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New Avenues of Payments Systems

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Contd. on Page No. 101

CONTENTS

Content Page

Special Features

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MISSION

The mission of the Institute is to develop professionally qualified and competent bankers and finance professionals primarily through a process of education, training, examination, consultancy / counselling and continuing professional development programs.

ध्येय

संस्थान का ध्येय मूलत: शिक्षण, प्रशिक्षण, परीक्षा, परामर्शिता और निरंतर विशेषज्ञता को बढ़ाने वाले कार्यक्रमों के द्वारा सुयोग्य और सक्षम बैंकरों तथा वित्त विशेषज्ञों को विकसित करना है ।

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Editorial

Mr. Deepak Kumar Lalla
Chief Executive Officer,
IIBF, Mumbai

The ever evolving and dynamic nature of financial sector underscores the need of staying updated with the emerging trends, opportunities and challenges in the sector. As a part of Member Education series, the Institute annually organises Memorial Lectures on contemporary topics. This issue of Bank Quest publishes the transcripts of Memorial Lectures along with other contemporary articles.

The Institute had organised 15th Shri. R. K. Talwar Memorial Lecture on 16th January, 2026. The lecture was delivered by Shri B. V. R. Subrahmanyam, (IAS) Chief Executive Officer, NITI Aayog on "Developing a Financial Ecosystem for Inclusive Growth: Leveraging Technology for Transformation". The speaker highlighted that a robust financial ecosystem could play a transformative role in achieving inclusive growth. Mentioning the three paradoxes of inclusion: Credit paradox, Protection paradox and Savings paradox; Mr. Subrahmanyam has suggested the use of technology and Artificial Intelligence in improving the inclusion and manage risks. We are publishing the transcript of 15th Shri. R. K. Talwar Memorial Lecture in this Issue.

Credit risk assessment is an essential process used by financial institutions to evaluate the creditworthiness and determine the likelihood of default. Traditionally, credit risk assessment has relied on credit scores and financial statements, but with the advent of Machine Learning (ML), Artificial Intelligence (AI), large language models, lenders have a new tool at their disposal. Aligning with this perspective, the 40th Sir Purshotamdas Thakurdas Memorial Lecture was delivered by Prof. Manoj Kumar Tiwari, Director, Indian Institute of Management, Mumbai, on the topic "Knowledge Graph Integrated Credit Risk Assessment" on 3rd December, 2025. The speaker discussed Knowledge Graphs integrated risk assessment framework. The lecture holds immense knowledge for the professionals working in banking and financial sector.

India's payment landscape has seen remarkable growth over the years, evolving through a calibrated yet adaptive process and becoming a global model for digital adoption. From the traditional card based digital payments, it has transformed to an ecosystem offering a bouquet of digital payment options catering to every need of the Indian consumer – instant payment systems, small value payment systems, large value payment, bill payment, bulk payment, offline payment, Government payments, toll payments and many more. Retail digital payments in India have grown from 162 crore transactions in the financial year 2012-13 to over 16,416 crore transactions in the financial year 2023-24. Digital Payment Index rose to 516.76 in September 2025, rising from 493.22 in March 2022.

With this increasing growth in the payments system, the focus on safety and security is equally important. The Reserve bank of India also released Payments Vision 2028, anchored in the theme, 'Shaping India's Payment Frontier'. The Payments Vision looks to guide the ecosystem towards an AI-led, data-driven approach to payments, while focusing on inclusivity, resilience, safety, ease of doing business and promoting systematic stability and integrity.

The significant growth in the payments sector has made it necessary to study and explore this topic further. In this regard, this Issue of Bank Quest is being published on the theme, "New Avenues of Payments Systems".

CBDC, digital form of currency notes issued by a Central Bank, is an example of innovation in technology-based payment system. The CBDC reduces operational costs by reducing the costs involved in physical cash management, fostering financial inclusion, bringing resilience, efficiency and innovation in payment systems. The article titled "The Emergence of Central Bank Digital Currency in Modern Payment Systems: Opportunities, Challenges and Prospects", authored by Mr. Thayalan P., discussed the associated benefits, challenges and future prospects of CBDC.

Giving a holistic view of Payment systems and related regulations, the next article is jointly authored by Mr. Sabu George and Prof. (Dr.) Saji T. G., on "India's Digital Economy: Innovations, Challenges and Regulatory Evolution". The authors have described about the various modes of payment systems and associated security challenges.

As the technologies such as Artificial Intelligence (AI) and quantum computing already under way, the challenge is how to embrace them with wisdom and purpose, and ensure that payment system is secure, inclusive, resilient and future-ready. As banking is becoming more digital, more connected, the need of cyber security is increasing. Though the conventional methods of safety and protection are powerful, new advanced ways are more technically sound and efficient. Forensic accounting has also a role to play in cyber security. The article titled "The Role of Forensic Accounting in Reducing Systemic Risk within India's Digital Public Infrastructure: An Analytical Study of UPI, ULI and CBDC" written by Mr. Saptarshi Datta and Dr. Himanshu D. Thakkar, revolves around the role of forensic accounting in reducing risk.

Irrespective of the quality of the technical layer of security, control and measures, security depends on appropriate end-user behaviour. The paper titled "Cyber Security in the Indian Banking Sector: trends, threats and strategic responses" authored by Dr. Meena Sharma, have touched upon the behavioural dimension of cyber security. The paper highlighted that the behavioural vulnerabilities such as trust bias, urgency bias, fear response, over confidence and greed motivation as major reasons why customers fall prey to digital fraud.

Digital lending has significant advantages over traditional lending process. Some of the advantages are speedier approval of credit and inclusion of informal sector. Though it improves financial inclusion and provides business opportunities to Fintech, NBFCs, it has some challenges too. Highlighting the Opportunities and Challenges of Digital Lending, the next paper is penned by Mr. Akash Solanki on "Digital Lending: Opportunities and Challenges".

Technology-enabled banking has the potential to improve the customer experience through personalized or customized financial services. Though it reduces face-to-face interaction with customers, it gives various avenues to attract and retain the customers. Giving the overview of models on customer experience, the paper

titled "Trust to Thrust: Harnessing customer engagement to elevate experience and growth" authored by Dr. Nikhil Kumar Gupta, providing the insights on use of customization, reward programs, brand position and use of Artificial Intelligence to enhance customer satisfaction.

Technological advancement in payment systems have enhanced the access and affordability of financial services by providing more avenues for payment and lowering their operational costs. The Hindi paper, titled "डिजिटल नवाचारों से समावेशी समृद्धि: यूपीआई एवं सीबीडीसी की उभरती भूमिका" linking the payment system with inclusion, very well-written by Mr. Chirag Pandya, Dr. Dinesh Kumar and Mr. Vikas Shrivastava, is a good addition to the literature on financial inclusion.

We hope that readers will appreciate its depth and comprehensive coverage.

We also encourage the bankers and academicians to contribute the papers in Bank Quest.

We will be glad to receive suggestions and feedback for further improving the contents of our Journal, Bank Quest.

Deepak Kumar Lalla

DEVELOPING A FINANCIAL ECOSYSTEM FOR INCLUSIVE GROWTH: LEVERAGING TECHNOLOGY FOR TRANSFORMATION

B. V. R. Subrahmanyam*

It is my privilege to deliver this year's R. K. Talwar Memorial Lecture, honouring the enduring legacy of Shri Raj Kumar Talwar, a towering figure in India's financial history and a distinguished institution builder.

Shri R. K. Talwar belonged to a generation that laid the foundations of India's modern financial system - at a time when capital was scarce, institutions were young, and confidence in markets had to be painstakingly earned. His leadership at the State Bank of India was marked by a deep belief that finance must serve national development, not merely commercial ends. That belief remains profoundly relevant today. Shri Talwar also stood for ethical finance and principled leadership — values that matter even more today as finance, technology and society get tightly intertwined.

Purpose of a Financial Ecosystem

Let me begin with a simple question we often overlook: what is the purpose of a financial ecosystem? One answer and the classical one, is efficient intermediation. This is a pre-requisite for sustained economic growth as the ecosystem intermediates savings – both domestic and foreign - into investment. By providing access to credit, savings, insurance and investment products, it enables individuals and businesses to invest in education, health and productive assets. If this is the purpose, then we are doing reasonably well. India's Digital Public Infrastructure (DPI) has lowered frictions across the board — Unified Payments Interface (UPI) has made payments instant and near-zero cost, Aadhaar-enabled e-KYC has collapsed onboarding time and costs, and frameworks like Account Aggregators (AAs) and Open Credit Enablement Network (OCEN) are reducing information asymmetry and enabling embedded credit.

If the answer is maximizing financial returns, we are also doing well. Our equity markets have delivered robust long-term Compound Annual Growth Rate (CAGR), retail Systematic Investment Plan (SIP) flows are at record high and products like Real Estate Investment Trusts (REITs) and Infrastructure Investment Trusts (InvITs) have broadened access to yield.

However, if the purpose is inclusive prosperity, household resilience and shared growth, then we are not yet there where we need to be. Digital rails have delivered access, but access has yet to translate fully into widespread upward financial mobility — and I am not convinced we have fully cracked the model and need to move faster.

Rapid expansion of Technology in the Last decade

Let us be clear, the last decade has been a transformative decade in India. From an era where improving access and inclusion were driven through physical expansion of branches, personnel and business models like Business Correspondents (BCs), we took a transformative leap forward by leveraging technology. We have built what many countries envy.

*Chief Executive Officer, NITI Aayog.
15th Shri R. K. Talwar Memorial Lecture was delivered by Shri B. V. R. Subrahmanyam, Chief Executive Officer, NITI Aayog, on January 16, 2026, in Mumbai.

- A world-class payments infrastructure as the backbone with UPI, the Aadhaar Enabled Payment System (AEPS) and the Bharat Bill Payment System (BBPS).
- A robust identity and data layer based on Aadhaar, DigiLocker and the Account Aggregator framework.
- A DPI stack that enables fintech innovation at scale.
- A vibrant startup ecosystem cutting across lending, wealth management and insurance.
- Macro stability that allows long-term planning and investment.

All this has been built on a large number of Government initiatives, driven partly through the banking system and partly through other channels. Aadhaar, with over 140 crore Identity Documents (IDs) has become the world's largest biometric identification system. The Jan Dhan Yojana marked a decisive shift in approach to inclusion. Consequently, bank accounts rose from ~15 crore in 2014 to over 50 crore in 2025, with deposits surging to Rs. 2.29 trillion, making it the world's largest financial inclusion programme. Mobile connectivity has been the third pillar of this trinity. India's mobile subscriber base has grown to over 120 crore by 2024, with smartphone penetration reaching ~ 65% of the population. This Jan Dhan-Aadhaar-Mobile (JAM) Trinity has created an unprecedented digital infrastructure that has enabled rapid scaling of financial services. This framework has been instrumental in reducing the cost of financial transactions and expanding access to previously unserved populations.

UPI has emerged as the core digital payment rail and transformed access to usage. It has increased from <1 billion transactions in FY2017 to 228 billion transactions in FY2025. The CAGR for the decade ending 2024 was 52.5% in terms of volume and 13% in terms of value. In December 2025 alone, UPI processed 21.63 billion transactions worth about INR 28 lakh crore. Further, the fintech sector has grown from a nascent industry to a vibrant ecosystem. Nearly 9 in 10 Indians have adopted some fintech solution. We rank third globally, behind only United States (US) and China, in the number of fintech unicorns with 28 of them. Companies like PhonePe, Razorpay, CRED and Paytm are not just serving India but exporting Indian financial innovation to the world. This is reflected in Reserve Bank of India's (RBI's) Financial Inclusion Index which was 67.0 for FY 2025, rising from 43 in 2017.

India's Robust Financial Ecosystem

Along with this, the overall financial ecosystem too has undergone a structural transformation. India now has

- A robust banking sector with improving asset quality;
- Deep capital markets;
- A fast-growing fintech ecosystem - Over 2,000 fintech entities have been registered in India over the last decade, spanning payments, lending, insurance, wealth management and Regulatory Technology (RegTech);
- Expanding insurance and pension coverage;
- An increasingly sophisticated regulatory architecture helped by structural reforms such as the Insolvency and Bankruptcy Code and rationalisation of arbitration and dispute resolution mechanisms in the banking and financial sector.

Inclusive Growth

Before we move on, we need to define inclusive growth. International development organizations, refer

to inclusive economic growth as one that distributes benefits fairly across society. The World Bank defines inclusive growth as growth that creates opportunities for all and ensures that the benefits of growth are shared equitably across all segments of society, particularly the poor and marginalized. The Organisation for Economic Co-operation and Development (OECD) emphasizes that inclusive growth should address inequalities in income, employment, education and access to basic services, ensuring that no group is left behind. The UN Sustainable Development Goals (SDGs) framework incorporates inclusive growth as a central principle, with specific targets for poverty reduction, employment generation and access to financial services.

Inclusive growth can be achieved in a variety of ways including employment generation, human capital development, social safety nets, regional balance and technology democratization. In addition to this, a robust financial ecosystem can play a transformative role in achieving Inclusive Growth.

In the Indian context, inclusive growth is encapsulated in the philosophy of "Sabka Saath, Sabka Vikas", which emphasizes the need to empower all sections of society and bring them into the mainstream of economic development. The demographic dividend that India possesses - with over 65% of the population below 35 years of age - can only be leveraged through inclusive growth that creates jobs and opportunities for all.

Finance is the connective tissue of this vision. Inclusive finance enables a small entrepreneur to scale, a farmer to absorb climate shocks, a student to invest in human capital, a household to manage health and longevity risks. In this sense, financial inclusion is not merely about accounts or credit — it is about capability expansion. Empowering citizens and enterprises not just to participate in the economy, but to thrive in it. However, India's demography is itself a financial design challenge. The question we face is not merely how many are included, but whether the financial ecosystem has the sophistication and flexibility to serve people across diverse contexts, roles and aspirations.

The Three Paradoxes of Inclusion

We have achieved a lot as I have just mentioned earlier. We should be proud, but not complacent. We have built the foundation, but the foundation is not the house. This is the moment for the next leap - where finance moves from improving user experience to reshaping capital allocation. If India is to grow at 7–8% consistently over the next two decades, this leap is a structural necessity.

The headline figure is 80 crore bank accounts. That is a triumph of policy. But the deeper question is: How many of these accounts are tools for wealth creation versus mere receptacles for subsidies?

Consider these three paradoxes:

The Credit Paradox - Access vs. Allocation: We have achieved near universal access. Financial account ownership is almost 90%, with gender and rural gaps largely closed. But how effectively are these accounts being used? Credit growth is healthy, but credit flows are skewed in a few directions. Many Micro, Small and Medium Enterprises (MSMEs) struggle for working capital. Women entrepreneurs remain underserved. Rural and informal enterprises face thin-file data and perceived risk. A report released by Small Industries Development Bank of India (SIDBI) estimated an addressable credit gap of approximately 24% or Rs. 30 lakh crore across the MSME sector. This gap is more pronounced in the services sector at 27% and particularly affects women-owned MSMEs at 35%.

Protection Paradox: Insurance penetration has improved, but coverage is still shallow. Only ~4% of Indians have life insurance that is actually adequate. Health shocks remain a leading driver of household

poverty. Climate and crop risks are rising faster than protection.

Savings Paradox - Participation vs. Future Security: Household financial assets are rising, yet long-term savings are shallow. Pension coverage is limited with the vast majority of people lacking savings for old age income. Retail participation in capital markets is often sentiment-driven.

In this context, we often ask whether India is financially included. I would argue we are doing better than most. The harder question is: are Indian households financially resilient? And if not, what will it take - institutionally, technologically and regulatorily - to change that?

Thinking differently for the future

In the last decade, fintech largely solved the front-end friction - onboarding, payments and user experience. The next decade must solve the back-end friction - underwriting, risk-sharing, capital access, compliance and trust.

And to enable this, I think we need the following shifts:

Form Innovation to Scaling Innovation

We have built world-class rails - Aadhaar, UPI, DigiLocker, AA. But rails are not the final product - they are the enablers. We now need trains and freight on those rails: innovative credit models, climate and health insurance, MSME cash flow lending, integrated safety nets and wealth products for the mass market. And most importantly, we need to scale our innovation and impact. We should only claim success when we solve these problems at population scale.

From Data Collection and Storage to Data Flows or Making Data work

While we have built worldclass architecture like Account Aggregator, let me ask you – are banks really sharing the data? It is high time we understood that Data's value does not increase when stored. Data's value is only unlocked when we make it work for us, to build trust where trust does not exist and allow capital to flow to those who have historically been invisible.

From Lending to Risk Management

Credit alone does not build resilience. We need integrated credit + insurance + pensions + risk pooling for farmers, gig workers, MSMEs and households facing climate and health shocks. Without this, we will formalize the economy but not protect it.

From Formalization to Monetization

Goods and Services Tax (GST), UPI and e-invoicing have made millions visible to the system. Now those digital footprints must convert into credit, productivity and higher incomes. Visibility without monetization just creates digital records, not economic mobility.

Leveraging Technology for the Future

If we start thinking differently as I mentioned, then we need technological tools to be able to act on it. We tend to focus more often on channels rather than on back end processes. Channels alone will not help solve the scale challenge at the back end. Some possible solutions I would mention are already in use in other contexts. I will mention a few of them.

Using Advanced Technologies as Drivers of Inclusive Finance: A data-based lending framework using digital footprints and transaction data can expand affordable credit to small businesses and MSMEs, supporting growth and formalisation. Adoption of Artificial Intelligence/Machine Learning (AI/ML) and decentralised finance can significantly deepen the digital payments ecosystem, enabling smarter, faster and more inclusive financial services.

AI-powered Know Your Customer (KYC): Use of AI-powered identity verification and real-time integration with databases with better security can remove the time and cost involved in doing this activity.

Multilingual Conversational AI: Multilingual conversational AI interfaces can bridge language and literacy barriers, allowing users to interact using regional languages and voice-based systems.

AI-based Risk Scoring and Personalised Services: AI-driven systems will streamline compliance and speed up credit decisioning, making digital finance smoother and more reliable.

Alternative Credit Scoring Uses Non-Traditional Data: Non-traditional data such as utility payments, rent, mobile usage, digital receipts and platform transaction records can be used to build credit profiles for individuals who lack formal credit histories.

As we rethink the future, we must also shift how we use technology. For the last decade, we focused on digitising channels and generating data. The next decade must shift from data to intelligence — where information moves, learns and acts. This means going beyond dashboards and analytics to financial intelligence systems that can underwrite risk, personalise services, detect fraud, anticipate shocks and allocate capital with far greater precision.

These are just a few examples. There will be hundreds more now and in future. And we must remember, technology also improves our own capacity to regulate. So, it is a win-win for all.

Managing Trade-offs in Using Technology

As we move forward, we will need to tackle difficult trade-offs:

Innovation versus stability. How do we allow fintech companies to move fast and reorder things without breaking the financial system? We need regulatory sandboxes that let startups test, but oversight that prevents systemic risk.

Access versus security. How do we lower barriers to entry for the excluded without creating security vulnerabilities? We cannot require multiple-factor authentication from a farmer who has never used a smartphone. This is a design challenge as much as a policy challenge.

Local versus Global. Our sovereign AI stack initiative is about building indigenous capabilities and ensuring that Indian innovation can be owned and exported by Indians. But it is also about not isolating ourselves from global best practices.

Concentration versus Decentralization. How do we build network effects and ecosystems without concentrating them geographically?

Inclusion versus Excellence. Do we build financial services for the poor that are adequate or do we ensure that poor people have access to the same excellence that the rich enjoy? Our philosophy should be clear: there is no compromise on quality. Our job is to make it affordable, not to make it second-rate.

Handling these trade-offs is as essential as leveraging technology. Avoiding technology is not the solution. Managing trade-offs is.

A point we must remember before getting excited about technology, is the importance of institutions. Where institutions are weak, technology can magnify risk rather than distribute opportunity. Strong institutions protect consumers, provide stability and anchor innovation. India's success with digital finance so far stands out precisely because it has been institution-led. There was regulatory clarity, public ownership of core infrastructure and strong accountability mechanisms. This institutional foundation ensured that innovation remained inclusive by design. We need a similar approach in future as well.

Conclusion

Let me conclude by returning to the spirit of this Lecture and to the values exemplified by Shri R. K. Talwar. He belonged to a generation of leaders who understood that discipline, credibility and

institutional culture are as important as balance sheets and profitability. The scale of our ambition is unprecedented, but so too is the responsibility that comes with it. Our financial ecosystem must, therefore, be technologically advanced, to meet the demands of a modern economy; institutionally sound, to preserve stability and trust; socially inclusive, to ensure broad-based participation; and ethically grounded, so that innovation remains aligned with public purpose.

The financial ecosystem of the future will not be judged by the size of banks or the sophistication of stock markets. It will be judged by the number of ordinary Indians – rural and urban, rich and poor, men and women, who have genuine agency over their financial lives.

India's potential is not in the future. It is happening right now. It is in the farmer who checked the Minimum Support Price (MSP) through UPI this morning. It is in the woman who accessed a micro-loan based on her digital payment history. It is in the young entrepreneur who launched a startup because fintech removed the gatekeepers. It is in the entrepreneur in Jaipur who is building credit solutions for artisans but cannot access Venture Capital (VC). It is in the agritech founder in Madhya Pradesh who is solving real problems but is invisible to the VC world.

By 2047, when we celebrate Viksit Bharat, the world will be watching India - not because our Gross Domestic Product (GDP) is large, but because we proved that development driven by inclusion creates prosperity that lasts. And because we proved that innovation is not the exclusive domain of a few, but a distributed capability that lives in every corner of our country.

If we have to leapfrog to the next stage of development and make India Viksit Bharat, I believe we must shift the narrative from "India's Fintech Story" to "India's Financial Resilience Story." This is the foundation of a *Viksit Bharat*.

Technology gives us the tools. Policy gives us direction. Finance gives us the fuel. But purpose must come from us. If we get the next decade right, we will build an ecosystem that is inclusive by default and resilient by design. That would be the most fitting tribute to R. K. Talwar.

Thank you.

BANK QUEST THEMES

The theme for "Bank Quest" is identified as:

1. **April - June, 2026: Financial Inclusion – The Next Phase**

KNOWLEDGE GRAPH INTEGRATED CREDIT RISK ASSESSMENT

Prof. Manoj Kumar Tiwari*

Credit risk assessment is an essential process used by financial institutions to evaluate the creditworthiness and determine the likelihood of default. The market for credit risk assessment solutions is valued at approximately $9.55 billion in 2025, growing at a Compound Annual Growth Rate (CAGR) of 14.1% and projected to reach $23.97 billion by 2032. Traditionally, credit risk assessment has relied on credit scores and financial statements, but with the advent of Machine Learning (ML), Artificial Intelligence (AI), large language models, lenders have a new tool at their disposal. By and large, ML algorithms are designed to classify borrowers based on their credit history and transactional data while leveraging the entity relationship involved in credit transactions. Financial market volatility, concentration risks, liquidity risk, interest rate fluctuations and operational risk emphasizing that credit risk remains the most direct threat to lender solvency.

