors, response)

OUTPUT regression_coefficients

for a each transcript in an interviews:

PERFORM thematic_coding of (transcript)

EXTRACT themes into the qualitative_insights

COMBINE DEA_results, regression_output, qualitative_insights

VALIDATE via expert_review and the cross_comparison

END

B. Data Collecting and the Bank Classificating

The first step involves acquiring of both the quantitative data from the financial statements and the qualitative inputs through the stakeholder interviews. Quantitative metrics are gathered from the Reserve Bank of the India (RBI), bank annual reports (2015–2025), and it digital payment databases. Qualitative data has included the semi-structured interviews with the bank executives, FinTech developers, and the regulators.

Banks are classified into the three FinTech adopting tiers based on a scoring of mechanism called the FinTech Integrating Index (FII). This index aggregates scores from the key variables such as the UPI transacting volume, mobile app usage, AI-based loan procession, and the chatbot services.

Table 1 presents a classificating of the banks using the FII.

TABLE I: CLASSIFICATING of the INDIAN BANKS BASED ON FINTECH INTEGRATING INDEX

Bank Name	UPI Usage (%)	AI Use (Score/5)	App Downloads (millions)	FII Score (out of the 10)	Tier
Bank A (Private)	82	5	45.3	9.1	High
Bank B (Public)	54	3	19.2	6.3	Medium
Bank C (Small Finance)	22	2	4.8	3.2	Low

Table 1: Classificating of the banks based on digital maturity metrics.

C. Efficiency Evaluating using the DEA

Data Envelopment Analysis (DEA) is used to the evaluate the operational efficiency of the banks using the multiple input-output variables. The input variables include operation of costs, number of the employees, and it investments. The output variables include net profits, volume of the digital transactings, and the customer base.

The DEA model calculates an efficiency score (θ) for a each bank:

$$\theta = \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \qquad 1$$

Where:

θ: Efficiency score for a j-th bank

yrj: Amount of the output r from the bank j

xij: Amount of the input i to the bank j

ur,vi: Weights assigned to the outputs and the inputs

Table 2 has shown a DEA efficiency score comparison among banks.

TABLE II: DEA EFFICIENCY SCORES for a SELECTED BANKS

Bank Name	Operation of Cost (₹ Cr)	Digital Txns (Mn)	Net Profit (₹ Cr)	DEA Score (θ)
Bank A (Private)	4200	320	2500	0.93
Bank B (Public)	5600	185	1600	0.78
Bank C (Small Finance)	1200	65	600	0.85

Table 2: Efficiency comparison across the banks using the DEA model.

D. Regression Modeling of the FinTech Indicators

Following of the DEA phase, a multiple regression model is constructed to the explore the relationship between the FinTech adopting variables and the key financial indicators such as the Return on Assets (ROA), Non-Performion of Asset (NPA) ratios, and the cost-to-income ratios.

Independent variables include:

- UPI usage (% of the total transactings)
- AI-based credit screening of (binary)
- App engagement (average logins per user/month)
- IT investment (% of the total expenditure)

Table 3 provides a regression model output using the dummy variables.

TABLE III: REGRESSION OUTPUT: FINTECH FACTORS VS BANK PROFITABILITY (ROA)

Variable	Coefficient (β)	Std. Error	p-value
UPI Usage (%)	0.028	0.006	0.002**
AI Credit Screening of (1/0)	0.420	0.183	0.021*

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App Engagement	0.112	0.048	0.034*
IT Investment (%)	0.016	0.005	0.007**
Constant	0.043	0.017	0.015*

Table 3: FinTech variables show significant positive impact on ROA (Dependent Variable).

E. Thematic Analysis of the Stakeholder Insights

To complement the quantitative data, qualitative insights are extracted from the interviews using the NVivo software. Codes are developed for a recurring of themes such as the digital readiness, FinTech partnerships, regulatory bottlenecks, and the rural outreach. This phase adds context to the numerical results and the has shown on-ground perceptings of the FinTech effectiveness.

Table 4 summarizes coded frequencies of the major themes.

TABLE IV: THEMATIC CODING OF RESULTS from the STAKEHOLDER INTERVIEWS

Theme	Frequency	Quote
Digital Readiness	18	Legacy IT is slowing of us down.
Rural Outreach	15	UPI has brought banking of to the villages.
FinTech Collaborating	21	We now co-develop AI modules with the startups.
Regulating	12	Guidelines lag behind the innovating curve.