Knowledge Graphs (KGs) as a foundational technology for next-generation credit risk assessment. A knowledge graph is described as a structured representation of entities (such as borrowers, firms, banks and accounts) and their relationships, enabling semantic understanding and relational reasoning. Knowledge graph allow efficient querying, contextual inference and integration of heterogeneous structured and unstructured data sources based on ontologies and graph databases. Benefits of knowledge graph include improved data integration, flexible connectivity, hidden pattern discovery and scalable analytics. Several financial institutions like JPMorgan, HSBC, Alibaba/Ant Financial and PayPal using knowledge graph driven credit risk assessment models. KG-based credit analytics is employed by Crediwatch (India), martini.ai (USA) and IceKredit (China/Global) for their fintech solutions.

Our students also developed a Knowledge graph-driven credit risk assessment model (RGCN-RF) based on the Relational Graph Convolutional Network (RGCN) and Random Forest (RF) algorithm. RGCN is employed to identify topological structures and relationships, which is currently nascent in traditional credit risk assessment methods. RF categorises borrowers based on the enterprise embedding vector generated from RGCN. This model is validated utilizing data from the Centre for Monitoring Indian Economy (CMIE) database queried through ProwessIQ and Industry Outlook. The RGCN-RF model achieved a balanced accuracy of 92%. Knowledge graph–integrated credit risk assessment offers a scalable, explainable and future-ready alternative to traditional scoring systems, particularly for complex, interconnected and data-rich financial ecosystems. In coming days, agentic-AI based on LangChain and LangGraph can be utilized for credit risk assessment.

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This is the excerpt from the 40th Sir Purshotamdas Thakurdas Memorial Lecture, which was delivered by Prof. Manoj Kumar Tiwari, Director, Indian Institute of Management, Mumbai, on December 03, 2025, in Virtual mode.

THE EMERGENCE OF CENTRAL BANK DIGITAL CURRENCY IN MODERN PAYMENT SYSTEMS: OPPORTUNITIES, CHALLENGES AND PROSPECTS

Thayalan P.*

Abstract

The increasing digitalisation of financial systems has compelled Central Banks worldwide to explore new forms of sovereign digital money. Central Bank Digital Currency (CBDC) is a digital version of fiat currency issued and regulated by a Central Bank and it is regarded as a significant innovation in modern payment systems. It seeks to improve payment efficiency, promote financial inclusion, lower transaction costs and enhance the robustness of financial infrastructure. Reflecting this global shift, India has introduced the Digital Rupee (e₹) through the Reserve Bank of India. This paper is an attempt to study the conceptual foundations, operational architecture and policy rationale of CBDC. It further explores the opportunities and challenges associated with CBDC implementation in India, particularly, in relation to financial inclusion, technological infrastructure, regulatory frameworks and cross-border payment systems. The study highlights the strategic importance of the indirect distribution model adopted by the RBI and the integration of CBDC with existing digital payment platforms such as the Unified Payments Interface (UPI). The paper concludes that CBDC has the potential to significantly reshape the financial ecosystem, provided appropriate technological safeguards, legal frameworks and institutional coordination mechanisms are established.

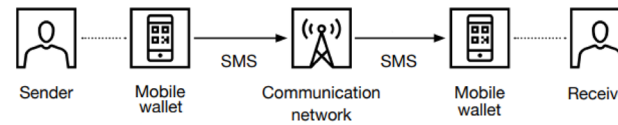
Keywords

Central Bank Digital Currency, Digital Rupee, Payment Systems, Financial Inclusion, Digital Economy

Introduction

India's Central Bank Digital Currency (CBDC), known as the Digital Rupee (e₹), serves as a vital new rail within the Digital Public Infrastructure (DPI) framework. The concept of CBDC has gained significant prominence in the rapidly advancing digital financial ecosystem, as it holds the potential to fundamentally transform financial infrastructure and redefine the functioning of economies and financial systems. As these digital currencies become increasingly integral to modern economic systems, it is essential for professionals to develop a thorough understanding of their theoretical foundations, practical applications and prospects.

Figure 1: Wallet to Wallet transfer



Source: India's digital currency frontier: Envisioning the future of CBDC, PwC.

A Central Bank Digital Currency (CBDC) is a digital form of legal tender issued by a Central Bank,

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equivalent to physical fiat currency and exchangeable on a one-to-one basis, with the only distinction being its electronic form. The Digital Rupee (e₹) can be held and transacted through digital wallets offered by banks and non-bank entities, enabling both person-to-person and person-to-merchant payments. Merchant transactions can be carried out by scanning either a CBDC QR code or a UPI QR code at the point of sale. The e₹ wallet is compatible with both Android and iOS platforms, does not require a minimum balance and allows users to load, redeem or transfer funds seamlessly between their bank account and wallet at any time on a 24/7 basis.

A key distinction between CBDC and private cryptocurrencies lies in the nature of governance and regulatory oversight. Cryptocurrencies such as Bitcoin function on decentralized networks that are not governed by any single authority. While this decentralisation provides a degree of autonomy and transparency, it also creates challenges related to price volatility, consumer protection and financial regulation. In contrast, CBDCs are issued and supervised by national monetary authorities, ensuring stability, legal recognition and integration with existing financial systems. By combining the efficiency of digital transactions with the reliability of sovereign currency, CBDCs are designed to offer a safe and reliable alternative to both physical cash and privately issued digital assets. It operates on a centralized or blockchain-based digital ledger maintained by the Central Bank, ensuring security, transparency and reliability. CBDC provides individuals, businesses and financial institutions with a trusted medium of exchange, as the central bank oversees its issuance, administration and regulation. CBDC also has the potential to enhance financial inclusion by enabling access to digital payments for individuals without traditional bank accounts. Through secure digital wallets and user-friendly payment interfaces, it can expand the reach of financial services to underserved communities, especially in rural and remote regions.

The retail CBDC pilot launched in December 2022 marked an important milestone in India's digital currency journey. At present, the retail e₹ pilot is ongoing with 19 banks - State Bank of India, ICICI Bank, Yes Bank, IDFC First Bank, Bank of Baroda, Union Bank of India, HDFC Bank, Kotak Mahindra Bank, Punjab National Bank, Canara Bank, Axis Bank, IndusInd Bank, Federal Bank, Karnataka Bank, Indian Bank, IDBI Bank, UCO Bank, Bank of Maharashtra and Bank of India and 7 million users, enabling Person-to-Person (P2P) as well as Person-to-Merchant (P2M) transactions. Additionally, two non-bank entities- CRED and MobiKwik, have been permitted to join the pilot. They will be extending CBDC wallet services to users in the near future. Interoperability with UPI is also enabling wider adoption of the e₹ without compromising user convenience.

According to the report released by Bank for International Settlements (BIS), CBDCs can improve payment efficiency, reduce settlement risks and enhance financial inclusion. The Bank for International Settlements (BIS) defines CBDC as a digital form of central bank money that differs from balances held in traditional reserve or settlement accounts.

The study done by Auer, Cornelli and Frost argue that CBDCs represent a natural evolution of payment systems in response to technological innovation and declining cash usage. Their study highlights that central banks are motivated by several factors, including maintaining control over monetary policy, improving payment resilience and addressing competition from private digital. The reports released by the Reserve Bank of India emphasise that CBDCs can complement existing digital payment systems rather than replace them. The RBI's concept note suggests that CBDC can function as a digital alternative to cash while leveraging India's well-developed digital payment infrastructure.

Thus, CBDCs are not merely technological innovations but represent a significant institutional development in the evolution of modern payment systems.

This paper examines the conceptual foundations, operational mechanisms and policy implications of CBDC, with particular emphasis on the Indian experience. It also examines the opportunities and challenges linked to the introduction of a sovereign digital currency and assesses its potential impact

on the future of payment systems in India as well as globally.

Architecture and Operational Models of CBDC

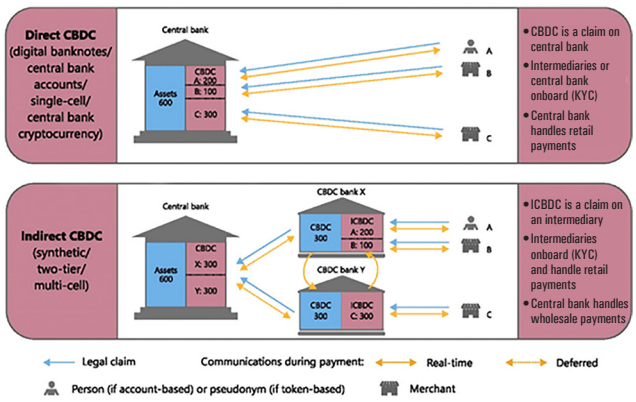
Central Bank Digital Currency (CBDC) is a digital representation of a nation's sovereign currency, issued and regulated by the Central Bank. It serves as legal tender and is fully interchangeable with physical cash, such as notes and coins, on a one-to-one basis. Unlike deposits maintained with commercial banks, CBDC constitutes a direct liability of the central bank.

CBDCs are broadly classified into two types:

Wholesale CBDC (W-CBDC):	**Retail CBDC (R-CBDC):**
Wholesale CBDC usage is limited to authorized wholesale market participants, including government entities, financial institutions, and others. It is designed for high-volume, high-value financial system transactions, includes wholesale payments, securities trading, and interbank settlements. Wholesale CBDC is designed to enhance the security, speed, and efficiency of inter-institutional financial transactions, thereby reducing systemic risks and improve the management of funds across the financial system to ensure liquidity is available where needed and operational risks are minimized.	The central bank issues R-CBDC, which the public, businesses, and individuals can purchase to hold and conduct transactions. It functions as a substitute for tangible currency and commercial bank deposits, offering a safe and practical means of transaction for routine affairs. R-CBDC facilitates the expansion of digital payment accessibility, specifically targeting unbanked and underbanked communities. It is compatible with established payment systems, such as mobile wallets and credit cards.

There are two main approaches to issue and manage CBDCs based on their distribution framework. In the direct model, the central bank is responsible for all functions, including issuance, account maintenance and transaction processing. In contrast, the indirect model involves the central bank issuing the CBDC while delegating distribution and customer-related services to intermediaries such as commercial banks and payment service providers, each carrying out specific roles.

Figure 2: Direct and Indirect CBDC



Source: BIS

In this framework, the central bank issues CBDC to intermediaries, who in turn, provide it to consumers. Customer-related services and claims are managed by these intermediaries, while the central bank primarily deals with them at the wholesale level. This indirect approach closely resembles the existing currency management system, where banks are responsible for distributing cash, maintaining customer accounts, ensuring compliance with Know Your Customer (KYC) and Anti-money Laundering/ Countering the Financing of Terrorism (AML/CFT) regulations, preventing illicit financial activities and facilitating transaction verification.

Examples from other countries

China's Digital Yuan (e-CNY) demonstrates the effectiveness of the indirect model, wherein, the People's Bank of China (PBoC) collaborates with commercial banks and fintech platforms such as Alipay and WeChat Pay for its distribution. This approach has enabled widespread adoption, streamlined onboarding and enhanced innovation and outreach. By mid-2025, this strategy attract users by simplifying onboarding (KYC) and utilizing private-sector innovation to reach rural and unbanked populations. This model has set a global benchmark, with e-CNY facilitating seamless transactions and supporting China's push for RMB internationalization. India can adapt similar strategies to accelerate e₹ adoption.

India has adopted the indirect distribution model, allowing the Reserve Bank of India to utilize established banking networks and digital payment platforms while maintaining regulatory oversight and scalability. The technological architecture of CBDC systems may involve centralized digital databases, Distributed Ledger Technology (DLT) or hybrid systems combining both approaches. The choice of technology depends on several factors, including transaction speed, cyber security, scalability and the overall resilience of the financial system.

Opportunities with CBDC

Central Bank Digital Currency (CBDC) presents

several important opportunities for strengthening and modernising financial systems, while also posing certain challenges that must be carefully addressed.

The inclusion of Prepaid Payment Instruments (PPIs) in CBDC distribution opens avenues for growth, exemplified by players like eRoute Technologies, an RBI-authorized PPI issuer since 2021 offering solutions like OmniCard. By integrating PPIs into CBDC distribution, India can achieve financial inclusion for rural and unbanked populations while driving product innovation through offline and loyalty-based wallets.

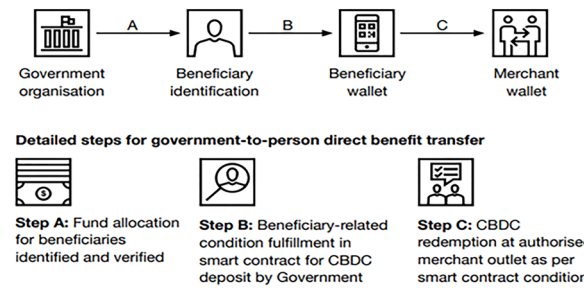
Strategic partnerships and merchant enablement for Small and Medium Enterprises (SMEs) create new revenue models and sector-specific solutions for transport or subsidies, ultimately boosting profitability through higher transaction volumes and incentives. This positions PPIs as key enablers in India's digital economy. India's Unified Payments Interface (UPI) is no longer a domestic phenomenon; it is a global export. Proved that high-velocity, low-cost micro-payments are viable at a continental scale.

CBDCs improve payment efficiency by enabling near-instant settlement of transactions, which reduces processing delays and lowers transaction costs for both consumers and businesses. This efficiency can significantly enhance the functioning of domestic payment systems and may also contribute to more streamlined international transactions. In the context of cross-border payments, CBDCs offer the possibility of simplifying remittance processes, which currently involve multiple intermediaries and often incur high fees. Through direct settlement between participating financial institutions, CBDCs can reduce transaction time and costs associated with international transfers. Furthermore, CBDCs have the potential to stimulate innovation within the digital finance ecosystem.

Emerging technological features such as programmable payments, smart contracts and the possibility of offline digital transactions can expand the capabilities of digital payment systems and support the development of new financial products and services.

Examples of User-level programmability is when a parent provides monthly pocket money to a child in the form of CBDC tokens. To control spending, the parent can set conditions such that the tokens may only be used within the school premises (geofencing), for a specific purpose like buying snacks from the canteen and within a defined time period, such as that month. Transactions will be completed only if all these pre-set conditions are met.

Figure 3: Programmability-based fund distribution to beneficiaries of CBDC



Source: India's digital currency frontier: Envisioning the future of CBDC, PwC.

The integration of smart contracts into transactions, along with conditions such as geofencing and Merchant Category Codes (MCC), enables the programmability of CBDCs in India. This capability allows issuers to exert greater control over the use of funds, ensuring that payments are executed only when specified conditions are met, thereby, minimizing dependence on intermediaries.

Programmability also introduces capabilities that traditional money cannot offer, paving the way for more efficient and innovative financial services. In this context, the Government has identified Direct Benefit Transfer (DBT) as a key use case, leveraging programmability to deliver targeted subsidies. For instance, the Subhadra scheme in Odisha could become one of the first initiatives to utilize CBDCs, potentially benefiting over one crore women in the state.

CBDC token carries a unique and immutable identifier, enabling authorities to trace its complete wallet-to-wallet journey from origin to end use. This feature supports Anti-Money Laundering and Countering the Financing of Terrorism (AML/CFT) efforts by making it easier to detect and investigate activities such as fund diversion and tax evasion. For agreement-based payments, the programmable features of CBDCs can be used to time-lock transactions for a specified period. Execution would require authorization from all relevant parties and if the conditions are not met within the defined timeframe, the funds are automatically returned to the original owner. This mechanism helps prevent fraud and enables smoother resolution of payment-related disputes.

Money mulling, a form of financial fraud in which criminals use third-party accounts to transfer illicit funds, can also be addressed through CBDC features. Capabilities such as traceability and trackability, strong AML measures and programmability enhance monitoring and control, helping to detect and prevent misuse of mule accounts.

The New Mandate for India's Digital Payments-Offline CBDC: In a transformative leap for India's digital payments landscape, the Reserve Bank of India (RBI) has unveiled a groundbreaking innovation — the Offline Digital Rupee. This Central Bank Digital Currency (CBDC) enables secure digital transactions without internet or telecom connectivity. This new phase of the digital rupee — appropriately described as "Cash, but Digital" — merges the universal accessibility of physical cash with the efficiency and traceability of digital money, cementing India's leadership in the global fintech ecosystem. Unlike internet-dependent systems such as UPI, the Offline Digital Rupee operates through proximity-based technologies like Near-Field Communication (NFC) and QR codes, enabling wallet-to-wallet transfers directly between users. Transactions are settled instantly and irrevocably, mirroring a physical cash exchange — with the crucial distinction that each unit of the digital rupee is backed by the RBI. Even "digital change" is handled intelligently, making this a true evolution of cash for the modern age.

Challenges Ahead

The model offers vast potential but requires addressing hurdles:

The strict KYC, AML and data privacy standards for all intermediaries, should be enforced. There is a need to strike a balance between transparency for oversight and privacy for users, while ensuring that all intermediaries—banks, fintech firms and payment service providers—adhere to uniform standards.

Accounting and Dealing in Tax Matters: Digital currencies represent a significant innovation in the payments landscape. However, a key challenge is the lack of universally accepted accounting standards and clear classification, particularly regarding whether digital currencies should be treated as assets, liabilities or other financial instruments. Resolving this ambiguity is critical before CBDCs can be properly recognized as financial instruments, which generally involve transferable rights to assets and corresponding obligations.

This uncertainty limits consistency in accounting practices and affects how digital currencies are reported in financial statements. A thorough understanding of blockchain technology is, therefore, essential for developing appropriate accounting, taxation and regulatory frameworks for the evolving digital currency ecosystem.

Technical complexity: The e₹ ecosystem must seamlessly integrate with existing banking systems, Prepaid Payment Instruments (PPIs) and digital platforms. Achieving this requires standardized protocols, real-time processing capabilities, robust cyber security measures and strong interoperability across banks, PPIs and CBDC platforms.

Distributed Ledger Technology (DLT), including blockchain, underpins this framework with key features such as decentralization, security, transparency, consensus-driven validation and

flexibility. Blockchain ensures that data is tamper-resistant, preventing unauthorized alterations or falsification. Its consensus mechanisms build trust by enabling collective validation of transactions rather than relying on a single central authority. Additionally, because the ledger is shared and distributed among network participants, recorded transactions are highly resistant to manipulation.

However, despite these advantages, challenges associated with blockchain technology must be addressed, including concerns related to security, scalability, regulatory compliance, system complexity and energy consumption.

Legal Implications of CBDC: The legal considerations surrounding the introduction of CBDCs largely depend on their operational and technological design. Different implications arise based on whether the CBDC is account-based or token-based. Account-based CBDCs, similar to traditional bank money, are treated as "book money" reflected as credit balances in accounts. In contrast, token-based CBDCs function as digital cash, where the central bank's liability is embedded directly within the token.

Another important concern relates to financial stability. If CBDCs become widely adopted by the public, individuals may prefer holding digital currency issued directly by the central bank instead of depositing money in commercial banks. This shift could reduce bank deposits and potentially affect the ability of banks to provide loans and credit to the economy.

Since bank deposits are a key source of funding for lending, any significant shift toward CBDCs could reduce deposit levels in banks. This, in turn, may impact their ability to extend credit to businesses and households, thereby, influencing the overall functioning of the financial system.

Lack of awareness: Raise awareness of e₹ benefits to boost adoption. Many individuals, particularly in rural and semi-urban areas, may lack awareness or trust in digital financial systems. Building digital literacy and trust is key to encourage individuals and small businesses to transition from cash-based to digital transactions. There is a need to raise awareness of e₹ benefits to boost adoption.

Merchant Infrastructure: Develop acceptance tools for rural and semi-urban businesses. Many small merchants, especially in rural and semi-urban regions, lack the infrastructure to accept digital payments. Investment is needed in affordable and user-friendly tools such as QR code systems, mobile-based payment solutions and offline transaction capabilities.

Offline CBDC transactions present distinct regulatory and operational challenges. The key risks include double spending, device compromise and delays in detecting fraudulent activity. To address these concerns, regulators typically impose transaction limits, require secure hardware environments and mandate periodic synchronization with the central system.

From a regulatory standpoint, offline CBDC must comply with existing frameworks related to anti-money laundering, consumer protection and operational risk management. Banks and intermediaries are expected to implement strong safeguards, effective monitoring systems and user awareness initiatives.

It highlights benefits like security and transparency but ignores potential drawbacks such as cost, complexity and regulatory challenges. The role of blockchain is mentioned, but there is no explanation of how it actually works in accounting systems. The risks like input manipulation and system vulnerabilities can still exist to cyber security threats, technical failures or data breaches.

Therefore, establishing a robust and resilient cyber security infrastructure is essential for maintaining trust and operational stability.

Future Prospects of CBDC in India

As per the recent amendments, the income tax rules applicable to cash transactions and withdrawals, will also apply to CBDCs. Accordingly, a user's identity may be established by authorities when funds are transferred from a bank account to a CBDC wallet, in line with banks' KYC requirements. A key benefit of CBDCs is their strong potential to enhance financial inclusion by expanding access to digital financial services.

India's digital payments revolution is no longer merely a technology success story—it is the central nervous system of the national economy. Platforms such as UPI, Immediate Payment Service (IMPS) and Aadhaar Enabled Payment System (AEPS), operated under the National Payments Corporation of India (NPCI) framework and regulated by the RBI, now process billions of transactions every month, underpinning consumption, credit delivery, welfare transfers and financial inclusion at population scale. In this environment, the cyber "attack surface" is no longer a defined perimeter. It is pervasive, real-time and deeply interconnected—cutting across banks, fintechs, Third-Party Application Providers (TPAPs), technology service providers and Digital Public Infrastructure (DPI).

From Cyber Risk to Cyber Resilience: As we enter 2026, a decisive strategic shift is underway. India's payments ecosystem is moving beyond cyber security as wall-building to cyber resilience as systemic shock absorption - the ability to withstand attacks, recover rapidly and continue operating without disrupting trust or liquidity. Traditional cyber security models are built on the assumption that threats can be identified, blocked and neutralised. Cyber resilience starts with a more pragmatic regulatory truth: breaches are inevitable. This thinking is already visible in regulatory signals. The RBI's evolving supervisory posture-across Digital Payment Security Controls, IT Frameworks for NBFCs and Banks, Outsourcing Guidelines and Cyber Incident Reporting norms - is steadily shifting from checklist-based compliance to outcome-based resilience. For real-time payment systems like UPI and IMPS, the regulatory objective is zero incidents or near-zero disruption and rapid restoration of trust. The RBI has introduced several systemic controls, including: The Mule Hunter framework to identify and prevent misuse of bank accounts, Real-time fraud monitoring systems, enhanced KYC and transaction authentication norms and stronger incident reporting requirements.

This can broaden access to Government benefits, digital payments and basic financial services, thereby, strengthening economic participation and reducing dependence on cash-based transactions. Another major benefit is incorporating PPIs into retail CBDC distribution signals a major evolution in India's financial system. These agile players, alongside banks and fintechs, bring innovation and reach to realize RBI's inclusive digital economy goals. With robust regulations and ongoing collaboration, India is well-positioned to lead in CBDC deployment globally, potentially prioritizing sovereign digital infrastructure over stablecoins.

India's established payment infrastructure makes the indirect model ideal. This approach leverages familiar user interfaces to drive adoption and encourages competition among players to foster innovation. Reserve Bank of India has officially constituted the Payment Regulatory Board under the Payment Regulatory Board Regulations, 2025, which came into force in 2025, marking a strategic institutional upgrade by replacing the erstwhile Board for Regulation and Supervision of Payment and Settlement Systems. Looking ahead to FY26, the RBI plans to scale programmable and cross-border features to fully integrate the CBDC into the global economy.

ISO 20022: Standardizing the Global Financial Dialect: The migration to ISO 20022 represents

more than a technical upgrade; it is the adoption of a universal data language. By aligning with this global standard, India has eliminated the "data silos" that historically led to reconciliation errors.

ISO 20022 is an international standard for electronic data interchange between financial institutions, developed by the International Organization for Standardization. It provides a common language and structured messaging format (based on XML and increasingly JSON) that enables banks, payment systems and financial entities to exchange information in a consistent, rich and machine-readable way. Unlike traditional messaging standards such as Society for Worldwide Interbank Financial Telecommunication (SWIFT) MT formats, ISO 20022 allows for significantly more detailed data to be included in each transaction. This includes information on the sender, receiver, purpose of payment and regulatory details, which enhances transparency, improves compliance with Anti-Money Laundering (AML) and Know Your Customer (KYC) requirements and reduces errors in processing.

ISO 20022 is widely used across various financial domains, including payments, securities, trade finance and foreign exchange. It is also being adopted globally for modern payment infrastructures such as Real-Time Gross Settlement (RTGS) systems and cross-border payment networks. In the context of emerging technologies, ISO 20022 is particularly important for integrating innovations like Central Bank Digital Currencies (CBDCs), as it ensures interoperability, scalability and efficient data exchange within digital financial ecosystems.

The Metadata Advantage: One of the most powerful features of ISO 20022 is its ability to carry rich and structured metadata along with every financial transaction. Unlike legacy systems, ISO 20022 carries detailed remittance information, invoice references and tax identifiers-directly within the payment message. This transparency reduces manual intervention, drastically lowering the cost of doing business across borders. This legal change provides formal statutory recognition for the issuance of CBDC by the Reserve Bank of India, thereby, creating the necessary legal foundation for the development and operation of a sovereign digital currency within the Indian financial system.

By using Central Bank Digital Currencies (CBDCs), India can facilitate atomic settlement—where the exchange of currency and the transfer of ownership happen simultaneously. This eliminates settlement risk and frees up billions in liquidity that was previously trapped in nostro/vostro accounts.

The future of cross-border payments is defined by three pillars: Velocity, Visibility and Volition. India's advantage lies in its unique "Trifecta":

- Scale: A massive, tech-savvy user base.
- Regulation: A Sandboxed approach that encourages innovation while maintaining systemic stability.
- Infrastructure: A modular and Application Programming Interface (API) - first architecture that is plug-and-play for the rest of the world.

The goal is no longer just moving money; it is the seamless integration of India into the global value chain.

Conclusion - A Paradigm Shift in Finance

Central Bank Digital Currency represents a significant milestone in the evolution of global payment systems. India's Digital Rupee initiative reflects the nation's commitment to developing a modern digital financial ecosystem that enhances efficiency, transparency and financial inclusion.

While CBDCs offer substantial advantages, their effective implementation demands careful attention to technological, legal and institutional considerations. Strong cyber security measures, well-defined regulatory frameworks and close collaboration

among central banks, financial institutions and fintech firms will be crucial to unlocking the full potential of CBDCs.

As digital financial ecosystems continue to evolve, the Offline Digital Rupee is not just a new payment system — it is a philosophical shift in how we understand and use money. By combining the trust and universality of cash with the efficiency and intelligence of digital technology, the RBI has reimagined money for the 21st century. This innovation promises a future where financial access is not limited by geography or connectivity — a future where every Indian, everywhere, can transact with confidence.

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India's digital currency frontier: Envisioning the future of CBDC, PwC.

INDIA'S DIGITAL ECONOMY: INNOVATIONS, CHALLENGES AND REGULATORY EVOLUTION

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Prof. (Dr.) Saji T. G.**

Abstract

The primary objective of the study is to study India's evolving Digital Public Infrastructure. It will highlight the importance of Unified Payments Interface, Unified Lending Interface and Central Bank Digital Currency along with recent advancements, the successful integration of RuPay and FASTag. This paper also examines the robust governance mechanisms implemented by Reserve Bank of India, including the Payment Regulatory Board and mandatory two-factor authorization. Continuous vigilance is required against growing cyber security threats and an urgent need to close the significant digital literacy gap threatening consumer trust. The key focus is the system's potential to accelerate national economic growth, along with the financial inclusion of marginalized populations. The study focuses on strategies for India to successfully manage its "digital-first" economy by addressing the complexities of scale and security.

Keywords

Digital Economy, UPI, ULI, CBDC

Introduction: India's Digital Public Infrastructure (DPI)

The Indian FinTech sector has undergone a major transformation as the country rapidly moves toward a digital-first economy. Key initiatives like the Unified Payments Interface (UPI) have revolutionized how people transfer money instantly and securely. The emerging Unified Lending Interface (ULI) aims to simplify and speed up credit access through digital platforms. The digital currency issued by Reserve Bank of India, the Central Bank Digital Currency (CBDC) issued is also a new initiative in this direction. Together, these systems form a strong Digital Public Infrastructure (DPI) that promotes transparency, interoperability and financial inclusion. India's model is now being recognized globally for its scale and innovation. This paper explores the latest developments, challenges and regulatory measures shaping India's digital payment ecosystem as of late 2025.

Recent Advancements in Core Payment Systems

The digital payment strategy of India focused on simultaneous innovations in the areas of credit, payments and currency systems to create a robust financial ecosystem. The speed, transparency and accessibility of financial transactions are ensured by the integration of UPI, ULI and CBDC. These advancements together strengthen India's position as a global leader in digital finance.

Unified Payments Interface (UPI)

UPI remains India's biggest success story and is now the world's largest real-time payment system by volume. In August 2025, UPI crossed 20 billion

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transactions in a single month, with a total value of over ₹24.85 lakh crore, making up more than 85% of all digital transactions in India by June 2025 (PBI, 2025). The transaction limit for Person-to-Merchant (P2M) payments in selected verified categories has been increased to ₹10 lakh per day, supporting high-value digital commerce. The UPI is being studied by the International Monetary Fund (IMF) as a model for other nations and it is also gaining importance within the BRICS group. The services of UPI is available in countries like France, United Arab Emirates (UAE), Singapore, Bhutan, Nepal, Sri Lanka and Mauritius. Additionally, the integration of RuPay credit cards with UPI has enabled credit-linked payments, increasing its use cases and average transaction values.

Central Bank Digital Currency (CBDC) - Digital Rupee (e₹)

The Reserve Bank of India (RBI) is carefully expanding the Central Bank Digital Currency (CBDC) pilot to build trust and ensure ease of use. By March 2025, the retail e-Rupee pilot grew to over 6 million users and 17 banks, with the total value of e-Rupee in circulation increasing by 334% year-over-year (Giottus, 2025). New features such as offline functionality have been added so that the digital rupee can be used even in areas with poor or no internet access. The CBDC now also supports programmability, allowing conditional and purpose-specific transfers that make Direct Benefit Transfers (DBT) more effective and secure. Moreover, the RBI has demonstrated interoperability between the CBDC and UPI, allowing both systems to work smoothly together for payment settlements.

Unified Lending Interface (ULI)

The Unified Lending Interface (ULI) is emerging as the next major digital platform aimed at making credit access more inclusive. It is a technology framework built to bring openness and interoperability to credit markets. ULI allows the secure and consent-based sharing of digital information—such as land records and other data—from different service providers to lenders. This helps reduce the time needed for credit appraisal, especially benefiting small borrowers and micro-entrepreneurs. Although it is sometimes referred to as the Unified Ledger Interface for connecting various payment systems on a single ledger. Its main goal is to transform the lending process, making borrowing easier, more transparent and accessible to all.

The Wider Digital Ecosystem: RuPay and FASTag

India's wider digital ecosystem is strengthened by homegrown innovations like RuPay and FASTag, both managed by the National Payments Corporation of India (NPCI). These systems play a vital role in promoting financial inclusion and driving the country's digital transformation.

RuPay is India's own domestic card payment network and an important tool for expanding banking access. It serves as the main card under the Pradhan Mantri Jan Dhan Yojana (PMJDY), helping bring unbanked citizens into the formal financial system (NPCI, 2025). The integration of RuPay credit cards with UPI has been a major milestone, allowing users to make credit-based payments through UPI's vast merchant network and thereby, increasing the use of credit cards across the country.

FASTag is an example of how digital adoption has been successfully implemented in the transport sector. Using the National Electronic Toll Collection (NETC) system, it enables 100% digital toll payments, reducing waiting times, saving fuel and improving overall logistics efficiency. It stands as a clear success story in digitizing a high-volume and everyday transaction segment across India's highways.

Economic Impact and Financial Inclusion

UPI, ULI and CBDC are acting as powerful catalysts for national economic growth and the financial inclusion of marginalized people.

Table 1: Benefits for Marginalized Groups and Economic Growth

Payment System	Primary Benefits for Marginalized Groups	Support for Economic Growth
UPI	Enables universal, low-cost access, empowering small vendors and micro-entrepreneurs to accept digital payments.	Creates a digital trail that curbs tax evasion and corruption, leading to an increased tax base.
ULI	Bridging the credit gap by providing data-driven, formal credit to the new-to-credit segments (MSMEs, rural borrowers) who lack traditional collateral.	Eliminates friction and delays in the lending process, increasing business productivity and capital access.
CBDC (e₹)	Features like Programmable CBDC (p-CBDC) ensure Government grants and targeted subsidies are used only for their intended purpose, drastically reducing fraud and leakage.	Reduces the high cost associated with printing, storing and transporting physical currency, enhancing system efficiency.

Source: Compiled by Author

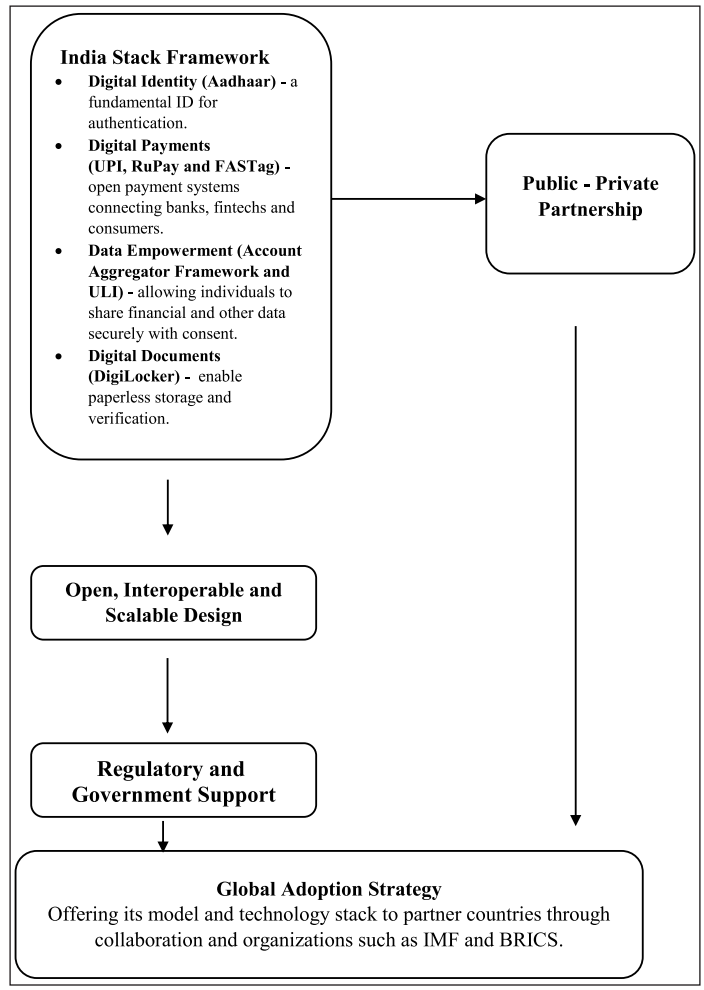
Global Ambitions and International Expansion

The Government of India promoted DPI with an intention to strengthen country's global presence and economic stability. The international expansion of systems like UPI and the digital rupee reflects India's ambition to become a leader in digital innovation. The global use of UPI is helping to make international money transfers faster and cheaper. This is especially important for India, which is the world's largest recipient of remittances, as it helps boost foreign exchange reserves and supports families receiving money from abroad. In addition, the Reserve Bank of India is conducting cross-border CBDC trials with countries such as the UAE and Singapore. These efforts simplified international payments, reduced the number of intermediaries and decreased transaction costs. The growing success of UPI and other DPI components also enhances nations soft power, positioning the country as a global example in building inclusive and efficient digital systems.

The Architecture of India's Digital Economy

The DPI in India is built on the "India Stack" model that brings together a set of digital platforms. Its components include Aadhaar for digital identity, RuPay and FASTag for payments, the Account Aggregator Framework and ULI for secure data sharing and DigiLocker for storing and verifying documents digitally. This system is designed with an open and scalable structure that allow banks, FinTechs and other countries to connect easily using standards. The Government builds the main digital framework, while the private companies creating apps and services on top of it. This process reduces costs and encourages innovation. The RBI and NPCI oversee standards, security and interoperability that maintain trust of the system. The DPI diplomacy of India, partnering with countries like UAE, Singapore and Mauritius and working with IMF and BRICS, helps other nations to adopt similar systems.

Figure 1: Architecture of India's Digital Economy



Source: Author's own work

Critical Challenges and Mitigation Initiatives

The rapid scaling of digital payments is accompanied by critical challenges related to security and inclusion.

Cyber security and Fraud

According to a report presented in the Lok Sabha in February 2025, the number of fintech cyber fraud cases reached 1.13 million in 2023, resulting in losses ₹ 7,488.6 crore (Business Standard, 2024). The fintech ecosystem now faces new and complex threats, including synthetic identity fraud and advanced AI-powered cyber-attacks. To address new risks, the RBI has updated its Master Direction to include offline payment aggregators under the same regulations as online aggregators. For better consumer protection, measures like zero customer liability in specific fraud cases and faster grievance redressal systems have been introduced to build confidence and ensure user safety in digital transactions.

While QR code payments offer a seamless and cost-effective digital transaction mode, they present significant challenges due to their "black box" nature. Users cannot verify a link's destination until they scan the code. Fraudsters create a primary security

hurdle called QR-phishing by embedding malicious links in emails or posters to harvest sensitive banking credentials. In public spaces, criminals often employ overlay fraud, where they paste counterfeit stickers over legitimate merchant codes to redirect payments into their own accounts. Additionally, scammers frequently exploit social engineering; they convince victims that they must scan a code to receive money, using this common myth to authorize unauthorized debits from the victim's account. To mitigate these risks, experts encourage users to use in-app scanners that provide URL previews and to treat any signs of physical tampering on a QR stand as a major red flag.

Digital Literacy and Inclusion

The success of India's digital system depends on how quickly we improve the digital literacy. Government programs like the Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA) play a major role in promoting digital awareness and training people in rural areas. To make digital tools more inclusive, it is essential to provide payment apps and CBDC wallets in all major Indian languages so that language does not become a barrier. At the same time, projects like BharatNet are working to bring broadband internet to every Gram Panchayat, ensuring that people across the country have reliable access to the digital world.

Legal and Regulatory Framework Updates

The Reserve Bank of India (RBI) has strengthened its legal and regulatory framework to balance digital innovation with strong consumer protection. A major step in this direction is the creation of the Payments Regulatory Board (PRB), a six-member body chaired by the Governor, RBI and including Government representatives. The Payment Regulatory Board is responsible for improving security, preventing fraud and ensuring transparency in all digital transactions. The PRAVAAH Portal (Platform for Regulatory Application, Validation and Authorization) portal became mandatory from May 1, 2025. It serves as a single-window online system for all regulated entities to submit applications for licenses and approvals, ensuring efficiency, processing speed and transparency.

In 2025, the RBI introduced new Security and Authentication Directions requiring at least two distinct factors of authentication for all digital payment transactions, with one being dynamic for non-card-present payments. Additionally, all entities must fully comply with the Digital Personal Data Protection Act, 2023, to safeguard users' personal and financial data. Further, the RBI issued updated regulations for Digital Lending and Payment Aggregators. The Digital Lending Directions mandate that loans will be directly credited to borrowers' bank accounts (not through lending service providers) and that all customer data be stored only on servers located in India (RBI, 2025). The Payment Aggregator Regulation introduced uniform rules for both online and offline aggregators, ensuring stricter merchant verification, stronger fund protection and better overall transparency in the digital finance ecosystem (Mondaq, 2025).

Conclusion and Recommendations

India's digital payment system, led by UPI, ULI and the CBDC, has become strong, innovative and fast-evolving. The Government and the Reserve Bank of India (RBI) are working together to manage this large-scale growth while ensuring proper regulation and consumer protection. A key priority is cyber security, which requires constant investment in research and development to fight Artificial Intelligence (AI)-driven cyber threats. Specific focus must be placed on mitigating "black box" risks like QR-phishing and overlay fraud, ensuring that technical convenience does not come at the cost of user security. It is equally important to have quick and effective systems for handling user complaints to maintain public trust in digital payments. Another recommendation is to create a sustainable UPI revenue model. This means developing fair incentives for banks and Payment Service Providers (PSPs), moving beyond the current zero-Merchant Discount Rate (MDR) model, so that the system remains financially viable in the long-term. Lastly, expanding digital literacy is crucial. Public

awareness campaigns should be organized against the common myths, such as the misconception that scanning a QR code is required to receive funds, to protect vulnerable users from social engineering. Campaigns in all major Indian languages, especially for people in rural areas and older citizens, will help close the digital divide and promote true financial inclusion. With these efforts, India's integrated digital public infrastructure is well-placed to deepen financial inclusion, remove long-standing barriers and strengthen the nation's position as a global leader in the digital economy.

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THE ROLE OF FORENSIC ACCOUNTING IN REDUCING SYSTEMIC RISK WITHIN INDIA'S DIGITAL PUBLIC INFRASTRUCTURE: AN ANALYTICAL STUDY OF UPI, ULI AND CBDC

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Abstract

The shift in India's financial infrastructure is driven by the rapid growth and development of its Digital Public Infrastructure (DPI). This includes Unified Payments Interface (UPI) payment systems, the Unified Lending Interface (ULI) lending platform concept and pilot tests for Central Bank Digital Currency (CBDC). These innovations have improved transaction speed and enhanced financial inclusion. However, alongside the benefits of new computerized banking systems, digitalization in banking has also increased the risk of sophisticated cyber-enabled financial crimes. As a result, traditional post hoc methods are becoming less effective. To address these challenges, forensic accounting methodology has been used to examine systemic risks, operational vulnerabilities and cyber security issues associated with these new payment methods. The study uses secondary data from the National Payments Corporation of India (NPCI). This data concerns transaction volume and usage by participating institutions. The analysis focuses on transaction volume and the total downtime of the infrastructure utilized by participating banks. The results indicate an urgent need to design an architecture that incorporates Forensic Accounting. The paper suggests that employing real-time data analytics, continuous anomaly detection and embedded digital forensics will help protect the integrity of fiscal operations. Additionally, recommended the need for suitable regulatory actions.

Keywords

Forensic Accounting, Unified Payments Interface (UPI), Unified Lending Interface (ULI), Central Bank Digital Currency (CBDC), Cyber Security, Fraud Analytics

Introduction

The Macroeconomic Paradigm Shift in Digital Public Infrastructure

India is currently experiencing a structural and epistemological transformation in the architecture of its financial system. Emerging market economies have historically faced frictional costs associated with cash-based operations, including high cash-to-Gross Domestic Product (GDP) ratios, leakage from unrecorded economic activities and barriers to financial inclusion. However, the aggressive expansion of India's Digital Public Infrastructure (DPI), built on foundational layers of identity (Aadhaar) and telecommunications, has fundamentally remapped the country's financial landscape.

The key factors that influence this new environment are the New Avenues for Payment Systems. The evolution of payment systems has become a complex combination of three separate payment systems: UPI, ULI and Central Bank Digital Currency (CBDC). Each payment system has been created with a specific purpose in the macroeconomic

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framework. UPI has created tremendous scale and democratised retail and Peer-to-Peer (P2P) transfers. ULI is poised to transform the way credit is delivered to customers, eliminating the information asymmetries that have prevented adequate funding for Micro, Small and Medium Enterprises (MSMEs) in the past and using algorithms to aggregate data for lenders, thereby, enabling frictionless lending. At the same time, CBDC (the e₹) was introduced as the sovereign solution to the decentralisation of digital assets, providing an institutionally backed electronic currency that is immutable and programmable and eliminating inter-bank settlement risk.

While all of these platforms provide unmatched operational efficiency and have significantly accelerated the formalisation of the economy as a whole, they create a paradoxical risk. As the time required to complete a transaction approaches zero, there will be less and less time to identify, interrupt and mitigate fraud in the financial system.

The Topology of Systemic Risk and Cyber-Enabled Financial Crime

The hyper-digitalisation of banking has dramatically changed the attack surface that cyber criminals target. Where physical fraud was limited by location, document verification and lengthy processing times/ transaction clearance processes in older banks, with digital money transfers, these constraints have been effectively removed. This means the "Fraud Triangle" (Opportunity/Pressure/Rationalisation) of fraud now exists entirely within the cyberspace domain.

Historically, the threats to banks were typically beyond their control, whereas, those created by today's banking systems are systemic. For example, according to recent data, the volume of UPI transactions is enormous, creating a complex environment where criminals can easily hide their attempts at micro-structuring and fast routing through complex networks of money mule accounts. In addition, phishing, application spoofing and Application Programming Interface (API) endpoint impersonation have become standard operating procedures.