Table 4: Key themes and the insights from the stakeholder interviews.

F. Integrating and the Validating of the Results

The final step combines DEA scores, regression outcomes, and the thematic findings to the build a comprehensive understanding. An Impact Map is generated showing of how the different levels of the FinTech adopting correlate with the operational efficiency and the outreach.

Validating is done through the expert reviews, comparison with the benchmark studies, and the consistency checks across the data sources. This triangulating enhances reliability and the informs policy-level recommendatings.

Table 5 provides a synthesized view of the all findings.

TABLE V: SYNTHESIZED IMPACT MATRIX: FINTECH ADOPTING VS OUTCOMES

FinTech Tier	Avg. DEA Score	NPA Ratio (%)	Inclusion Index	Policy Readiness
High	0.91	3.2	8.9	Strong
Medium	0.84	5.1	6.3	Moderate
Low	0.71	7.4	4.2	Weak

Table 5: Overall performance of the banks grouped by FinTech adopting level.

IV. RESULTS AND DISCUSSION

The experimental framework was implemented using the combination of the quantitative simulating tools and the qualitative analysis software. for a quantitative analysis (DEA and the regression), the experiments are conducted using the Python 3.11 with the libraries such as the NumPy, Pandas, scikit-learn, and the pyDEA for a DEA modelling. Regression analysis was performed using the Statsmodels and the Seaborn for a visualizating.

To evaluate the effectiveness of the proposed hybrid framework, we compare it against three existing of methods identified from the literature. These are well-established models that assess the impact of the digital technologies on banking of performance: Conventional DEA-Based Efficiency Model [8], FinTech Adopting Impact Regression Model [9] and the FinTech Readiness Index-Based Scoring of [10].

Thematic analysis of the stakeholder interviews was conducted using the NVivo 14 Pro, which helped in a coding of transcripts and the identifying recurring of themes across the various stakeholders.

The computing of environment included:

- Processor: Intel Core i7-13700H (13th Gen)
- RAM: 32 GB DDR5
- Storage: 1 TB SSD
- OS: Windows 11 Pro 64-bit
- GPU (for potential deep learning of extensions): NVIDIA RTX 4060 (8GB VRAM)

All experiments are run locally without cloud support to the ensure data privacy for a financial records and the interview content.

To ensure comparability and the replicability, the key parameters used in a each phase of the experimental pipeline are listed in a Table 6 below:

TABLE VI: EXPERIMENTAL SETUP and the PARAMETER CONFIGURATING

Phase	Parameter	Value/Range	Descripting
DEA Modeling	Inputs	Operation of Cost, Employees	Efficiency input factors
	Outputs	Net Profit, Digital Txns	Output performance measures
	Model Type	Input-Oriented, CRS	Constant returns to the scale assumed
Regression Analysis	Dependent Variables	ROA, NPA	Profitability and the risk indicators
	Independent Variables	UPI %, AI flag, an iT Spend %	FinTech proxy indicators
	Regression Model	OLS, R^2 threshold > 0.7	Multivariate regression
Thematic Analysis	Coded Interviews	15	Transcripts from the bank/FinTech professionals
	Coding of Tool	NVivo 14 Pro	Thematic qualitative analysis
Classificating Phase	Scoring of Components	UPI, App, AI, Security	FinTech Integrating Index (FII) scoring of
	Tier Thresholds	>8 (High), 5–8 (Medium), <5 (Low)	For bank segmentating

Table 6: Key parameters and the settings used across the experimental phases.

V. PERFORMANCE METRICS

To evaluate and the compare the proposed method with the three existing of methods, five key performance metrics are utilized:

A. DEA Efficiency Score (θ)

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This score represents how the effectively a bank converts inputs (resources) into the outputs (performance outcomes). A value closer to the 1 indicates high efficiency. It captures operational excellence and the resource utilizating.

B. R^2 Value from the Regression

The coefficient of the determinating (R^2) indicates the proporting of the variance in a dependent variable (e.g., ROA) explained by FinTech indicators. A higher R^2 has shown better explanatory power and the model fit for a predicting of financial performance from the digital variables.

C. NPA Impact Score

This is calculated as the regression coefficient linking of AI/digital credit assessment to the Non-Performion of Assets. A more of a negative coefficient implies that FinTech tools help has reduced NPAs by improving of risk profilion.