As ULI continues to grow rapidly, the risk of synthetic identity fraud will increase. Since ULI requires financial institutions to aggregate multiple digital footprints (e.g. digitised land registrations, Goods and Service Tax (GST) returns and alternative banking sources), the integrity of the data silos that underpin lending, in this regard, is becoming a critical vulnerability for financial institutions. If a threat actor can manipulate or intercept the API data flow, they can algorithmically exploit the system to generate unsecured and irrecoverable debt. Similarly, while the distributed ledger technology underlying CBDC architectures is mathematically robust, the vulnerability shifts to the retail endpoints-specifically, cryptographic key theft and digital wallet exploits. These complex threat vectors represent a convergence of cyber-intrusions and economic exploitation, creating a risk landscape that threatens the fiscal integrity of the broader banking system.

The Inadequacy of Traditional Auditing and the Epistemological Shift

Conventional audit methods used for governance auditing have thus become outdated due to the increasing number and complexity of high-technology threats. Traditional financial governance audits are retrospective, static and use sampling techniques; therefore, these audits generally rely on end-of-business-day account reconciliations and analyses of events that occurred before the audit. Consequently, the typical audit process will not detect a discrepancy or an unauthorised fund transfer conducted using a real-time gross settlement system for some time after those funds have moved illegally through multiple jurisdictions and been converted into indistinguishable assets.

To address systemic latency, financial institutions need an epistemological shift in how they approach compliance enforcement and asset protection. Specifically, there needs to be a shift from reactive auditing to proactive enforcement via a variety of defence mechanisms. Forensic accounting can illustrate its benefit in this area.

Forensic accounting is more than just confirming the accuracy of financial records; rather, it represents a new approach to accounting, as an interdisciplinary science through which such things as investigative accounting can be integrated with econometric modelling techniques, investigating legal frameworks and using sophisticated technology and digital data analytic techniques to analyse the available information. Forensic accounting provides analytical tools needed to investigate Electronic Funds Transfer (EFT) activity within India. EFT transactions can be analysed using various methods, such as statistically examining the distribution of large transaction datasets under Benford's Law. In addition to statistical analysis, credit applications may also be reviewed for unusual behaviour patterns using machine-learning tools and tracing systems (blockchain), which will allow for creating a map of the transaction flow of programmable digital currencies and CBDCs.

The Concept of Forensic-by-Design

This paper proposes that, for India to secure its digital future, simply overlaying security protocols on existing systems will not suffice; it is necessary to create a "Forensic-by-Design" structure across the ecosystem. The ecosystem must have the capability to include continuous control monitoring APIs, automated anomaly-detection triggers and digital evidence preservation protocols, natively hard-coded into the foundational switching layers of UPI, ULI and CBDC networks. By incorporating forensic methodologies into the payment infrastructure, financial institutions can shift their focus from an investigative to a deterministic/preventative model.

Literature Review

The academic discourse surrounding the Digital Public Infrastructure (DPI) has historically been divided into two distinct streams: macroeconomic studies focusing on financial inclusion and purely technical literature detailing cryptographic protocols. However, a critical interdisciplinary gap persists in applying forensic accounting methodologies to real-time and high-velocity digital payment systems. This review synthesises the prevailing literature across UPI, ULI and CBDC ecosystems to establish a conceptual foundation for Forensic-by-Design architectures.

The Operational Efficacy and Systemic Risks of the Unified Payments Interface (UPI)

The Unified Payments Interface (UPI) has been extensively described in the literature as a facilitator of the disintermediation of retail payments. Many of the foundational papers describing India's DPI highlight how the interoperable API switches that allow users to access and transfer fiat to one another immediately are architecturally beautiful (Jaison P et al., 2026). However, recent studies in criminology and financial security highlight a dark complement to resistance-free payment systems: the industrialisation of cyber-enabled crimes against financial institutions (Chinkhando Banda et al., 2025).

Current literature identifies that the "friction" of the traditional banking system, such as clearing house delays and the need for a person to verify the signature of the person attempting to deposit a physical check, functioned as an effective security measure on its own (Thakkar et al., 2025). With UPI, that "friction" is essentially zero, as it settles in milliseconds, effectively eliminating any time for the victim of traditional fraud to intervene.

The cyber security community in digital payments has noted that the source of threat vectors has shifted from complex algorithmic hacking to scalable social engineering approaches that utilise techniques such as application spoofing, SIM swapping and automated phishing payloads. Scholars have also noted that there is a proliferation of "mule account" networks (Rabha & Chourasia, 2025), which interests malicious actors who take advantage of the asymmetrical Know Your Customer (KYC) compliance standards across various regional and co-operative banks, allowing the malicious actor to transfer value through a variety of different intermediaries (Thakkar et al., 2025). As a result of the traditional auditing process's reliance on periodic sampling, it is empirically incapable of detecting these micro-structuring techniques, necessitating

a shift from periodic assessments of the legitimacy of transactions to the use of real-time forensic data analytics to monitor the movement of illicit funds within banking networks (Sateesh Kumar et al., 2025). Forensic accountants face many challenges, such as international collaboration issues, utilization of advanced forensic data analytics, ethical leadership, etc. (Dimitropoulos & Reading, 2025)

Unified Lending Interface (ULI) and the Emergence of Synthetic Identity Fraud

The transition of the ecosystem from payment facilitation to seamless delivery of credit through the Unified Lending Interface (ULI) demonstrates a fundamental change in systemic risk as found in the existing literature. ULI, which operates under the Open Credit Enablement Network (OCEN), is focused on algorithmically approving credit based on multiple disparate sources of secondary data (e.g. digitised land records, GST returns and alternative banking histories) (Chidipothu et al., 2026).

The risk of synthetic identity fraud and data contamination is significant in financial risk literature and in an automated lending environment, a cyber criminal can manipulate streams of data from an Application Programming Interface (API) to create a synthetic legitimate borrower profile based on a series of fragmented or stolen pieces of identity (Dattatreya Murthy, 2026). Recent studies into open banking frameworks has identified the risk of credit circularity associated with unverified microloans being continually rolled over among different lending platforms by manipulating the digital footprint of the borrower, making that footprint appear current; as related to banking, risk between platforms is a high level of risk (Thakkar et al., 2025). In forensic accounting, the academic literature identifies static historical KYC documentation lacks holistic view of customer in a ULI-based environment (Sampathkumar et al., 2026). Academics recommend implementing behavioural biometric and predictive forensic modelling to validate the authenticity of the data stream prior to credit generation, a concept quantitatively tested in this paper by analysing downtime vulnerability (Thakkar et al., 2024).

Central Bank Digital Currency (CBDC): Architectural Resilience and Endpoint Vulnerabilities

The introduction of Central Bank Digital Currencies (CBDCs) is opening up a new type of cryptographic opportunity. Several studies on CBDC deployment (such as the digital RMB and the Sand Dollar) have focused on the "Anonymity vs. Traceability" problem (Ghosh & Das 2026). Many of the working papers published by central banks discuss the fact that while Distributed Ledger Technology (DLT) maintains the integrity and security of the data contained in a CBDC, there is very little that can be done to reduce the risk that cyber crime will occur within a CBDC ecosystem (Thakkar et al., 2024).

Most of the cyber security literature on digital currencies clearly distinguishes between attacks on ledgers and cyber-attacks on endpoints. The CBDC network itself is designed to withstand centralised attacks, while the user-facing retail digital wallets are vulnerable to key theft, malware injection and smart contract exploits. Costly forensic analyses of blockchain environments have demonstrated that it is extremely difficult to trace programmable currencies after they have been laundered through a decentralized mixer or through the dark web (Brühl, 2026). The consensus among experts on securing a CBDC is that advanced digital forensic techniques, such as automated algorithmic tracing tools capable of mapping complex blockchain networks, will assist law enforcement agencies in investigating digital currency crime without violating the privacy rights of legitimate users (Desai & Bhatt, 2025).

The Paradigm Shift: From Retrospective Audit to Continuous Control Monitoring (CCM)

The standard audit method cannot keep up with the new forms of digital payment. Traditional audits are based on historical records of transactions settled after the fact, generally requiring an assessment of the dollar amount involved and a reference to records maintained by the entity, which are typically reviewed manually. These audit requirements do not align with current digital payment practices (Hoti et al., 2025).

Current forensic accounting papers generally recommend that accounting bodies immediately shift to Continuous Control Monitoring (CCM). Under CCM, automated scripts and forensic algorithms will be incorporated directly into financial institutions' information technology infrastructures. Various studies have shown that using statistical anomalies, such as Benford's Law, can detect patterns of clustering and automation in very high-volume and fast-moving electronic payments data (Wang et al., 2026). Many sources state that machine-learning-based anomaly detection systems are critically important for developing and maintaining baseline behaviours of user accounts and will trigger immediate forensic transactions suspension when deviations occur (Correia, 2026).

Research Objectives and Scope of the Study

This study examines India's new payment system architecture to assess its structural resilience. This study is based solely on secondary empirical data obtained from the Reserve Bank of India (RBI), the National Payments Corporation of India (NPCI) and the Indian Computer Emergency Response Team (CERT-In). To accomplish its goals, the study is organized around four principal objectives:

- The quantitative evaluation of the loads placed upon and the adoption rates of the UPI, ULI and CBDC payment ecosystems by examining and analyzing historical empirical data between 2025 and 2026.
- The discovery and mapping of cyber security vulnerabilities and operational constraints associated with high-velocity payments.
- The analysis of the effectiveness of forensic accounting methods — specifically continuous-control monitoring and predictive-data analysis — at mitigating synthetic identity fraud, transaction laundering and endpoint exploits.
- The development of a structural and regulatory framework — Forensic - by - Design — for banking institutions to incorporate proactive investigative mechanisms into their digital public infrastructure.

By addressing the objectives stated above, this study will advance the emerging field of forensic economics and provide actionable policy guidance to banking industry professionals, regulatory authorities and law enforcement agencies responsible for ensuring the security and integrity of the nation's payment systems.

Research Methodology

This study adopts a descriptive-analytical research design that utilises secondary data to assess the operational landscape of India's payment systems.

Data Sources: The primary datasets were extracted from the National Payments Corporation of India (NPCI) official statistics, specifically focusing on product statistics and downtime reports for the fiscal year 2025-2026.

Variables Analysed: Transaction volume (in millions), transaction value (in ₹ Crores), ecosystem participation (number of live banks) and system downtime incidents/duration.

Analytical Framework: The empirical data is subjected to specific analytical techniques mapped directly to the study's core objectives; the Trend Analysis is applied to the transaction volume and value datasets to address Objective 1 (quantitative evaluation of ecosystem loads). Pareto Analysis is utilised for system downtime incidents to address Objective 2 (discovery and mapping of operational constraints and vulnerabilities). Finally, the identified systemic pressure points are evaluated through a Forensic Risk-Assessment Matrix to address Objectives 3 and 4, enabling the analysis of forensic mitigation strategies and the development of the Forensic-by-Design framework.

Analysis and Findings

The foundational premise of forensic analytics in digital payments relies on understanding the scale and stress points of the infrastructure.

Transaction Velocity and Ecosystem Stress

The explosive growth of UPI creates a massive,

continuous dataset. For forensic accountants, this volume represents both a challenge (data fatigue) and an opportunity (rich datasets for machine learning-based anomaly detection).

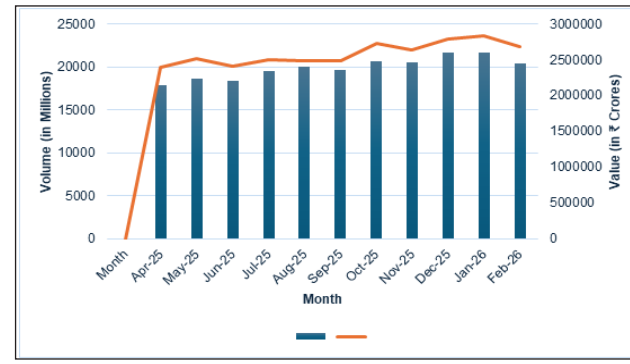
Table 1: UPI Monthly Transaction Volume and Value

Month	Volume (in Mn.)	Average Daily Volume (in Mn.)	Value (in ₹ Cr.)	Average Daily Value (in ₹ Cr.)
March-2026	11,187.14	745.81	1,508,868.86	100,591.26
February-2026	20,394.20	728.36	2,684,229.30	95,865.33
January-2026	21,703.46	700.11	2,833,481.26	91,402.62
December-2025	21,634.67	697.89	2,796,712.71	90,216.54
November-2025	20,466.98	682.23	2,631,632.64	87,721.09
October-2025	20,700.92	667.77	2,727,790.71	87,993.25
September-2025	19,633.43	654.45	2,489,736.52	82,991.22
August-2025	20,008.31	645.43	2,485,472.90	80,176.55
July-2025	19,467.95	628.00	2,508,498.10	80,919.29
June-2025	18,395.01	613.17	2,403,930.69	80,131.02
May-2025	18,677.46	602.50	2,514,297.01	81,106.35
April-2025	17,893.42	596.44	2,394,925.87	79,830.86

Source: Compiled by the Author based on National Payments Corporation of India (NPCI) official statistics (2025-2026)

The Unified Payments Interface (UPI) is a digital payment platform that enables instant payments between two users via their respective banks. Table 1 presents monthly UPI transaction metrics for each calendar month from April 2025 to March 2026. The magnitude of UPI's digital transformation can be gauged by the peak monthly transaction volume in January 2026, which exceeded 21.7 billion UPI transactions. Additionally, these total transaction volumes, when viewed from a forensic accounting perspective, create an unparalleled amount of data requiring processing; existing audit methodologies, which are based on sampling less than one percent of total transactions, are incapable of providing significant levels of audit assurance due to the volume of data that would have to be reviewed. To maintain ongoing audit assurances, banks will need to adopt fully automated, high-volume, big-data analytics to monitor the integrity of their ledger systems continuously.

Figure 1: Dual-Axis Trend of Volume vs. Value



Source: Compiled by Author

According to Figure 1, the Temporal Trajectory of UPI Adoption exhibits a strong volume-value asymmetry. All data points indicate that both volume and value are trending upward; however, the visual asymmetry suggests that the financial system is significantly more weighted towards high-frequency and low-value transactions than towards low-frequency

and high-value transactions. This visual trend line is directly correlated with the camouflage used by forensic investigators during source-and-method analysis to determine whether Micro Structuring or Smurfing operations have occurred. The graph shows how destructive actors can potentially distribute a substantial amount of illicit cash through Dollars at License (DALC). By leveraging the sheer velocity of retail microtransactions, a destructive actor may completely bypass any value limits established by legacy Anti-Money Laundering (AML) criteria.

Ecosystem Expansion and Security Disparities

As the number of participating banks increases, the variance in internal cyber security standards widens. A single compromised bank API can serve as a conduit for systemic attacks.

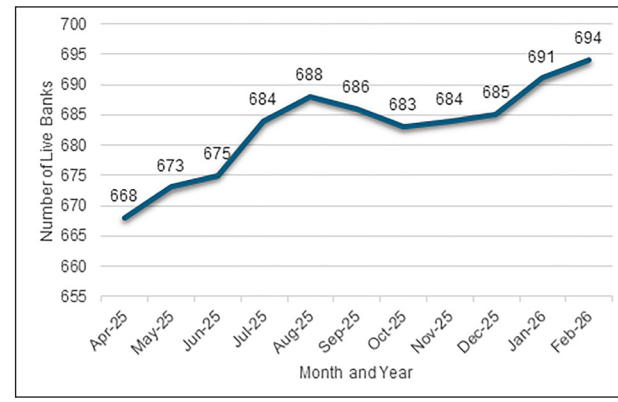
Table 2: Ecosystem Growth - Banks Live on UPI

Month	No. of Banks live on UPI	Month-Over-Month Change	Forensic Risk Implication
February-2026	694	+3	Expanding API endpoint attack surface
January-2026	691	+6	Increased need for endpoint standardization
December-2025	685	+1	Stable ecosystem mapping
November-2025	684	+1	Stable ecosystem mapping
October-2025	683	-3	Potential de-registrations/mergers
September-2025	686	-2	System consolidation
August-2025	688	+4	Rapid regional bank onboarding
July-2025	684	+9	High risk of non-compliant API integration
June-2025	675	+2	Steady growth
May-2025	673	+5	Steady growth
April-2025	668	Base	Baseline

Source: Compiled by Author based on National Payments Corporation of India (NPCI) official statistics (2025-26)

Table 2 tracks month-by-month growth in the integration of financial institutions on the UPI network, resulting in 694 banks now live. This integration reflects the structural de-centrality of the payments architecture in India. The table illustrates a growing disparity in IT budgets and internal audit capabilities between these newly integrated institutions and other regional, co-operative and payments banks as they transition to UPI's centralised infrastructure. In summary, this numerical growth demonstrates the systemic need for standardised, mandated security compliance to ensure that newly onboarded institutions will not adversely affect the integrity of the broader network.

Figure 2: Expansion Trajectory of Participating Banks



Source: Compiled by Author

Figure 2, an area chart, represents the growing attack surface for the UPI ecosystem. The area under the trendline is a visual representation of the "API Endpoint Risk" to the network. As the ecosystem's visual footprint expands, the likelihood of a cyber-intrusion increases due to a less secure node. The visualisation supports the forensic premise that digital public infrastructure is only as resilient as its least well-integrated endpoint; therefore, continuous perimeter stress testing should be conducted across all entities in the ecosystem.

Operational Vulnerabilities: Downtime as a Forensic Indicator

System downtime is not merely a technical glitch; from a forensic viewpoint, it is a critical vulnerability window. Outages disrupt reconciliation, creating blind spots where malicious transactions can bypass real-time monitoring.

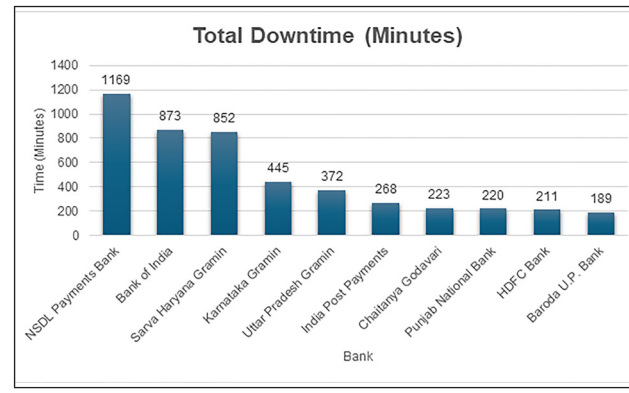
Table 3: Technical Downtime Analysis by Member Banks (February 2026)

Sr. No.	Name of the Member Bank	Incident Count	Downtime (Hours: Minutes)	Forensic Classification
1	NSDL Payments Bank Limited	5	19:29	Critical Vulnerability Node
2	Bank of India	3	14:33	High Risk
3	Sarva Haryana Gramin Bank	1	14:12	High Risk
4	Karnataka Gramin Bank	1	07:25	Moderate Risk
5	Uttar Pradesh Gramin Bank	1	06:12	Moderate Risk
6	India Post Payments Bank	4	04:28	Recurring Instability
7	Chaitanya Godavari Grameen Bank	1	03:43	Low-Moderate Risk
8	Punjab National Bank	4	03:40	Recurring Instability
9	HDFC Bank	1	03:31	Low Risk
10	Baroda U.P. Bank	1	03:09	Low Risk
11	Central Bank of India	2	01:50	Low Risk
12	IndusInd Bank	1	01:20	Minimal Risk
13	Indian Overseas Bank	1	00:33	Minimal Risk

Source: Compiled by Author based on National Payments Corporation of India (NPCI) official statistics (2025-26)

Table 3 presents technical downtime metrics for a sample of member banks, showing that the level of infrastructure capability differs significantly across banks. In particular, payment institutions (also known as payments banks) and regional rural banks experience significantly higher downtime than other banks; for example, NSDL Payments Bank recorded more than 19 hours of downtime in February 2026. Looking at this from a forensic perspective, these minute-by-minute records of downtime are significant weaknesses, as they indicate specific times when automated reconciliation cannot occur, when real-time transaction-monitoring systems are offline and when there are no records in the digital ledger.

Figure 3: Analysis of System Downtime (February 2026)



Source: Compiled by Author

In Figure 3, the downtime data is examined to provide a visual representation of the severity of the structural asymmetry observed in the organisation's network operational resiliency. The cumulative percentage line suggests that approximately 80% of the instability caused across multiple systems can be attributed to a very small number of institutions in the network. Forensic accountants and IT auditors will use this chart as a prioritisation matrix during their audits. Regulatory audits and digital forensics resources should be closely focused on these nodes with high levels of downtime to limit their potential to serve as unauthorised access channels for cyber-enabled financial fraud.

Integrating ULI and CBDC: The Next Frontier of Financial Crime

While the empirical data above highlight the pressures on existing infrastructure, the imminent scaling of ULI and CBDC introduces complex new threat vectors.

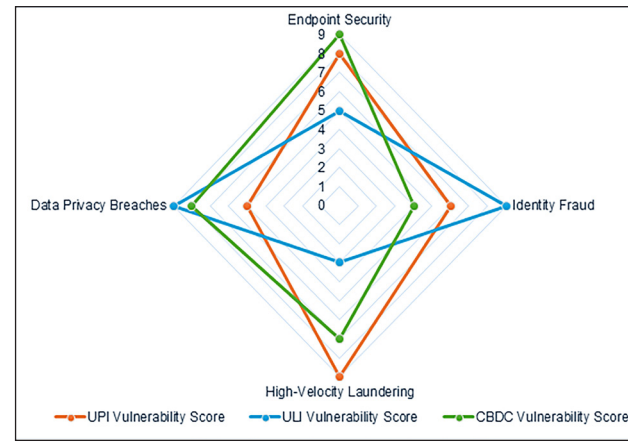
Table 4: Comparative Threat Topology across DPI Avenues

Payment System	Primary Architecture	Core Forensic Risk Area	Prevailing Cyber Threat Vectors
UPI	Centralized Switch, API-driven	Transaction Laundering, Mule Accounts	App Spoofing, Phishing, SIM Swapping
ULI	Decentralized Data Aggregation	Synthetic Identity Fraud, Credit Layering	Credential Stuffing, API Data Interception
CBDC	Distributed Ledger Technology	Endpoint Compromise, Smart Contract Logic Flaws	Cryptographic Key Theft, Wallet Exploits

Source: Compiled by Author

Table 4 lists multiple risk vectors related to UPI, ULI and CBDC. Each architecture is assigned a vulnerability score based on a 10-point forensic risk scale, where 1 indicates minimal systemic threat and 10 indicates a critical, highly probable vulnerability requiring immediate intervention. Based on this framework, UPI exhibits a high vulnerability to high-velocity laundering (Score: 9/10), ULI shows critical risks regarding identity fraud (Score: 9/10) and CBDC demonstrates severe vulnerability to endpoint security compromises (Score: 9/10). Therefore, it can be concluded that no single security protocol can be used for all financial institutions; instead, individual forensic interventions are required for each financial institution's unique infrastructure.

Figure 4: Forensic Focus Distribution Matrix



Source: Compiled by Author

The chart in Figure 4 presents a multidimensional view of how to approach forensics differently for different payment types. Each of the unique shapes—UPI, ULI and CBDC—depicts that the

same types of threats are likely to evolve based on the underlying technology. In fact, while CBDC protects the master ledger (absorbing risk on the anti-money laundering axis), it increases endpoint security risk. This makes this chart an essential tool for a Chief Information Security Officer (CISO) when designing a flexible and layered forensic defence architecture.

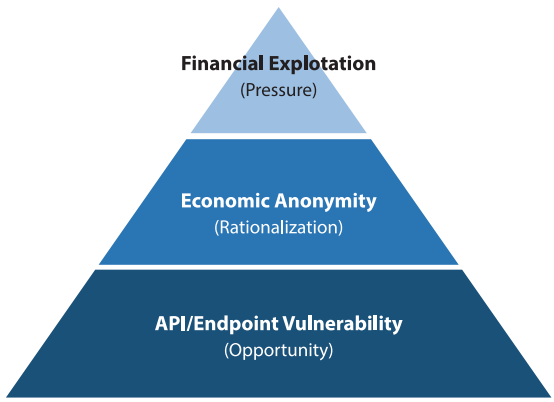
Table 5: Mapping Forensic Interventions to DPI Threat Vectors

Identified Threat Vector	Traditional Audit Shortfall	Required Forensic Accounting Intervention
Synthetic Identities (ULI)	Relies on static and historical KYC documents.	Implementation of behavioural biometrics and cross-referencing disparate digital footprints.
Micro-Structuring (UPI)	Sample-based transaction testing misses low-value networks.	Automated Link Analysis and Graph Theory to map illicit fund flow networks.
Wallet Compromise (CBDC)	Cannot verify the legitimacy of cryptographic signatures post-facto.	Blockchain forensic tracing algorithms are embedded at the institutional node level.

Source: Compiled by Author

Table 5 presents the theoretical data requirements for setting up Continuous Control Monitoring (CCM) systems. In developing these rules, there are several metrics defined: transaction velocity (requests per minute) vs value, so that the machine-learning algorithms can distinguish legitimate retail transactions from coordinated financial cyber crime in order to set up quantitative rules for these two types of transactions, which make up the logic for automated forensic intercepts at a financial institution's switch.

Figure 5: The Digital Payment Fraud Triangle



Source: Compiled by Author

Figure 5 provides a conceptual redesign of Cressey's well-known Fraud Triangle geared toward the architecture of Digital Public Infrastructure. The typical human-driven behaviour in traditional fraud can now be replaced by systemic flaws in technology (i.e. API/endpoint vulnerabilities, economic anonymity and financial exploitation). As a result of these changes, the diagram illustrates a different approach to fraud prevention. In the fast-paced digital world, forensic accounting should focus on identifying structural IT vulnerabilities and algorithmic anomalies proactively rather than on assessing the historical intent of the individuals involved.

Discussion: Towards a Forensic-by-Design Framework

The evidence-based analysis of aggregated transaction volume historical data, together with historical data on system downtimes, leads to one inescapable conclusion concerning the state of transaction processing systems: the infrastructure itself possesses high levels of robustness, but the proportionate nature of its resilience is structurally asymmetric. As evidenced by significant downtime at Grameen banks and designated payments banks due to substandard IT infrastructure, these locations are precisely the nodes cybercriminals exploit by injecting fraudulent requests or establishing mule accounts at lower-performing locations.

With the establishment and automation of the credit sanctioning process via API connections to land registry and GST portals, the time for a human underwriter to identify an anomaly is eliminated, leaving predictive modelling as the transition point for forensic accounting.

Proposed Solutions and Regulatory Interventions

To safeguard the future of India's DPI, the regulatory interventions will be required.

Table 6: Proposed Forensic Compliance Framework for DPI Ecosystems

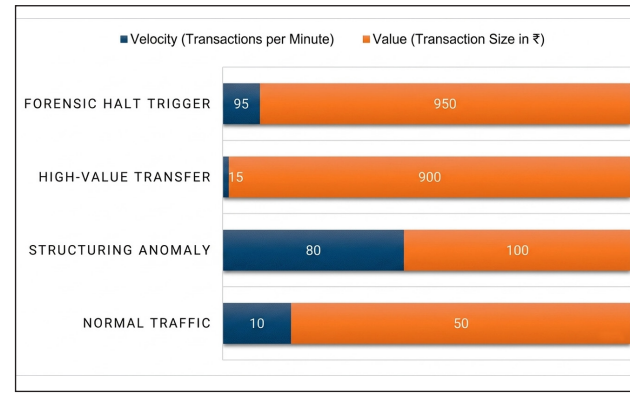
Initiative	Target System	Implementation Strategy	Responsible Entity
Continuous Forensic Auditing (CFA)	UPI Switch	Mandate real-time anomaly detection APIs alongside payment gateways.	NPCI and Partner Banks
Identity Traceability Protocol	ULI	Embed forensic data validation algorithms before credit generation.	Credit Information Companies
Ledger Endpoint Security Validation	CBDC	Annual mandatory digital forensic audits of institutional wallet infrastructure.	RBI and Scheduled Banks

Source: Compiled by Author

Table 6 shows India's Digital Public Infrastructure (DPI) transitioning from a reactive to a proactive approach through a "Forensic-by-Design" architecture. This framework identifies forensic initiatives and their respective target systems (i.e. Unified Payments Interface (UPI), Unified Lending Interface (ULI) and Central Bank Digital Currency (CBDC)) and converts the theoretical concept of risk mitigation into practical regulatory mandates. For example, a Continuous Forensic Audit (CFA) mandate associated with the UPI switch requires that both the National Payments Corporation of India (NPCI) and participating banks embed algorithmic anomaly-detection APIs into their payment gateways to nullify micro-structuring at the point of initiation effectively.

Another example is found in the context of the ULI, where the requirement for the "Identity Traceability Protocol" demonstrates that Credit Information Companies are tasked with validating behavioural biometrics before approving automated credits to their member institutions. With respect to the CBDC, this framework moves the audit focus away from the immutable central ledger and toward performing "Endpoint Security Validation" at the institutional wallet level. Ultimately, this table format serves as a prescriptive guide for regulators that highlights that developing a resilient system requires custom, hard-coded forensic interventions differentiated based upon the particular structural mechanics associated with each respective digital payment type.

Figure 6: Forensic Alert Threshold Configuration



Source: Compiled by Author

Figure 6 plots the normative financial behaviour that visually separates from forensic anomalies. The spatial clustering vividly demonstrates how continuous auditing operates in real-time. Transactions in the high-velocity and high-value quadrant immediately trigger an automated "Forensic Halt," disrupting the flow of illicit capital before settlement. This visualisation exemplifies the goal of "Forensic-by-Design", replacing post-facto human investigation with deterministic, algorithmic prevention.

The Role of Forensic Accounting in Mitigating Systemic Digital Risk

As the DPI evolves from a payment rail (UPI) to a credit engine (ULI) and a sovereign ledger (CBDC), traditional post-facto auditing becomes functionally obsolete. Forensic accounting must transition from a reactive investigative tool into a proactive and embedded security architecture.

Algorithmic Tracing in High-Velocity Networks (UPI)

In the UPI environment, primary function of Forensic accounting is to identify cluster formations of anomalies in real time. Forensic accountants can map complex networks of mule accounts using techniques such as Graph Theory and Link Analysis. Forensic algorithms must determine the velocity of an incoming transfer from the receiving account to the downstream accounts that will subsequently receive a transfer from that account. Any accounts that exhibit immediate and/or high-volume dispersal of incoming funds will be flagged for freezing; this action disrupts the cycle of money laundering before funds are withdrawn from the financial services industry.

Behavioural Biometrics and Synthetic Identity Detection (ULI)

The Unified Lending Interface presents challenges regarding automated sanctions on credit based on aggregated API data. Thus, forensic accountants will shift their focus from determining the integrity of the data stream to validating it before generating credit for the client. Therefore, forensic professionals will create systems to analyse behavioural biometrics, including typing cadence, device fingerprinting and geolocation anomalies, to detect "Synthetic Identities." Therefore, if a ULI credit application contains legitimate Goods and Services Act (GST) data but originates from a device or user with a history of credential stuffing, the forensic process will prevent automated approval of the credit application and require the forensic application and the credit request to undergo human-based investigative review.

Cryptographic Ledger Auditing (CBDC)

The rollout of the digital Rupee (e₹) means forensic accountants will need to find a way to bridge the gap between the auditing of fiat money and forensic analysis of blockchain. Although the Central Bank uses an immutable distributed ledger (blockchain) to record transactions, retail wallets that interact with the network are susceptible to key theft and malware. Forensic accountants will utilise both "Smart Contract Audits" and ongoing monitoring of the flow of digital tokens to detect when wallets have been compromised when using programmable money, preventing those funds from being irretrievably sent to dark web mixing services.

Practical Implementation for Banking and Finance Professionals

Banking professionals must operationalize theoretical forensic frameworks to safeguard institutional integrity. The following practical implementations are essential:

Transitioning to Continuous Control Monitoring (CCM)

The dependence on periodically conducted, sampling-derived internal audits must be eliminated for finance professionals. Moving to Continuous Control Monitoring (CCM) requires embedding forensic data analytics directly into the Core Banking System (CBS) of a financial institution, so that all digital transactions can be tested against a complete population using a predetermined forensic rule set. As soon as an anomalous transaction pattern is detected, such as an unexpected increase in transaction velocity from a dormant account, an automated alert will be triggered in milliseconds.

Establishing Digital Forensic Incident Response (DFIR) Units

Banks must restructure their risk management departments to include specialized Digital Forensic Incident Response (DFIR) units. These cross-functional teams, comprising forensic accountants, cyber security experts and legal professionals, must

be able to immediately quarantine compromised API endpoints, execute volatile memory captures on affected servers and preserve digital evidence in accordance with the Information Technology Act, 2000, ensuring admissibility in a court of law.

Enhanced Inter-Institutional Threat Intelligence Sharing

Given the interoperability of DPI, a cyber-attack on one institution can threaten the entire network. Finance professionals must actively participate in secure and anonymised threat intelligence-sharing platforms. By pooling forensic data on new phishing vectors, synthetic identity signatures and compromised mule account lists, the banking ecosystem can establish a collective and proactive defence mechanism.

Challenges and Future Directions

While the integration of forensic accounting into digital payments offers a robust defence, several systemic challenges remain:

Interoperability Hurdles

An inconsistent set of regulations and resources have created a large challenge. Banks receive detailed, tight guidance from the RBI on Cyber Security. In comparison, many smaller co-operative banks lack the resources to invest in the advanced forensic tools necessary to maintain a strong Cyber Security program. Because of this regulatory arbitrage, these smaller institutions represent a weak link in the overall network of interconnected Digital Payment Infrastructure (DPI) systems. In the future, it would be beneficial that all institutions, including the co-operative banks, implement a minimum "Forensic-by-Design" Infrastructure Standard for connecting to any UPI, ULI or Central Bank Digital Currency (CBDC) switch.

The AI Arms Race in Financial Crime

In an era where technological advancement has driven every aspect of life, the future of digital crime will be algorithmic. Cybercriminals are using Artificial Intelligence (AI) and more specifically Generative AI, to automate phishing campaigns, generate fraudulent KYC videos using deepfake technology and develop virally self-mutating malware that can circumvent static firewall rules. Consequently, forensic accounting needs to move toward predictive forensics and use adversarial machine learning to anticipate an AI-based cyber-attack and neutralise it before it breaches the bank's perimeter.

Privacy Paradox in CBDC Implementation

The rollout of retail CBDCs faces the challenge of balancing forensic traceability with individual privacy rights. Designing cryptographic protocols that allow the Law Enforcement Agencies (LEAs) to trace illicit funds without establishing a surveillance state remains a critical area for future academic and technical research.

Conclusion

The introduction of UPI, ULI and CBDC into India's financial transactions has ushered in a remarkable era of digitisation. Despite this success, findings from this study on transaction velocity, ecosystem growth and downtime due to infrastructure constraints reveal an alarming truth: Financial digitisation has created an ever-expanding cyber-attack surface. Traditional methods of auditing financial records—mainly reconciling previously recorded data—will not provide adequate protection over nearly instantaneous and real-time public infrastructure. The continued viability and integrity of these public infrastructures depend on the prompt and universal implementation of forensic accounting practices to monitor all abnormal transactions and shift from traditional auditing to continuous, automated forensic monitoring to protect India's digital financial architecture from the scale of modern-day organised cyber crime.

Policy and Regulatory Recommendations

To ensure that India's fast-growing Digital Public Infrastructure has robust financial support, regulatory authorities and industry groups should require that all participating financial institutions adopt a "Forensic-by-Design" architecture. The coordinated efforts on Regulatory Framework Enhancement,

Capacity Building in Forensic Accounting, Real-time Monitoring and Reporting Mechanisms, Incident Reporting Protocols and Collaborative Risk Assessment initiatives are required. This means changing the way regulations operate, from focusing on whether requirements were met after an event to Continuous Control Monitoring (CCM), which includes hard-coding anomaly-detection APIs and behavioural biometrics into switches for UPI and ULI transactions to eliminate synthetic identity fraud and micro-structuring proactively. The systemic infrastructure downtime as a major security incident can be considered, so that mandatory independent digital forensic audits are performed for any high-downtime nodes to ensure that typical outages are not concealing a concurrent cyber intrusion or data breach. Ultimately, implementing these in-house forensic measures and enabling advanced certification programs for bank employees will help transform the ecosystem from merely reactive to an evidence-based, proactive defence, thereby, supporting the continual resilience of the sovereign entity's digital payment and credit networks.

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CYBER SECURITY IN THE INDIAN BANKING SECTOR: TRENDS, THREATS AND STRATEGIC RESPONSES

Dr. Meena Sharma*

Abstract

This study examines the rising incidence of cyber fraud in India's banking sector, driven by rapid digitalisation and increased adoption of electronic payment systems such as UPI and mobile banking. Using secondary data from the Reserve Bank of India (RBI), Ministry of Home Affairs (MHA) and National Cyber Crime Reporting Portal (NCRP), the study analyses recent trends in cyber fraud cases and financial losses during 2022-25. The findings indicate that while cyber fraud cases are high in volume and increased by over 70% between 2022-25, the average value per case remains relatively low, highlighting the dominance of retail digital fraud. The paper also identifies key vulnerabilities, including social engineering attacks and gaps in user awareness. It emphasises the growing role of artificial intelligence in fraud detection and prevention, while recommending policy-level, institutional and customer-centric strategies to strengthen cyber security resilience in the Indian Banking ecosystem.

Keywords

Cyber Security, Digital Banking, Cyber Fraud, UPI Fraud, Artificial Intelligence in Banking, Financial Risk Management

Introduction

The Indian banking sector has undergone a profound transformation over the past decade, driven by rapid advancements in digital technologies and proactive policy initiatives. The development of mobile banking apps, the introduction and broad use of the Unified Payments Interface (UPI) and the emergence of fintech platforms have significantly changed how financial services are provided and used. With billions of transactions performed each month, India is now one of the biggest digital payment ecosystems in the world, demonstrating improved financial inclusion, convenience and operational efficiency.

This digital shift has significantly reduced transaction costs, improved accessibility in rural and semi-urban areas and enabled real-time fund transfers. This shift has been expedited by Government programs like Digital India and the need for a cashless economy. Banks are using data analytics, cloud computing and Application Programming Interfaces (APIs) to offer seamless and customised consumer experiences. However, the financial sector is now more vulnerable to cyber threats due to rapid digitisation, which has also increased the attack surface for cybercriminals. (RBI, 2024; NPCI, 2025)

Cyber crime in India has grown in both scope and sophistication in tandem with this expansion. Complex, multi-layered attacks incorporating social engineering, malware injection, identity theft and Artificial Intelligence (AI)-driven fraud processes

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have supplanted earlier kinds of cyber fraud, such as simple phishing emails and phoney lottery schemes. Cybercriminals are increasingly employing techniques like deep fake communications, impersonation schemes, fraudulent mobile applications and phoney investment platforms to take advantage of both technological flaws and human behavioural weaknesses. Malicious actors have increased the speed, accuracy and scope of these attacks by incorporating automation and artificial intelligence.

Recent data highlights the scale of cyber fraud in India, with over 36.4 lakh cases reported in 2024[1] and rising financial losses, though actual figures may be higher due to underreporting. Despite efforts by the regulators, increasing digital adoption and low user awareness continue to outpace security measures.

Cyber security has, thus, become vital to financial stability, requiring a holistic approach combining regulations, technology (Artificial Intelligence/ Machine Learning) and user awareness. This remains a gap in the integrated analysis of digital payment fraud and institutional response mechanisms.

Literature Review

Recent academic and policy literature highlights the growing systemic importance of cyber security in modern financial systems. Reserve Bank of India (RBI) emphasizes that increasing digital transactions have significantly elevated cyber risk exposure in banks, particularly within payment systems and third–party digital ecosystems (RBI, 2024). Similarly, Aldasoro, Frost, Gambacorta and Whyte (2022) identified cyber risk as a major source of financial instability due to interconnected networks, contagion effects and operational concentration risks.

Kshetri (2023) found that cyber crime in emerging economies such as India, is driven by weak digital literacy, low cyber security awareness, regulatory gaps and increasing dependence on smartphones. In the Indian context, rapid adoption of UPI, mobile wallets and app-based banking has expanded convenience but also increased fraud opportunities. Bose and Leung (2023) observed that financial institutions are increasingly deploying Artificial Intelligence (AI), Machine Learning (ML) and predictive analytics for fraud monitoring. These technologies improve anomaly detection, reduce manual intervention and enable real-time transaction screening. However, concerns remain regarding false positives, privacy issues, algorithmic bias and explainability.

In the study by Romanosky (2016) found that data breaches impose significant financial and reputational costs on financial institutions, often leading to customer attrition and regulatory penalties. This suggests that cyber security failures are not only technical risks but also strategic business risks.

Anderson et al., (2019) estimated that the global cost of cyber crime is substantially higher than previously believed when hidden economic losses, productivity decline, fraud recovery costs and trust erosion are included. Their findings support the need for stronger preventive cyber security investment rather than reactive fraud management.

Junger, Montoya and Overink (2017) highlighted that phishing attacks succeed primarily due to behavioral manipulation rather than technical sophistication. Victims often respond under urgency, fear, authority pressure or greed incentives. This is highly relevant in India, where One-Time Password (OTP) fraud, fake Know Your Customer (KYC) alerts and impersonation scams dominate retail fraud patterns.

PwC (2025) reported that social engineering frauds, phishing attacks, impersonation scams and identity theft continue to account for a dominant share of banking fraud globally. Deloitte (2026) similarly highlighted behavioral vulnerabilities such as trust bias, urgency bias, fear response, over confidence

[1]National Cyber Crime Reporting Portal.

and greed motivation as major reasons why customers fall prey to digital fraud.

Arner, Barberis and Buckley (2020) noted that fintech innovation and open banking models increase efficiency but simultaneously create new cyber security vulnerabilities through APIs, outsourced platforms and ecosystem integration. This is especially relevant in India's fast-growing digital finance environment.

NCRB (2024), MHA (2025) and RBI reports indicated that India has experienced sharp growth in UPI-related frauds, fake investment scams, SIM swap attacks and identify theft. However, existing studies often examine either aggregate cyber crime trends or global frameworks, with limited India-specific integrated analysis combining fraud patterns, behavioral economics and AI-based response system.

Thus, the literature establishes cyber security as a multidimensional issue involving technology, governance, human behavior and financial stability. Yet there remains a significant research gap in evaluating India's recent cyber fraud surge through an integrated banking sector lens.

Research Gap

Despite extensive literature on cyber security and financial risk, there is limited integrated studies focusing specifically on the recent surge in digital payment-related fraud in India. Existing studies largely analyse aggregate cyber crime trends or global frameworks, with insufficient attention to:

- The behavioural dimension of retail cyber fraud.
- The divergence between high-volume and high-value fraud patterns.
- The role of AI in the Indian Banking fraud ecosystem.

Objectives

The study aims to:

- Analyse recent trends and structural patterns of cyber frauds in India.
- Examine major types and behavioural drivers of cyber crime in digital banking.
- Evaluate the role of Artificial Intelligence (AI) in fraud detection and prevention.
- To propose policy and institutional measures to strengthen cyber security resilience.

Research Methodology

The study is exploratory and policy-oriented in nature, based on secondary data. Information has been gathered from reports released by the Ministry of Home Affairs (MHA) – NCRP databases, the Reserve Bank of India and other Governmental and institutional sources. The report captures current trends in cyber fraud and financial losses in India and covers the years from 2022 to 2025. The nature of fraud, its growth patterns and their effects on the banking industry have been investigated using analytical techniques, including trend analysis and comparative analysis. Behavioural analysis in the study is based on interpretation of reported fraud patterns, documented modus operandi and secondary evidence from regulatory and crime databases.

The study does not involve primary data collection. Trend analysis, percentage growth analysis and comparative interpretation techniques were used to identify fraud patterns and financial losses. The methodology is suitable for policy–oriented research but may not capture micro-level behavioural insights.

Discussion

Trends in Cyber Fraud in India

The trajectory of cyber fraud in India reflects a dual pattern of rapid expansion in volume and disproportionate escalation in financial impact. Cyber crime has developed into a systemic issue that affects both customers and financial institutions due to the

growing digital penetration of banking, payments and fintech platforms.

Growth in Cyber Fraud Cases

Table 1: National Cyber Fraud Trends in India (2022-2025)

Year	Reported cases (Lakhs)	Estimated loss (₹ Crore)	Growth in Cases (YoY)	Growth in Losses (YoY)	Key Insights
2022	10.29	6,204	-	-	Rapid expansion of digital fraud with growing UPI usage
2023	15.96	7,465	55.1%	20.3%	Sharp rise in complaints linked to phishing and UPI scams
2024	22.68	22,845	42.1%	206.0%	Surge in losses due to investment and impersonation frauds
2025*	28.15	22,495	24.1%	-1.5%	Cases continued rising; losses stabilised due to improved blocking systems

Source: Compiled from data published by the Ministry of Home Affairs (MHA), National Cyber Crime Reporting Portal (NCRP) and RBI reports.