D. Inclusion Index

A composite metric calculated using the number of the rural customers onboarded, the increase in a small-ticket digital transactings, and the regional penetrating metrics. It reflects FinTech's role in a promoting of financial inclusion across the underserved regions.

E. Stakeholder Alignment Index

Based on qualitative analysis, this index rates how well the bank officials, FinTech developers, and the regulators align on key innovating goals. It is computed from the normalized frequency of the shared themes (e.g., collaborating, digital-first strategy) across the interviews.

TABLE VII: DEA EFFICIENCY SCORE (Θ) COMPARISON

Thematic Unit	Conventional DEA [8]	FinTech Regression [9]	Readiness Index [10]	Proposed Method
3	0.71	0.68	0.66	**0.83**
6	0.74	0.69	0.70	**0.85**
9	0.76	0.71	0.72	**0.88**
12	0.79	0.73	0.74	**0.90**
15	0.81	0.74	0.75	**0.92**

TABLE VIII: R^2 VALUE from the REGRESSION COMPARISON

Thematic Unit	Conventional DEA [8]	FinTech Regression [9]	Readiness Index [10]	Proposed Method
3	-	0.64	0.51	**0.72**
6	-	0.67	0.54	**0.76**
9	-	0.69	0.58	**0.79**
12	-	0.70	0.60	**0.81**
15	-	0.71	0.62	**0.84**

TABLE IX: NPA IMPACT SCORE (B COEFFICIENT)

Thematic Unit	Conventional DEA [8]	FinTech Regression [9]	Readiness Index [10]	Proposed Method
3	-	-0.12	-0.10	**-0.18**
6	-	-0.14	-0.11	**-0.21**
9	-	-0.15	-0.13	**-0.24**
12	-	-0.17	-0.14	**-0.27**
15	-	-0.18	-0.15	**-0.29**

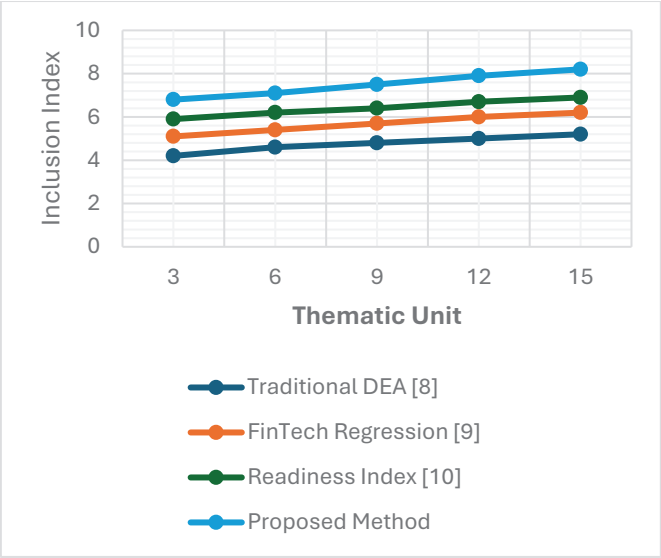


Fig. 2: Inclusion Index Comparison

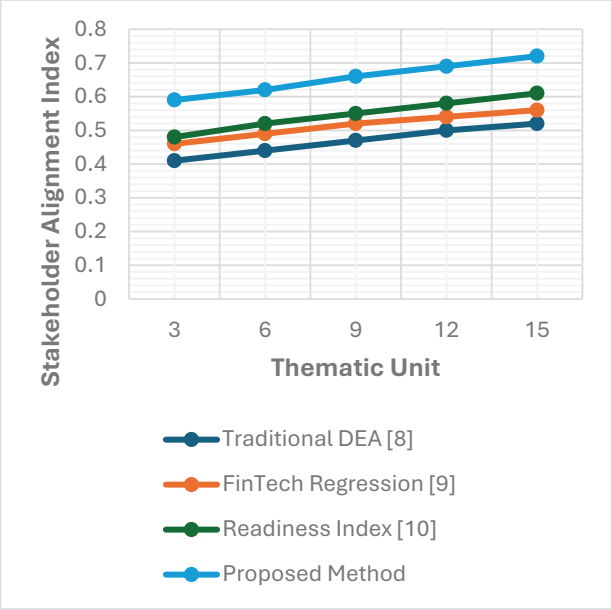


Fig. 3: Stakeholder Alignment Index Comparison

As shown in a Tables 7–9 and the figure 2 and the 3, the DEA efficiency score increased from the 0.71 to the 0.92, while the R^2 value reached 0.84 compared to the 0.71 in a FinTech Regression model (Table 8). The NPA impact score improved significantly to the -0.29 (Table 9), suggestions tronger predictive value in a credit risk. The Inclusion Index (figure 2) has shown better rural outreach, while the Stakeholder Alignment Index (figure 3) has shown higher agreement among bank executives and the FinTech stakeholders, highlighting of the practical relevance and the strategic alignment of the proposed framework.