*Provisional data

The data indicate sustained growth in cyber fraud complaints in India from 10.29 lakhs in 2022 to 28.15 lakh cases in 2025. While the number of incidents continued to rise, financial losses surged sharply in 2024 before stabilizing in 2025, suggesting improved fraud detection, transaction freezing and intervention systems. The trend confirms that India faces a dual challenge of rising fraud frequency and evolving high-value scams models.

A major contributor to the surge in financial losses during 2024 was the rise of fake investment and trading scams, where victims were lured through social media groups, fraudulent trading applications and promises of unusually high returns. Though lower frequency than retail payment frauds, such scams involved higher average ticket size and significantly increased total losses.

Overall, the trend shows a structural shift – cases are rising rapidly, but losses have stabilized, suggesting better real-time detection and regulatory response. However, high volumes indicate fraud is becoming more widespread, posing ongoing risks to financial stability and consumer trust.

Frauds in Banking sector in India (2022-2025)

Table 2: Frauds in Banking sector in India (2022-23 to 2025-26)

Category	2022-23	2023-2024	2024-25	2025-26 (latest available)
Total fraud cases	13,462	36,052	23,879	~5,092 (H1)
Amount involved (₹Crore)	16,502	11,261	34,771	21,515 (H1)
Card/Internet Fraud (Cases and Amount involved)	High share in volume	~80% of cases (high volume)	66.8% of cases (~70,756 cases), ₹252 crore	Declining share, ₹4 crore (H1)

Category	2022-23	2023-2024	2024-25	2025-26 (latest available)
Amount from Card/Internet Fraud (₹Crore)	277	1457	520	14
Loan-related (Advances) Fraud (Cases and Amount involved)	Major share of losses (₹15,065 crore)	4113 cases, ₹9,160 crore	7934 cases, ₹31,911 crore	₹17,501 crore (H1)
Structural Trend	Legacy fraud recognition	Retail fraud surge	High-Value concentration	Continued vigilance required

Source: Report on Trend and Progress of Banking in India (2023–24, 2024–25) and subsequent updates for FY2025–26 (H1), Reserve Bank of India.

Note: H1 is April to September

RBI fraud statistics reveal a structural shift in Indian banking fraud. Retail digital frauds such as card and internet fraud account for the majority of reported cases but involve relatively lower value. In contrast, a smaller number of loan-related and institutional frauds contribute disproportionately to total monetary losses. This suggests that Indian banks must simultaneously address mass retail cyber fraud and large-value governance-linked fraud risks. Overall, the sector faces a dual challenge - rising digital fraud volume and high-value loan fraud risk – requiring stronger cyber security and improved credit risk management.

Types of Cyber Frauds in India

Cyber fraud in India is becoming more complex, driven by rapid digitalization and evolving tactics of cybercriminals. With the rise of digital banking, fraudsters increasingly exploit vulnerabilities, especially targeting users with low cyber security awareness. Platforms like Unified Payments Interface (UPI), mobile wallets and online banking have become primary channels for such frauds. These scams are not only more frequent but also more sophisticated, combining technology with psychological manipulation.

A significant proportion of cyber frauds in India are linked to social engineering techniques such as phishing, impersonation, OTP scams and fraudulent investment schemes rather than purely technical systems intrusions (Junger, Montoya, & Overink, 2017).

Common Fraud Types

Phishing Attacks: Phishing remains a significant cyber threat in India by exploiting human trust rather than technical flaws. Scammers impersonate banks or Government entities through deceptive emails and SMS, directing users to sophisticated "cloned" websites designed to steal login credentials and financial data. Because this method is highly scalable and relies on psychological manipulation, it is exceptionally difficult to stop using security software alone.

UPI and QR Code Frauds: UPI and QR code fraud exploits the "receive money" myth, where scammers trick victims into scanning codes or approving "collect requests" that authorise debits. Because UPI transfers are instantaneous and irreversible, funds are moved immediately, making recovery extremely difficult. This psychological manipulation has made UPI scams a dominant and high-impact category of modern cyber crime.

OTP/Account Takeover Frauds: These frauds use

malware, SIM swapping or social engineering to obtain One-Time Passwords (OTPs). After gaining access, they take over bank accounts and carry out illicit operations. These frauds highlight vulnerabilities in authentication systems and demonstrate how multifactor authentication can fail if users are manipulated into sharing credentials.

Investment and Trading Scams: Fake trading apps and crypto schemes are the most financially damaging frauds, where fraudsters lure victims with the promise of high returns via WhatsApp groups, mobile apps or fake trading platforms. Victims are shown fake profits to build trust before losing large sums. Though fewer in numbers, these scams account for a disproportionately high share of total losses.

Identity Theft and KYC Frauds: Cybercriminals misuse personal information such as Aadhaar card, PAN details or bank credentials to open fraudulent accounts, obtain loans or conduct illegal transactions. Identity theft is becoming a bigger worry due to the rising availability of personal information online, especially in situations involving data breaches and unprotected databases.

Impersonation and Digital Arrest Scams: In these situations, scammers pose as Government, bank or law enforcement officials and threaten victims with legal action to coerce them to provide money. These scams are especially successful with less knowledgeable consumers because they mainly focus on fear and hurry.

Malware and Fake Application Frauds: Malicious mobile apps that pose as banking or utility apps are distributed by fraudsters. Sensitive information, such as SMS, OTPs and banking passwords, can be accessed by these apps once they are installed. With malware enabling remote control and user activity monitoring, mobile devices have become a key target due to the increase in smartphone usage.

Most cyber-attacks are hybrid, combining technology with psychological manipulation and are low-cost, scalable and global in reach. This makes cyber crime in India increasingly widespread, exploiting both technological vulnerabilities and human behavior.

Investment–related Frauds: Emerging High-Value Risk

Investment–related cyber fraud has emerged as one of the fastest growing and most financially damaging categories of cyber crime in India. According to data released by the Indian Cyber Crime Coordination Centre (I4C) under the Ministry of Home Affairs, stock trading scams accounted for the highest cyber fraud losses in India during the first nine months of 2024, amounting to ₹4,636 crore across 2,28,094 complaints, highlighting the growing severity of investment-linked digital frauds. In addition, investment-related scams caused losses of ₹3,216 crore from 1,00,360 reported complaints (The wire staff, 2024, November 27). These figures indicate the rapid rise of high-value digital investment frauds in India. Fraudsters typically lure victims through social media advertisements, WhatsApp/Telegram groups, fake stock advisory services and fraudulent trading applications promising unusually high returns.

Unlike low-value phishing or OTP frauds, investment scams usually involve repeated transfers and larger ticket size, causing severe household financial losses. Victims are often shown fake dashboards displaying profits to build trust before being persuaded to invest additional funds. This indicates a structural shift in Indian Cyber fraud from high-volume retail frauds toward fewer but higher-value financially sophisticated scams.

The growing incidence of such frauds highlights the urgent need for stronger investor awareness, platform verification mechanisms, tighter digital advertising controls and coordinated enforcement between banks, regulators and cyber crime agencies.

Table 3: Indicative Share of Investment fraud in India (2024)

Category	Estimated Loss (₹ Crore)	Risk Nature
OTP/UPI frauds	Lower per case	High volume
Phishing frauds	Moderate	Mass retail
Stock trading scams	4,636+	High value
Investment – related scams	3,216	High value
Impersonation frauds	High	Psychological

Source: Indian Cyber Crime Coordination Centre (I4C), 2024; Cyber fraud complaint and financial loss statistics (January-September, 2024) and Ministry of Home Affairs, Government of India.

The table indicates that investment-related cyber frauds, though fewer in number compared to OTP and UPI scams, account for disproportionately high financial losses, making them one of the most serious emerging threats in India's digital economy. In contrast, UPI and phishing frauds are higher in frequency but generally involve lower average transaction values. This highlights a dual fraud pattern in India – mass retail frauds by volume and investment scams by monetary impact.

Behavioural Drivers of Cyber crime in Digital Banking

The rapid growth of cyber fraud in India's digital banking ecosystem is not driven solely by technological vulnerabilities but also by behavioural factors influencing customer decision-making. Fraudsters increasingly exploit cognitive biases, emotional reactions and gaps in financial literacy to manipulate users into voluntarily authorizing transactions or disclosing credentials.

Trust Bias: Many victims believe messages appearing to come from banks, RBI, police authorities or known brands. Fraudsters use official logos, caller ID masking and professional language to create legitimacy.

Urgency and Fear Appeals: Messages such as "Your account will be blocked", "KYC expired" or "Police action initiated" create panic, leading users to act quickly without verification.

Greed and Reward Motivation: Fake investment schemes, cashback offers, lottery winnings and job scams exploit the desire for quick financial gains.

Convenience Behaviour: Users often approve UPI requests, click links or share OTPs quickly to save time, especially during busy hours.

Low Digital Literacy: First-time digital users, elderly citizens and rural customer may lack awareness regarding QR codes, collect requests, fake apps and phishing links.

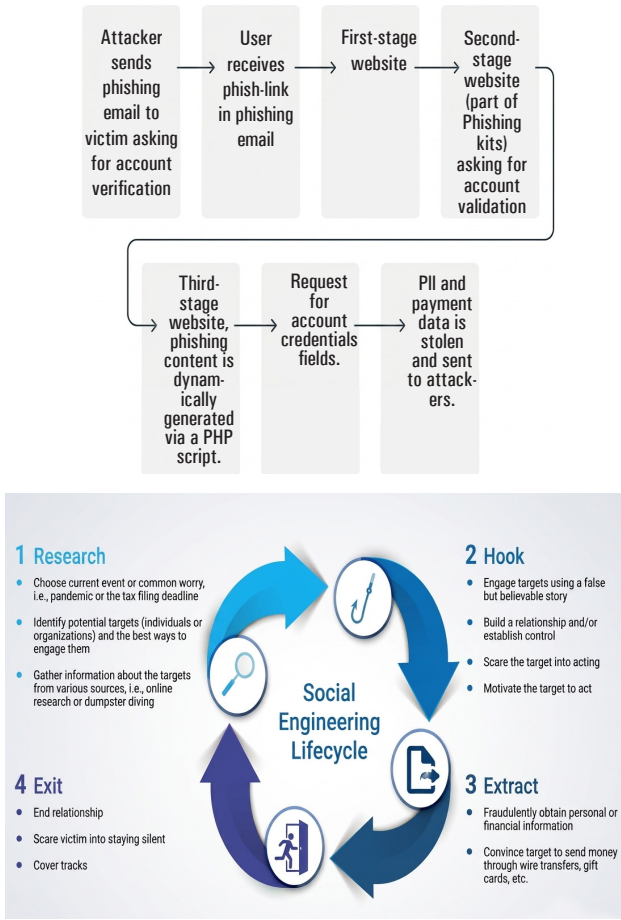
Overconfidence Bias: Experienced smartphone users may underestimate cyber risk, assuming fraud only happens to others.

These behavioural factors indicate that cyber fraud prevention requires not only stronger technology but also behavioural interventions such as warning prompts, friction-based authentication, customer education and simplified fraud alerts.

Modus Operandi of Cybercriminals

Cyber fraud in India has evolved into a multi–stage, tech-driven and behaviour-based process, where criminals use integrated tactics like malware, social engineering, data analytics and financial laundering. Despite variations, most cyber crimes follow a predictable lifecycle, as observed in the Ministry of Home Affairs (MHA) and the National Crime Records Bureau (NCRB) data.

Figure 1: Life Cycle of Cyber Fraud in India



Source: Compiled by Author

Figure 1 highlights the sequential lifecycle of cyber-fraud, emphasizing critical intervention points.

Stages of Cyber Fraud Life Cycle

***Target Identification and Data Collection*:** Cybercriminals collect personal and financial data from sources like the dark web, phishing lists, hacked databases and social media. Growing digital footprints and low awareness, especially among first-time users, make individuals more vulnerable to targeted attacks (NCRB).

***Social Engineering and Initial Contact*:** Fraudsters use messaging apps like WhatsApp, emails, SMS and phone calls, posing as banks or authorities and using urgency, fear or lucrative offers to manipulate them. Around 70-80% of cyber frauds involve social engineering, making human behaviour the key vulnerability.

***Credential Theft/Compromise*:** After gaining trust, fraudsters trick victims into sharing PINs or OTPs, clicking on malicious links or installing fake apps, often aided by malware. The RBI highlights that such credential breaches are the main cause of digital banking fraud, especially in card and online transactions.

***Transaction Execution*:** Once access is gained, scammers execute quick transactions via UPI, cards or online banking, often in multiple small amounts to avoid detection. Though low in value, such digital frauds account for over 66% of banking fraud cases.

***Money Laundering*:** The stolen funds are transferred through a network of "mule accounts", often opened using fake or stolen identities. These accounts are used to Layer transactions, withdraw cash and transfer funds internationally. Law enforcement agencies have identified organised cyber crime networks using hundreds of mule accounts, thereby significantly complicating traceability and fund recovery efforts.

Real Case Examples from India

Case 1: Rs. 58 Crore Cyber Fraud Syndicate (Uttar Pradesh)

A cyber crime network defrauded victims of over Rs. 58 crore using phishing calls and fake banking alerts, using fake SIM identities, mule accounts and layered inter-state transactions. The case highlights the organised and networked nature of modern cyber crime beyond individual fraudsters.

Case 2: Investment Scam via Fake Trading Apps (Pan-India)

Victims were lured through social media advertisements and WhatsApp groups promising high stock returns. Fraudsters created realistic trading dashboards, showed fake profits and encouraged repeated investments, leading to significant financial losses and a major share of cyber crime-related damage.

Case 3: UPI Collect request Fraud

A victim approved a fake "refund" request and lost money, highlighting low awareness of push vs pull transactions in UPI. The National Cyber Crime Reporting Portal (NCRP) under the Ministry of Home Affairs (MHA) data shows over 36 lakh annual complaints, mostly linked to UPI, investment and OTP frauds - where high-frequency frauds are retail-based, while high-value frauds are investment or corporate -driven.

Emerging Trends in Modus Operandi

AI and Deepfake-based fraud: Cyber criminals are increasingly using AI tools to:

- Clone voices
- Create deepfake videos
- Impersonate executives

Cross-Border Operations: Many fraud networks operate from outside India, making jurisdictional enforcement difficult.

Automation and Scalability: Use of bots and automated calling systems allows fraudsters to target thousands of victims simultaneously.

The evolving nature of cyberfraud in India highlights the need for a comprehensive strategy combining technology, policy and user awareness. Early prevention - especially at the stages of social engineering and credential compromise - can significantly reduce losses. As threats evolve, adaptive and intelligence-driven security frameworks are essential to safeguard digital banking.

Role of Banks in Cyber Security

Banks are the primary defence in safeguarding the digital financial ecosystem, with roles extending to risk management, fraud prevention and customer protection amid rising digital transactions. They must adopt a multi-layered cyber security approach combining technology, regulation and user awareness, supported by the Reserve Bank of India guidelines, to remain resilient against evolving cyber threats.

Preventive Measures by Banks

Banks have implemented a range of preventive and proactive measures to mitigate cyber threats, focusing on both technological safeguards and behavioural risk management.

Multi-factor Authentication (MFA): MFA enhances banking security by requiring multiple identity checks (passwords, OTPs, biometrics or device authentication), reducing the risk of unauthorised access even if one credential is compromised. However, its effectiveness depends on user behaviour, as social engineering can still bypass it if users share OTPs.

Transaction Monitoring Systems: To identify odd trends, banks use sophisticated transaction monitoring systems that continually monitor customer behaviour. These systems examine variables including device usage location, frequency and transaction size. Early fraud detection is made possible by flagging suspicious transactions for additional verification.

Real-time fraud detection: Banks have implemented machine learning-powered real-time fraud detection systems in response to the growing speed of digital transactions, particularly through immediate payment

systems. These systems can minimise financial losses by promptly identifying irregularities and sending out notifications, blocking transactions or temporarily freezing accounts.

Tokenisation of card data: Tokenisation replaces sensitive card information with unique tokens during transactions, ensuring that actual card details are not exposed or stored. This significantly reduces the risk of data breaches and card-related fraud, particularly in online and contactless transactions.

Customer awareness campaigns: Banks actively carry out awareness efforts via SMS warnings, emails, ads and in-app notifications since they understand that a significant percentage of cyber fraud is caused by human mistakes. These campaigns educate customers about common fraud tactics, such as phishing and OTP scams and emphasize safe digital practices.

RBI Guidelines and Regulatory Framework

The Reserve Bank of India has established a comprehensive regulatory framework to strengthen cyber security in the banking sector, focusing on both prevention and customer protection.

Zero liability for customers in unauthorised transactions: RBI guidelines ensure that customers are not held liable for unauthorised transactions if they report the incident promptly and have not contributed to fraud through negligence. This provision enhances customer confidence and encourages timely reporting of cyber incidents.

Mandatory reporting timelines: Banks are required to report cyber fraud incidents within specified timelines to regulatory authorities. This facilitates faster investigation, enables coordinated responses and helps in building a centralized database of fraud patterns for better risk assessment.

Fraud monitoring systems: RBI mandates banks to establish robust fraud monitoring and risk management systems, including dedicated cyber security units and incident response teams. These systems are expected to incorporate advanced analytics, periodic audits and continuous surveillance to detect and mitigate threats effectively.

Banks play a critical and diverse role in combating cyber frauds in India. A well-rounded strategy that incorporates cutting-edge technology, legal compliance and consumer involvement is essential to their efficacy. Strengthening these systems will be crucial to ensure a safe, secure and trustworthy banking environment.

Preventive Measures for Individuals

In the context of rising cyber fraud, individual users play a crucial role in the first line of defence against cyber threats. In India, human mistakes, ignorance or behavioural manipulation account for a large percentage of cyber fraud instances rather than system malfunctions. Adopting secure digital practices is crucial as digital financial grow quickly, especially through platforms like the UPI. Preventive measures at the individual level can significantly reduce the likelihood of fraud and limit financial losses.

Some of the best practices for individuals are mentioned below:

- Never share OTP/ PIN
- Avoid unknown links/apps
- Verify UPI requests carefully
- Use official banking apps only
- Enable transaction alerts.

The effectiveness of cyber security ultimately

depends on the human element, often the weakest link. Despite advanced safeguards by banks and the Reserve Bank of India, many frauds exploit user behaviour through manipulation. Vigilant, informed users and continuous technological upgrades are essential to reduce cyber risks and ensure safe digital banking.

Role of Artificial Intelligence (AI) in Cyber Security

AI is transforming cyber security in banking by shifting from reactive to proactive risk management. With the rapid growth of digital transactions in India (especially UPI), AI enables real-fraud detection, faster response and improved accuracy by analysing large volumes of transaction and behavioural data.

Key application of AI

- *Fraud detection:* AI systems analyse transaction behavior instantly and flag suspicious payments.
- *Anomaly detection:* AI identifies unusual login patterns, device changes or abnormal spending behavior.
- *Predictive analytics:* Historical faud data is used to predict likely future attacks and vulnerable users.
- *NLP (Phishing detection):* AI scans emails, SMS and websites to identify phishing content.

Example: RBI-supported Digital Payments Intelligence Platform (DPIP) aims to improve real-time fraud coordination.

Broader Impact

Benefits: Faster detection, reduced losses, lower false alerts, scalability for millions of transactions.

Challenges: Deepfake misuse, privacy concerns, model bias, implementation cost and need for skilled workforce.

AI is, therefore, both a defensive necessity and an emerging strategic tool in modern banking cyber security. In India, the Reserve Bank of India is actively promoting AI-driven fraud monitoring systems such as the Digital Payments Intelligence Platform (DPIP) to improve real-time fraud detection and inter-bank coordination.

Strategies to minimise Cyber Frauds

In a rapidly digitizing economy like India, reducing cyber crime requires a coordinated and multi-layered approach involving banks, tech firms and the Government. With threats becoming dynamic and complex, the focus must shift to preventive, intelligence-driven and collaborative strategies supported by strong institutions, technology and regulations.

Policy–level Measures

At the macro level, Government and regulatory authorities play a critical role in shaping the cyber security landscape through legislation, enforcement and institutional coordination.

Strengthening Cyber laws: Robust and updated legal frameworks are essential to address emerging cyber threats such as AI-driven frauds, deep fakes and cross-border cyber crime, with stricter penalties and faster prosecution. Continuous updates by the Reserve Bank of India and other agencies are necessary to keep pace with evolving risks.

Faster grievance redressal mechanism: Timely response is crucial to recover funds in cyber fraud cases. Strengthening systems like the National Cyber Crime Reporting Portal (NCRP) and improving coordination among banks, regulators and law enforcement can ensure faster reporting, tracking and action.

Cross-border cooperation: As many cyber frauds originate from global networks, international collaboration, data-sharing and joint investigations

are essential to track and dismantle cyber crime syndicates and strengthen responses to transnational threats.

Bank-level Measures

Banks serve as the operational core of cyber security implementation and must adopt advanced tools and frameworks to detect and prevent frauds in real-time.

AI-based fraud monitoring: Banks are increasingly deploying AI and machine learning tools to monitor transactions continuously and detect suspicious patterns. These systems analyses large datasets in real-time, enabling early identification of fraudulent activities and immediate intervention. AI-driven monitoring enhances both speed and accuracy, reducing financial losses and improving customer protection.

Behavioral biometrics: Behavioral biometrics involves analyzing unique user behavior patterns such as typing speed, touch pressure, navigation habits and device usage. Unlike traditional authentication methods, this approach provides continuous verification throughout a session, making it highly effective in detecting account takeovers and unauthorized access.

Blockchain-based security: Blockchain technology offers a decentralized and tamper-resistant framework for secure transactions and data management. By ensuring transparency and immutability, blockchain can reduce fraud risks in areas such as payment processing, identity verification and record-keeping. Its application in banking can enhance trust and reduce the likelihood of data manipulation or unauthorised alterations.

Technology-level measures

Technological advancements are the backbone of modern cyber security systems, enabling secure communication, authentication and data protection.

End-to-end encryption: End-to-end encryption ensures that data transmitted between users and banks remains secure and cannot be intercepted or accessed by unauthorised parties. This is particularly critical for online banking, mobile applications and payment systems, where sensitive information such as account details and transaction data is exchanged.

Zero-trust architecture: Zero-trust security models operate on the principle of "never trust, always verify", requiring continuous authentication and authorisation for every access request. This approach minimises the risk of internal and external breaches by ensuring that no user or system is automatically trusted, regardless of their location or credentials.

Secure APIs: APIs are integral to modern banking, enabling integration with fintech platforms and third-party services. Securing APIs is essential to prevent unauthorised access and data breaches. This involves implementing strong authentication protocols, encryption and regular security testing to ensure safe data exchange.

Minimising cyber fraud requires a holistic strategy combining strong governance, advanced technology and proactive institutional measures. As threats grow, integrating AI, blockchain and secure systems – backed by robust policies - will be key to building a resilient financial ecosystem.

Key Findings

The study finds that cyber fraud in India has grown sharply alongside digital banking expansion, particularly through UPI, mobile banking and online payment channels. A large proportion of fraud cases are low-value retail incidents involving phishing, OTP theft, QR code scams and impersonation tactics, indicating that fraud is increasingly behaviour-driven rather than purely system-driven. While the number of

fraud cases has risen substantially, aggregate losses show signs of stabilization in some periods due to improved intervention systems and faster blocking mechanisms.

The study further find that high-value frauds are concentrated in investment scams and institutional lending irregularities, even though such cases are fewer in number. Banks are increasingly using artificial intelligence for real-time fraud monitoring, anomaly detection and transaction screening. However, low customer awareness, weak digital literacy and delayed reporting remain persistent structural vulnerabilities. Effective cyber security, therefore, requires coordinated action by regulators, banks, technology providers and customers. Behavioural biases such as trust, urgency, fear and greed significantly increase customer vulnerability to digital fraud. However, low customer awareness remains a major systemic weakness, increasing vulnerability to fraud.

Conclusion

Cyber security is now a critical pillar of financial stability in India's rapidly digitising banking system. While innovations like UPI improve inclusion and efficiency, they also increase vulnerabilities, with a shift towards high-volume retail frauds and high-value institutional frauds.

Addressing this requires an integrated approach – strong regulation, AI-driven technologies, robust banking controls and customer awareness. As threats evolve, a coordinated, proactive and intelligence-driven framework is essential to build resilience, sustain trust and support India's digital financial growth. The study examines cyber security in India's banking and digital payments ecosystem, focusing on retail fraud and institutional responses. The study has few limitations, including:

- Reliance on secondary data (with possible underreporting);
- Restricted access to bank-level data due to privacy.

Despite this, it offers a reliable and policy-relevant overview of cyber security challenges and strategic responses in India.

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DIGITAL LENDING: OPPORTUNITIES AND CHALLENGES

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Abstract

Digitalization has been tremendously increasing both internationally and domestically. The boost to digital lending has received post onset of pandemic especially on account of lockdown related restrictions, which caused hindrance with reference to traditional banking activities. The factors supporting rapid expansion of digital credit in the Indian context has been the development of Indian stack and also introduction of Aadhaar as a unique identifier in 2009. The increased smart phone penetration has also helped in increased diffusion of digital credit. The regulatory landscape included initiatives taken by Reserve Bank of India (RBI) such as issuance of Account Aggregator related guidelines in 2016 and Peer-to-Peer (P2P) related guidelines in 2017 enhanced trust in Digital lending. With the opportunity of increasing the reach of credit, some issues and concerns have also been experienced with reference to digital lending such as data privacy and security, cyber security and digital frauds, fake lending apps, complaints pertaining to usurious rate of interest being charged. In order to address these concerns and protect the customers, digital lending guidelines were issued by RBI in 2022, which have helped in addressing these issues.

Keywords

India Stack, BigTech, Embedded Finance, Account Aggregators, Marketplace Lending, Digital Lending

Introduction

The digitalization has increased globally in the past few years. Although it has substantially increased in the developed economies, emerging and developing market economies are not far behind. The share of the individuals involved in the process of receiving or making digital payments had increased from 55% in 2021 to 62% in 2024, in developing economies and 96% with reference to OECD countries[1]. Riding on this increasing digitalization, fintech lending has also increased substantially. As per the BIS report, the total global alternative credit (being lent through Fintech companies and BigTech companies) in 2019 amounted to USD 795 billion[2]. Out of this, the share of credit by Fintech and BigTech companies have amounted to USD 223 billion and USD 572 billion, respectively. The United States (US), United Kingdom (U.K.) and China are the largest markets with reference to Fintech credit. It has also been observed that BigTech has shown rapid increase in Asia, viz., Southeast Asia, Korea, Japan and China. Further, global alternative lending market is expected to grow at a Compound Annual Growth Rate (CAGR) of 13.4% annually between 2025 to 2029 and the global lending market is expected to reach a level of $ 884.1 billion at the end of 2029.

In the Indian context, digital revolution has been a huge success and the digital consumer base has been the

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The views expressed in this article are those of author and do not represent the views of the organisation to which the author belongs to.

[1]Supporting informed and safe use of digital payments through digital financial literacy, OECD.

[2]Bank for International Settlements Working paper no 887, titled "Fintech and big tech credit: a new database.

second largest globally and as per the Internet and Mobile Association of India, there were approximately 759 million active internet users in 2022. In the Indian context, the overall volume of digital credit being lent has seen an increase of approximately 1115% from ₹11,671 crore in 2017 to ₹1,41,821 crore in 2020[3].

Digital Lending

Digital Lending can be defined as the credit intermediation through digital means. As per Financial Stability Board, Fintech Credit or Digital Lending can be defined as "all the credit activity facilitated by electronic platforms, whereby, borrowers are matched directly with lenders".

In the Indian context, the Non-Banking Financial Companies (NBFCs) have been at the forefront of digital lending and it can be classified in to two types, viz., balance sheet lending and marketplace lending. In case of balance sheet lending, the concerned entity carries the risk on its balance sheet with reference to the loan disbursed and in case of marketplace lending, the NBFC acts as an intermediary for bringing together the lender and borrower. Institutionally, the digital lending ecosystem is comprised of lending by regulated financial institutions and also lending by individuals other than banks, fintech and NBFCs. The lending by regulated financial institutions can be further sub-divided into consumer lending and small business lending e.g. invoice discounting, Small and Medium Enterprise (SME) discounting. The lending by regulated financial institutions comprises of Balance sheet lenders (banks/NBFCs), marketplace lenders (NBFC/P2P) and in case of hybrid lenders (balance sheet lenders who are participating in marketplace). From user's side, the digital lending cycle, in turn, is comprised of a number of steps including, lending app discovery and registration, loan application processing, user verification, loan disbursement and loan repayment.

In the Indian context, the digital lending can be done in various categories such as personal loans, embedded finance, gold loans, Micro, Small and Medium Enterprise (MSME) loans and loans related to credit cards. One of the most common type of digital loans is personal loans. The report published by Experian, the personal loans constitute 51% (by value) and 77% (by volume) of the total fintech loans. In case of Embedded Finance, a non-financial app offers financial service or lending, e.g. E-Commerce companies are offering 'Buy Now and Pay later' and in case of Education Tech Sector, 'Study Now and Pay later' services are being offered. It has also been observed that delivery, health or travel apps have been integrating insurance products which are offered to their customers. Certain financial institutions have been offering loans which are lent against gold holdings of the borrowers, in certain instances, the holding can be in the form of digital gold. Fintech companies have been offering supply chain financing solutions with reference to the Micro, Small and Medium Enterprise (MSME) sector, the fintechs have undertaken digitization among the concerned entities and has also revolutionized the supply chain financing segment. Certain lending platforms are also offering credit card as a service which is relevant to the customer needs and they are also a tool for unsecured loan and also facilitating financial access.

Some examples of digital lending platforms in India includes, KreditBee, CASHe, Lending Kart, Pay Later, Early Salary etc. These platforms provides short-term and personal loans and the major clientele of these loans are freelancers, salaried individuals and young professionals. The methodology which is followed includes digital onboarding using e-Know Your Customer (e-KYC), Artificial Intelligence (AI) based credit scoring, using banking transactions data, smart phone usage patterns and analyzing social media, along with the credit reports of the customers with reference to the onboarding process. Some platforms primarily give loans to the MSME sector and offers working capital and business loans. They

[3]Report of the Working Group on Digital Lending, November 18, 2021, RBI.

collects financial data through the medium of Goods and Services Tax (GST) filings, bank statements, etc. They also provide loan products based on the principle of 'buy now and pay later'.

Literature Review

Damodaran et al. (2019), has mentioned that the scope of digital lending is enormous with reference to funding MSMEs. In the Indian context, the role of digital lending had increased on account of downturn of the NBFC sector. There has been enhanced access to customer data, on account of increased smart phone penetration and this, in turn, has helped the digital lenders in evaluating the credit risk with reference to lending to MSMEs and also startups.

Sommer (2021) has mentioned that the COVID-19 pandemic has accelerated the digitalization trend. An important concern in this regard is that MSMEs and underserved households who have had limited credit access may end up in a loan trap which may increase in indebtedness. Therefore, it has been advocated that it is incumbent upon regulators to lay down necessary regulations and introduce necessary reporting by these financial entities, in order to prevent such type of exploitative financialization.

Aramonte et al. (2022) had mentioned that in order to promote lending to the vulnerable sectors of the economy, Decentralized Finance (DeFi) needs to undertake tokenization of real assets and decrease its reliance on collateral and emphasize more on gathering information in case of credit decisions.

Vaidya (2022) mentioned that the digital lending platforms have made a substantial impact on the overall lending space in India. It has been observed that personal loans space have the highest share in the total digital lending space amounting to 72%. Further, it was mentioned that app-based lending has achieved importance in the unsecured loan segment and another emerging area is secured lending using digital collateral.

Yadav and Shanmugam (2022) had tried to study the challenges with reference to the adoption of digital lending. The study had tried to analyze the challenges from three perspectives, namely, regulatory perspective, customers and financial institutions. The study reported lack of trust, lack of awareness, financial illiteracy and privacy issues from the customers' perspective and increase in credit risk, poor internet connectivity and rise in Non-Performing Assets (NPAs) as major challenges from the financial institution's perspective.

Cornelli et al. (2023) had taken a global database of bigtech and fintech volumes with reference to 79 countries during the period 2013-18 and using panel regression analysis, it was observed that the newer forms of digital lending have become more popular in countries which have higher per capita Gross Domestic Product (GDP). Further, it has been observed that alternative forms of credit are more developed in countries which have efficient judicial system, investor protection and greater degree of investor protection.

Chen et al. (2023) have undertaken a study regarding the well-being of the borrowers of Kenya based on their data during the period April 2018 - January 2022. The major finding of the study has been that alternative data is able to increase credit access with reference to underserved individuals who do not possess credit history. It has also been mentioned that digital lenders in developing economies are able to use the personal data of the individuals for offering new financial products since statutory limitations on the usage of this type of data is lesser vis-à-vis developed economies such as Europe and US. It was further mentioned that the digital lenders should explore using innovative approaches for using this type of data.

Doerr et al. (2023) have examined how California Consumer Privacy Act (CCPA), 2020 has granted

users control over the data and how it has helped in mitigation of concerns regarding sharing of the same. It was also concluded that CCPA has resulted in increase in loan applications to the fintech companies, since the fintech companies are able to provide more individualized pricing on account of sharing of data by the borrowers.

R and Nagouda (2024) had tried to study the impact of digital lending on MSMEs in the Indian context and it was concluded that the digital lending has had an significant impact with reference to improving credit access with reference to MSMEs. However, there is need for implementation of enhanced financial education, reinforcement of infrastructure and also putting in place supportive regulations in this regard.

Arya and Sharma (2025) had tried to assess the impact of the digital lending on the Indian commercial banking sector with reference to loan origination, customer satisfaction, operational cost and credit risk management. Survey was conducted and data was collected from 1,000 participants comprising of both clients and bank staff personnel. It was concluded that digital lending is supportive of credit risk management using AI-driven risk evaluation. It has been further mentioned that although digital lending has changed the banking sector, however, there is still scope of enhancing regulatory frameworks, financial literacy initiatives and also cyber security infrastructure.

Research Gap

The previous literature has covered the impact of digital lending on the Indian commercial banking sector, on MSMEs in the Indian context, impact with reference to Indian lending space, etc. The uniqueness of this paper is that it has reviewed and collated factors, opportunities, concerns and issues with reference to digital lending. This has been covered in greater detail in this paper. This paper encompasses recommendations pertaining to issues with reference to digital lending which may not be covered by the existing literature since they are largely intuitive in nature. Another important topic not addressed by the previous literature is embedded finance. This paper also covers in details, the extant guidelines, regulatory instructions issued by the regulator, viz., RBI with reference to the digital lending ecosystem in India, which has not covered in detail by the previous studies.

Objectives

The objective of this study is to undertake a comprehensive review of the existing ecosystem of digital lending in the Indian context, factors which have impacted digital lending, opportunities with reference to digital lending, regulatory landscape and in the end recommendations in this regard; in the context of increasing digitalization both domestically and internationally, since the process of receiving and making payments digitally had increased more than 60% in 2024.

Methodology

The methodology involved review of the various publications and research papers including circulars issued by RBI, reports issued by RBI, research articles/papers on issues pertaining to digital lending.

Discussion

Factors influencing Digital lending

A key factor in the rise of Digital lending is digitalization which is supported by the development of India stack. The India stack consists of three integrated and overlapping layers, viz., data, payment and identity. The setting up of stack can be traced to the introduction of Aadhaar in 2009.

There has been a significant increase in transaction volume of digital payments, raised to 12520 crore in H1: 2025[4]. An important development regarding the digital payments ecosystem has been the introduction of Unified Payments Interface (UPI). The UPI was launched by National Payments Corporation of India in 2016 and it was envisaged as an inter-

[4]Payment Systems Report, 2025, RBI.

operable protocol allowing third-parties to build apps for providing service of making payment to their customers, the same can be undertaken through QR codes, mobile numbers or other type of identifiers. The usage of UPI through mobile devices have helped in bridging the digital divide and have helped inclusion of hitherto unserved/underserved segments of the population by the financial institutions.

Another important factor is that a higher segment of the Indian population is young and is also digitally literate, the median age of the population being 28.4 years[5]. Therefore, the extent of digitalization has been widespread in the context of Indian economy.

The imposition of lockdown due to COVID-19 pandemic provided a major boost to the digitalization with a massive increase in the digital payments. The increase in the fintech activity was much more pronounced in those countries where the lockdown restrictions were much more stringent. In the Indian context, with the imposition of the lockdown restrictions, there was decline in activities requiring face-to-face interaction, whereas, on the other hand, digital transactions and digital lending saw a massive increase.

Therefore, the factors which have facilitated or promoted the growth of digital lending can be categorized in to smart phone revolution, increased digital off-take in the wake of COVID-19 pandemic and use of Big data analytics, Artificial Intelligence (AI) and Machine Learning (ML).

Opportunities

MSME sector which constitutes 95% of the industrial units[6], plays a very important role in the job creation. However, MSME sector is constrained on account of lower funding due to inadequate credit history. Only 19% of the MSME credit was met by formal credit sources, Rs. 80 lakh crore remained unmet.[7] An important characteristic of digital lending is that it is able to cater to underserved/underserved sections of the society. However, since the access to credit is based primarily on assessment of the credit history of the borrowers, it appears that in cases of such unserved/underserved sections of the society, the credit assessment is hampered on account of scanty credit history. However, these segment of borrowers still leave digital footprints in the form of internet usage, social media usage, e-commerce platforms etc. The credit worthiness of these borrowers can, therefore, be assessed based on the information which can be accessed from these digital footprints.

In such a scenario, the usefulness of the alternative data assumes importance. The alternative data can be classified in two categories, viz., financial and non-financial. The financial data includes, data on utility payments, suppliers' payments, transactions on e-commerce websites, etc. and non-financial data includes data on internet browsing, social media, etc. Therefore, in the context of MSME sector, alternative data in conjunction with traditional credit assessment can yield valuable information regarding their credit worthiness.

Another important sector which can get benefitted from alternative data with reference to credit assessment are the gig workers, especially since they do not have fixed income, therefore, they face obstacles in accessing the credit.

The usage of alternate data can be helpful in gaining deeper insights into the borrower behavior with the help of diverse data sources, expedited credit risk assessment processes, facilitating credit access to individuals, MSMEs with scanty/limited credit history, advancement of financial inclusion on account of credit availability to wider sections of the society.

Embedded Finance

An important innovation with reference to digital lending is the emergence of embedded finance, which has emerged banking upon the successful dissemination of E-Commerce platforms/websites

[5]India@ 100, EY India.
[6]Invest India. Growth Imperatives for the MSME Sector, 2021.
[7]Enhancing competitiveness of MSMEs in India, NITI Aayog.

such as Amazon and Flipkart, which have developed credit products such as Amazon Pay Later and Flipkart Pay Later. These products provide credit lines to the customers, allowing them to defer payments or alternatively pay interest free instalments. In this regard, the onboarding process is facilitated by electronic KYC procedures and also alternative data based credit assessment. Apart from consumer credit, embedded credit has also been helpful in facilitating credit to the agricultural and supply chain segment. These platforms use transaction level data such as sales, input purchases and also produce volumes for assessing credit worthiness in the absence of complete and accurate credit history and banking upon the integration of UPI with reference to various consumer facing applications, has also facilitated embedded finance. This helps the customers in making the payments without being directed to external banking related applications, example, Zomato and Swiggy have embedded UPI based payment options as part of their food delivery interfaces. These integrations have helped the small and medium enterprises in accepting digital payments. Further, these fintech platforms are also helpful in allowing small and medium enterprises in becoming operational within a short period of time with reference to payment acceptance infrastructure.

Concerns and issues with reference to Digital Lending

Digital Divide: A major challenge with reference to alternate data source is the digital divide. For the segments of the society, which do not have much digital footprints, credit related inputs will not be available or difficult to gather.

Privacy and Data security: With reference to the use of Artificial Intelligence/Machine Learning (AI/ML) in the digital lending applications, one of the major issue of concern is regarding the black box nature of the algorithms which are increasingly being used by Lending Service Providers/Digital Loan Applications. With reference to digital lending, these algorithms are being used to go through a large number of data variables in conjunction with credit history.

The fintech platforms collect a large volume of data, which includes financial and personal information and records pertaining to the customers. This raises the concerns regarding unauthorized access and security of the customers data. There are also concerns regarding whether explicit consent has obtained from the customers in this regard. There have also been concerns regarding sharing of the credit information without the consent of the customers. In certain instances, it has also been observed that some of the digital loan applications do not clearly disclose the banks/NBFCs with whom they are associated.

Cyber security and cyber frauds are also concerns in case of the digital lending. The fraudsters use stolen identities such as Aadhaar, PAN Card and other documentation of other individuals for availing loan.

As per a study undertaken by the Working Group on Digital Lending set up by the RBI in 2021, out of a total of 1,100 digital loan apps which were in operation during that period, approximately 600 were illegal apps and customers who visit the website of these apps may end up sharing their sensitive personal and financial information with them, which may subsequently be used by them for carrying out phishing attacks and also carrying out identity theft.

Irregularities: Another important issue is the case of usurious rate of interest being charged by some of these lending platforms, which in certain cases is more than 100% per annum, which becomes quite challenging for the customers to repay. There may also be the instances of harassment with reference to the loan recovery in certain cases.

Rising competition: Another important cause of concern is the entry of the BigTech companies in the fintech sector, since these companies already

have the advantage of having access to an existing consumer base. These companies may end up cross subsidizing their fintech sector business with their core business, however, this may lead to the fintech sector being dominated by these large BigTech firms, which may thus lead to concentration risk.

Financial Stability related issues: It has been observed that although share of digital lending in the overall credit ecosystem is limited, therefore, the impact on the financial stability is lower. However, there is scope that on account of increase in digital lending, it may impact the financial system in future. The risk can emanate from the entities which operate in the fintech space, which do not have adequate banking experience; the extent to which there is inter-connectedness between different entities involved in the fintech space. Another important point of concern from the systemic perspective is that the fintech lending activity is spread over multiple entities, which may lead to issues with reference to assumption of operational responsibility. There is also possibility that it may lead to regulatory leakage on account of shifting of capital intensive activities by banking institutions to the fintech space.

Regulatory Landscape

To regulate the digital lending landscape, Digital Lending Guidelines were released by RBI on September 02, 2022. The guidelines mentioned that the regulated entities shall ensure that all loan disbursements shall be made directly to the bank account of the borrower and it also needs to be ensured that all loan servicing needs to be undertaken by the borrower directly into the bank account of the regulated entity. It was also mandated that regulated entity needs to furnish a Key Fact Statement, which shall provide details regarding Annualized Percentage Rate of interest, recovery mechanism, details of the Grievance Redressal Officer, to the borrower. Any fees or charges not mentioned in the KFS may not be charged to the borrower. Annual Percentage Rate may be disclosed upfront to the borrowers before sanctioning of the loan and details of the lending service provider acting as recovery agent may be shared with the borrower.Instructions were issued that the Digital Lending Apps of regulated entities and lending service provider need to have link to the websites of the regulated entities. An important safeguard to the customers/prospective borrowers, has been provided by mandating that the Lending Service Providers/Digital Loan Apps do not need to store personal information of the borrowers except maintaining certain minimal information regarding them. Further, it needs to be ensured that any collection of data by the digital loan apps or lending service provider should be need-based and also with explicit consent of the borrower. Further, RBI has also operationalized a directory consisting of details regarding of all digital loan apps which are deployed by the regulated entities. Government of India through its Indian Cyber Crime Coordination Centre is trying to combat the menace of illegal loan apps by facilitating reporting of cyber incidents through launching of National Cyber Crime reporting portal and also National Cyber Crime Helpline Number.

In the Indian context, the statutory backing for digital lending can be found in terms of the Section 5 (b) of the Banking Regulation Act, 1949, which provides for the definition of banking, as being the business where loans are provided through both physical and online mode. The RBI Act, 1934 lays down the concept of principal business criteria in case of NBFCs, wherein financial activity is considered the principal business of an entity where financial assets and financial income constitute more than 50% of the total assets and total income, respectively. The regulatory approach, promotion of innovation along with safeguarding of the financial system, putting in place necessary guardrails. Another important development is the issuance of Account Aggregator (AA) framework by RBI, introduced in September 2016. The objective

behind issuance of the AA framework is to make the aggregation and also sharing of the financial data by an intermediary, which are known as Account Aggregators. The role of Account Aggregators is collection and retrieval of credit related information from the holders of such information who, in turn, are known as Financial Information Providers and in turn, provide the information to the specified users who are known as Financial Information Users. As part of the digitalization journey, the recent initiative by RBI has been the introduction of Unified Lending Interface (ULI). The objective of this platform is to ensure seamless and consent-based flow of digital information, the source of this information is from multiple land records and also multiple data providers. The uniqueness of this ULI architecture is the plug-and-play approach in order to access information from multiple service providers. It is envisaged that JAM-UPI-ULI will become a game changer regarding the digital lending ecosystem. On account of an increase in digital lending experienced in the Indian context, it was felt necessary that a framework for digital lending may be laid down and therefore, a Working Group on Digital Lending including Lending through Online Platforms and Mobile Apps was set up by RBI in January 2021. Consequent to the submission of the recommendations by the Working Group, Guidelines on Digital Lending were issued including, First Loss Default Guarantee (FLDG). The FLDG is a contract between banks and other regulated entities with fintechs and Lending Service Providers, whereby, it is provided that latter compensates the lender for the loss caused on account of the borrower's default up to a certain limit, which is specified upfront.