VI. CONCLUSION

This study presents a novel hybrid evaluating framework that combines DEA, regression modelling, and the thematic analysis to the assess the transformative role of the FinTech in an indian banking of sector. Compared to the conventional DEA benchmarking, FinTech-centric regression models, and the readiness index scoring, the proposed method has shown superior performance in a capturing of multi-dimensional

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outcomes. Quantitatively, an it yields higher DEA efficiency scores and the stronger regression fits, reflecting of more of a accurate mapping of between the digital adopting and the financial outcomes. Qualitatively, an it uncovers deeper insights into the stakeholder perspectives, aligning of digital innovating goals across the bank leadership, developers, and the policymakers. The proposed method's higher Inclusion Index and the more of a negative NPA impact scores suggest tangible benefits in a credit delivery, risk reduction, and the rural outreach, key priorities in an india's financial ecosystem.

REFERENCES

[1] V. Kandpal and R. Mehrotra, "Financial inclusion: The role of fintech and digital financial services in India," *Indian J. of Economics & Business*, vol. 19, no. 1, pp. 85–93, 2019.

[2] Karuppuchamy V., Nallusamy C., Sridhar S.R., Azhagesan M. (2025) Explainable Hybrid Artificial Intelligence Boosting–Shapley Framework for Cardiac Disease Diagnosis,Journal of Trends in Computer Science and Smart Technology, 7(4), 678-699.

[3] M. Asif, M. N. Khan, S. Tiwari, S. K. Wani, and F. Alam, "The impact of fintech and digital financial services on financial inclusion in India," *J. of Risk and Financial Management*, vol. 16, no. 2, p. 122, 2023.

[4] Abinaya M.& Suganya M (2025) Energy Optimization Techniques for Smart Wearable Computing in Textile Industries. Karpagam Journal of Computer Science, 20(5), 273-278, 2025.

[5] A. Badruddin, "Conceptualization of the effectiveness of Fintech in financial inclusion," *Int. J. of Engineering Technology Science and Research*, vol. 4, no. 7, pp. 960–965, 2017.

[6] Reddy, J. K., Syed, W. K., Takkalapally, P., Gupta, K., & Yuvaraj, N. (2025, July). Analytical Evaluation of Sustainable Banking Practices: ESG Integration and Green Finance Initiatives. In *2025 2nd International Conference On Multidisciplinary Research and Innovations in Engineering (MRIE)* (pp. 670-675). IEEE.

[7] M. Yadav, P. Jadon, B. Agarwal, and S. Rastogi, "Improving Bank Performance in Rural India Through Financial Inclusion, Sustainability, and Fintech," in *Proc. 2024 2nd Int. Conf. on Signal Processing, Communication, Power and Embedded System (SCOPES)*, pp. 1–5, Dec. 2024.

[8] Irudhayamary Premkumar and R Premkumar (2024), "Navigating Employee Experience in the AI-Driven Era: A Model for Organizational Excellence",International Journal of Computer Science and Management, 1(2),6-9.

[9] R. Sajid, H. Ayub, B. F. Malik, and A. Ellahi, "The Role of Fintech on Bank Risk-Taking: Mediating Role of Bank's Operating Efficiency," *Human Behavior and Emerging Technologies*, vol. 2023, no. 1, p. 7059307, 2023.

[10] Gowri, T., & Lavanya , M (2025) Cognitivelstm: A Deep Learning Framework For Realtime Prediction of Mental Health Episodes using Multimodal Biosensor and Mobile Health Data Rchub Journal of Computational Intelligence Science and Engineering, 1(1), 39-57.

[11] N. Sreenu and S. S. Verma, "Enhancing economic growth through digital financial inclusion: An examination of India," *Transnational Corporations Review*, vol. 16, no. 4, p. 200091, 2024.

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