The Buy Now and Pay Later based schemes function beyond the traditional lending based framework. This type of lending is not based on comprehensive credit assessment of the borrowers. Therefore, there are concerns regarding increasing indebtedness among digital savvy consumers. This may adversely impact the economy from the financial stability perspective. The Digital Lending Guidelines issued by RBI have tried to address these issues. As per the guidelines, it is mandated that all loan disbursements need to be routed directly to the borrowers' bank accounts; the lender needs to provide clear information regarding fees, interest rates to be charged to the borrower, through issuance of Key Fact Statement. The digital lending platforms need to obtain explicit consent from the customer before they are able to access the personal data of the customer and it is also mandated that the regulated entities would be fully responsible for the action of their lending service providers.

With reference to the digital lending, another important point of concern is the processing and usage of vast volumes of personal data, which may lead to concerns regarding data privacy. Therefore, in this regard, an important legislative development is the enactment of the Digital Personal Data Protection Act, 2023.

A major landmark initiative taken by RBI with reference to the digital lending ecosystem has been the issuance of P2P lending guidelines in 2017. In terms of P2P guidelines, it was envisaged that certain non-banking financial institutions can act as an intermediary which will provide an online market place or platform. In order to further strengthen these measures, RBI had issued revised guidelines in August 2024. It was mandated that the P2P platform should not be promoted among the investors as an investment product with features such as assured minimum returns, liquidity options, etc. It has also directed that no loan should be disbursed unless matching of the lenders and borrowers has been undertaken. An escrow mechanism framework also needs to be laid down, whereby, two escrow accounts, out of which one escrow account would be utilized for transfer of funds from the lenders' bank account to the lender's escrow account which, in turn, is disbursed to the specific borrower's bank account and the borrower's escrow account, whereby, the borrower shall transfer funds from his/her respective bank account to the

escrow account, through which the funds will be transferred to the lenders' bank account.

With reference to customer protection, RBI has also laid down Fair Practices Code (FPC) both for NBFCs and banks. This FPC provides for transparency in interest rates/fees, prevention of any type of harassment in the case of recovery of loans and grievance redressal mechanism. RBI has also laid down code of conduct in outsourcing of financial services. This code provided for regulated entities in ensuring that their service providers are properly trained with reference to dealing with customers, ensuring fair treatment of borrowers and ensuring security and customer data privacy.

RBI has also formulated an Integrated Ombudsman Scheme, for providing an grievance redressal mechanism for the resolution of complaints against regulated entities in this regard.

To promote innovation with governance, the RBI introduced the regulatory sandbox in 2019, in order to undertake live testing of innovative services and products. In this regard, the framework for inter-operable regulatory sandbox was also laid down. In order to encourage financial innovation, RBI has set up an Reserve Bank Innovation Hub in 2022. The objective behind setting up of the Innovation Hub is to promote access to the products and financial services with reference to the low income population.

Recommendations

In order to address the concerns pertaining to digital lending, there is need for information sharing between the regulatory agencies, law enforcement agencies for timely redressal of the complaints/issues. There is also need for enhancing awareness programmes among members of general public consisting for digital lending guidelines issued by RBI, so that they can safeguard themselves from risks associated with digital lending in order to spread financial awareness among the general public, this platform can be utilized for spreading awareness regarding digital lending guidelines, cyber security, key fact statement, etc. There is also need for sensitization of the regulated entities with reference to assessing the suitability and appropriateness of the various loan products based on the customers' profile, as easier access to credit is leading to increase in indebtedness.

Conclusion

It can be concluded that digital lending has been a major game changer with reference to facilitating credit access to hitherto under-served segments of the society, which do not have adequate or no credit history. It has simplified the onboarding process and also credit disbursal process. Although in a developing economy, the digitalization and role of digital credit particularly can be very useful from the financial inclusion perspective, however, concerns regarding data privacy and security, cyber security, frauds, etc. have also been observed. Therefore, there is need for robust supervision and timely redressal of these concerns by regulatory bodies. There is also need for increased consumer awareness so that such incidents can be prevented in future.

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TRUST TO THRUST: HARNESSING CUSTOMER ENGAGEMENT TO ELEVATE EXPERIENCE AND GROWTH

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Abstract

Banking sector in India has conventionally focused on managing and experimenting with various service delivery channels for the customers. With the increasing digitalization of banking and financial services, the proliferation of banking facilities has become more intense and increasingly homogenous. This made customer retention a new pressing challenge for the banking industry. In this context, customer engagement is an area which holds the key to reinvigorate the entire banking system. The conventional models of customer engagement have been restrictive. This paper is based on a thorough analysis of key models of customer engagement and proposes a three-tiered approach to enhance customer engagement to ensure better customer retention as well as proliferation of banking products. The results of the study were discussed through three proposed frameworks, namely, a Gamified Unique Experience Service System (GUESS), a Personalized and Unbiased Responsive Enterprise (PURE) and a Brand Recognition, Association and Gesture (BRAG). These innovative frameworks proposed to introduce a more intense gamified banking environment to the consumer which could amplify the customer experience while invoking key human emotions. As a result of these frameworks, banks could find a niche position within the emotive space of each consumer, connecting and establishing more personal ties where both the bank as well as the consumer is able to find association with each other. Such model holds the key to reinforce the connection with the customer while also amplifying the potential for growth for the banks.

Keywords

Customer Engagement, Customer Service, Customer Experience, Personalization, Banking, Gamification

Introduction

The Banking, Financial Services and Insurance (BFSI) sector stands at the crossroad where the growth prospects are highly volatile and the technological changes and growing competition have made the pursuit of innovation and reimagination of their business models indispensable (McKinsey & Company, 2023). There is an urgent need of multifarious innovative and technology-driven avenues in every realm of the economy (Reserve Bank of India, 2023b). With the unprecedent success and reach of Unified Payments Interface (UPI) and never-seen-before penetration of the BFSI players into every nook and corner of the economy, the Indian economy has already set an example of its ability to innovate and explore (IBEF, 2025). However, this promising picture of the economy also warrants an exploration of the underlying challenge for financial institutions.

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Banking sector displays a unique synergy when it comes to the macroeconomic trends of economy. This synergy could be observed through an unprecedent adaptiveness shown by the BFSI sector to the changing technology. However, this adaptiveness is also marked by the presence of a contagious effect which permeates through the entire banking system making the processes and products across the industry appear similar. This gives rise to a homogenizing trend in the banking and financial services sector (Rao & Moorthy, 2014). Another important development in this direction is the rising competition, further intensified by the multimodal penetration of new age financial service providers such as Payments Banks, Non-Banking Financial Companies (NBFCs) and Fintechs (Reserve Bank of India, 2023b). Owing to this commotion, the behemoth sized financial institutions have been forced to rethink and reimagine the entire gamut of banking services (Accenture, 2023; Accenture, 2025). Failure to engage in this contemplative reimagination of banking and financial service could cost the banks their sustained growth and profitability.

A major theme which holds the potential to act as the fulcrum for the BFSI sector amidst this transformative period is customer engagement (Ernest and Young, 2025). With the plurality of financial service providers and an entire market of similar appearing products and services, the service providers are faced with a situation to make their business proposition interesting for their customers to ensure a sustained customer engagement and interest (Accenture, 2025). Understood from a more fundamental perspective, this need to reimagine the ways of engagement between the customer and the service providers is not a passing fad but an instrumental theme of any business model. Extensive studies have been done on various models of customer engagement (Accion, 2018; Keller, 2010; Kini & Basri, 2022; Rao & Moorthy, 2014; Sharma, 2022; Sondinti et al., 2025). However, the reimagination of the banking sector in India from a customer engagement perspective deserves a more focused approach. This paper explores how customer engagement could be introduced in conventional banking services in India to elevate its business growth and stability.

The unpredictable position of the customer emerges from the fact that the customer can freely choose from the available service providers in the market. Some studies have found that such volatile behavior is due to the lack of engagement avenues for the customer (Accenture, 2023). This might partly explain why the financial service providers find it difficult to retain their customers against the various marketing gimmicks of the other players. In such situations, the marketing campaigns lacking the avenues of engagement often lead to the underperformance or short-lived performances of such efforts.

A common approach adopted by the banks to cope with this challenge is to make the deal sweeter for the customer. The banking institutions, in India particularly, have often adopted the traditional business model of bouquet-of-services (also called 'bundled products') (Dimitrieska & Efremova, 2020; Reserve Bank of India, 2019, 2025). However, as such products become readily available, an ironic trend emerges. The customers often take-for-granted the bundled products and begin to find more meaningful and relatable avenues of engagement. Thus, when discussed from the business point of view, the bouquet of services approach proves to be outdated, if not irrelevant altogether. This aspect highlights an important gap in the marketing strategy of the banks in India where the focus needs to be brought to reimagination of ways of customer engagement instead of a projected display of things the banks have on offer. A study by McKinsey (2023) has suggested that hyper-personalization, supported by advanced analytics, could increase conversion and retention rates by three to five times. Similar observation have been given by a report published by Accenture (2023) which suggested

that by strengthening human-centric engagement and forging emotional connections, banks have the potential to boost revenues from primary customers by up to 20 percent. It would a dismissive to suggest an end of the marketing potential in the banking sector. The opportunities for the financial service providers can never cease to exist, provided an appropriate approach is maintained.

The meaning of the term 'customer' has transformed in the contemporary times. The role of the customer has changed from being a passive receiver to being an active stakeholder in the banking processes (Ernest & Young, 2025). The expanding frontiers of customer experience demand the ability to customize and personalize the financial services to match their ever-changing needs. This, in turn, affects the various processes and products of the bank and alters the very position of the customer within the BFSI multiverse. This shift is also underpinned by data: global studies revealed that approximately 75% of consumers are drawn to fintech alternatives that offer fast, seamless and cost-effective services, thereby, raising expectations for traditional banks (PTI, 2022).

The sensitivity towards the issue of customer engagement in banking has already knocked the doors of the Indian policymakers (Indian Banks' Association, 2025b, 2025a). But the narrative of the discourse on customer engagement remains largely limited to proliferation of various service delivery channels. This paper explores the avenues of engagement from a customer's point of view. Several insights could be drawn through different gamification models (Christopoulos & Mystakidis, 2023) which would help retain the customers while also improving the profitability of the service provider. Such business models have been effectively implemented in various industries. The paper attempts to explore and employ the logic used in different business sectors, like social media (Vaidhyanathan, 2018) to enhance customer engagement and retention.

Literature Review

The paper has made references to three prominent models on customer service and engagement: first, the SERVQUAL model; second, the Negotiation model and third, the Gamification model. Although elaborate work has already been done in these areas, several nuanced observations and arguments could be developed through these models with reference to the BFSI sector in India.

Firstly, the SERVQUAL model of Parasuraman, Zeithaml and Berry (1988) provides an early attempt to understand and improve the service quality and customer experience. The model has been effectively used across sectors such as banking, hospitality and healthcare; and helps to capture gaps and discrepancies between expectations and perceptions for the customers (Bhasin, 2024). The model has been developed to measure service quality through a multi-item scale based on a survey method which attempted to measure service quality by comparing service expectations and service perceptions (Jurevicius, 2025). The evolutionary development of the model has seen some realignment of the parameters used to assess the quality of service. As a result, the originally conceived 10 dimensions were segmented into the popular RATER model[1] of 5 dimensions (Bhasin, 2024; Jurevicius, 2025; Parasuraman et al., 1988).

Although the SERVQUAL model has been used to assess and improve the standards of customer service across different sectors. The perception of the model remains inclined towards the supply-side, that is, the service provider only. The fact that service delivery and service experience are two contrary ends of a business process pushes the Servqual model in a state of perpetual dilemma. A significant aspect of customer experience relates to the attitude and the state of mind rather than the materiality of the service itself. By keeping the service delivery and experience always apart, the servqual model undermines a key aspect.

Parasuraman's (1988) perception of service quality 'as the degree and direction of the discrepancy between consumers' perceptions and expectations does not take into account the role of creative expression of the consumer in defining the scope and experience of any service. The application of customer engagement in the service perception can alter the overall outcomes and results. For these reasons, while Servqual model might serve as a measure to study the relation between consumer expectations and organisational response, it falls short in drawing upon the potential of customer engagement in business processes.

Another widely referred model of customer service is the Negotiation model which emphasises upon the importance of customer engagement and a continuing process of deliberation (Fisher et al., 2011). While negotiation takes place in every business scenario, it is important to channelize and streamline such negotiations to reach the desired ends. The negotiation model is based on such planned process. This approach focuses on collaboration, mutual gains and problem solving on merits. The purpose of negotiation, under this model, is to arrive at agreements that are wise, durable and enhance relations between parties. This model proposes that service delivery should not be perceived as a one-sided process but a dynamic process, wherein, the meaning of the value is created through engagement and interaction.

Negotiation often reshapes the customer expectations and experience in real time (Parasuraman et al., 1988). As a result, the outcomes of a business process might alter as a result of interaction between the service provider and the customer. Vargo and Lusch (2004) have opined that values are not intrinsic to any specific service. Instead, value is created through the process of engagement and interaction. In this sense, customers have become an 'operant resources' (Constantin & Lusch, 1994) which play an equally important role in giving meaning to a service and an outcome.

Thinkers like Fisher (2011) have also believed that flexibility in service design often leads to a higher relational value. This flexibility connects customer engagement theory with customer service. However, the potential of the model can be extended to bring more productive outcomes if applied in collusion with gamification. This is partly because of the underlying models of engagement which impresses the attention of the customer and the service provider both.

The Gamification theory taps upon the fundamental emotions that play an important role in shaping our behaviour and response (Christopoulos & Mystakidis, 2023). The application of gamification in banking has multifarious dimensions which extends the conception of financial services beyond need satisfaction and towards the realms of exploration and achievement in personal and professional aspects of life. Gamification introduces elements of enthusiasm and engagement through game-design concepts and techniques (M. & Aithal, 2023).

The evolution of the gamification theory is generally traced to the first decade of the 21st century and in the works of Shirky and Terrill (Christopoulos & Mystakidis, 2023; Deterding, 2015). The tenets of gamification have been applied to various educational fields as an attention and interest enhancement method (Christopoulos & Mystakidis, 2023). However, an important application of gamification has been found in the business world through various models calling for a deeper customer engagement and involvement. Through various instruments such as campaign design, product association and recognition matrix, the business models are transformed into a lifecycle of rewards and achievements which are linked to the personal ambitions of the consumer. The narratives, themes and metaphors used by the corporate world are sometimes used to guide and motivate the consumer to get involved with the product or service. The framework of games in education, involving rules, goals and logics, is often directly employed in real life scenarios involving finance.

[1]RATER model is based on 5 broad parameters, namely - Reliability (4-items), Assurance (5-items), Tangibles (4-items), Empathy (5-items) and Responsiveness (4-items). This major change was done in 1988 and widely used across different industries. The overall model was further modified several times later, but the teleological approach remained, more or less, the same.

Several frameworks[2] have been developed under the overall umbrella of gamification model (Christopoulos & Mystakidis, 2023). Every framework explores different aspects of engagement and behaviour. The overall impact of these frameworks is positive in terms of interest and involvement of the stakeholders. For instance, it is argued that people tend to engage better and take initiatives in the acts or processes which impress and entertain them. These aspects of engagement at an individual level also accords the corporate services an important dimension, that is, Personalisation. The gamification framework establishes an affirmative belief and confidence in the participant which helps reinforce the relevance of the learning environment. The same logic is often employed by the businesses to maintain their relevance and continuity in the market.

Based on the psyche of different players (participants), the game scenario adopts a different approach to present itself as a desirable and achievable objective (Christopoulos & Mystakidis, 2023). The contemporary business models often apply these logics while building the business environment for their prospective clients. Some studies have explored the compulsive aspects of these models which often act as an external coercive force upon the customer (Vaidhyanathan, 2018). An application of these business models has been observed to have an compelling effect on their consumer base which result in significant increase in sales and performance.

The logics of gamification can be observed being applied in various contemporary industries ranging from consumer goods to social media. Interestingly, the advent of digital age has acted as a catalyst in increasing the use of gamification and other models of customer engagement. The growth of these models can prove to be instrumental in reinvigoration of the banking sector as it holds the avenues for unleashing the untapped potential of customer engagement in banking and finance industry.

Objectives

The multifarious concerns and challenges faced by the BFSI sector warrants a focussed analysis. The primary concerns of this paper focus on three broad objectives related to banks in India, namely:

- To understanding customers' expectations from the bank and linking this aspect with service design and delivery.
- To study the avenues of customer retention, specifically, amid growing homogenisation of the banking industry.
- To study the avenues of increasing bank's business and profitability through better customer engagement.

The relevance of these objectives can be observed throughout the evolution of banking sector from being transaction-oriented to being based on Banking as a Service (BaaS) (Hodges, 2023). The continued relevance of these areas could also be observed through the incumbent waves of Enhanced Access and Service Excellence (EASE) reforms in Public Sector Banks (PSBs) in India (Indian Banks' Association, 2025a, 2025b). Thus, this study acts as an intervention to address the limitations of the conventional bundled products approach which attempts to bombard the customers with a mix of banking services without being empathetic and aware of the customer's expectations (Accenture, 2023).

As an epistemic endeavour, the paper attempts to find an application of the various models of customer engagement and customer service in the Indian banking sector. Through the various deliberations and reforms in the banking sector in India (Indian Banks' Association, 2025b; Reserve Bank of India, 2023b), the need for a deliberation on more adequate framework of customer engagement and service is orchestrated. This paper attempts to curate such framework for the banking system.

[2]Christopoulos and Mystakidis (2023) have observed around 40 such frameworks under the Gamification model. Some of the popular ones are - Mechanics, Dynamics, Aesthatics (MDA); Fogg behavioral model; Attention, Relevance, Confidence and Satisfaction (ARCS); Oktalysis; RECIPE and 6D.

Methodology

The paper explores the dimension of banking from a customer engagement perspective and attempts to discuss a human-centric customer engagement model for the banks in India. The study undertakes a secondary study approach, dwelling primarily upon an analytical reading of the vast literature on various aspects related to marketing and customer service. A critical reading of the theoretical models has helped to synthesise the arguments from different fields of knowledge to be applied to the specific case of banking. The synergy of the theoretical models supplemented with various research and reports suffice to offer adequate grounds to test the proposed model in real life scenarios. The study also attempts to explore the nuances of customer engagement through examination of established pedagogical approaches. This framework has been helpful to understand the business ecosystem and consumer mindset.

The exploration of an appropriate model of customer engagement for the banking sector in India entails an engagement with some prominent theoretical models of customer service, namely, SERVQUAL (Parasuraman et al., 1988), Negotiation model (Fisher et al., 2011) and Gamification (Christopoulos & Mystakidis, 2023; Deterding, 2015) to find a niche framework which could be applied to the banking sector in India. In doing so, such understanding would find a practical application in the banking industry and in this way, it would become more than an epistemic activity. The application of such insights could be cross-sectional as it would be equally relevant for the bank management, policymakers and other direct and indirect stakeholders.

The theoretical positions have been grounded through reference to various reports and publications from various financial institutions and corporate bodies. Such reports and publications serve as a mirror to the changes taking place in the BFSI sector in India and abroad. The reading of published reports also assists in an epistemic activity of enrichment of the prevailing frameworks. The reports of different Government and non-Government bodies has been referred to understand the nuances of potential and scope of customer engagement in financial services (Accenture, 2023, 2025; Ernest & Young, 2025; McKinsey & Company, 2023; Indian Banks' Association, 2025b). These reports found to be instrumental in projecting the results of an engaging model of customer engagement in the Indian context and in establishing the positive correlation between the arguments presented and the possible trajectory of the banking sector in India.

Discussion

Changing Paradigm of Banking Sector

The banks, in India, have gained a kaleidoscopic experience since the nationalisation of banks in 1969 (International Monetary Fund, 1973). The banking industry has witnessed an evolutionary change from being transaction-oriented to a more Customer Experience (CX) and relationship-centric model. This changing approach can be observed clearly through the changing industrial outlook itself (Indian Banks' Association, 2025b; Reserve Bank of India, 2019).

The changing stance of the banking sector can be well captured through the waves of Enhanced Access & Service Excellence (EASE) reforms (Indian Banks' Association, 2025b). What started with a noble reform objective of bringing responsiveness and responsibility among banks has now been transformed into an innovation driven Business Process Reengineering and customer-centric effort. The reformed outlook of the banking industry today is based on the themes - Risk & Resilience, Innovation, Excellence and Socio-economic Impact (Indian Banks' Association, 2025b). The changing outlook combined with the digitalisation of banking industry has further radicalised the aspects related to CX and capability. This enhancement of capability is also key to the growth and development of the consumer as well as the economy (Sen, 1999).

The inclination of banking sector towards customer service and experience has forced the banks to rethink the ways to engage their customers and other stakeholders in more meaningful ways (Ernest and Young, 2025). The market experience have informed the banking sector of the receding relevance of banking as a bouquet of services model (Reserve Bank of India, 2019). The turn of the century took place along with the advent of the digital age of banking where the dependence upon the brick-and-mortar model of banking has given way to the digital banking channels. This paradigmatic shift from a transaction-based banking to a model of emotive banking has changed the way banking is imagined in the contemporary times.

The framework of giving boost to the business through a better customer engagement model follows some key arguments and assertions which can be elaborated using findings from this study.

Gamified Unique Experience Service System (G.U.E.S.S.)

The changing paradigm of banking has made a significant impact upon the psyche of the consumer. A reference to the customers' inclination towards banking services shows that a bank customer is now more inclined to regularly use multiple banking services across a wide spectrum of asset and liability products (Ernest and Young, 2025). The propagation of the banking products among customers is often viewed as an effective tool for business promotion and profitability. This proliferation of the bank service delivery channels have been actively pursued by the banks and could also be observed in the annual reports of several banks (Bank of Baroda, 2022; HDFC Bank, 2022; State Bank of India, 2022). This approach bears a close resemblance to the SERVQUAL model approach (Parasuraman et al., 1988) which attempts to improve the quality of service from a service providers' end. However, the restriction of such approach has been felt lately as the banking industry have moved towards a greater homogenisation of the service offerings and product modelling (Reserve Bank of India, 2023b).

A positive impact of the digital revolution on the banking sector in India is the acquaintance of the lay consumer with the expanding possibilities of banking (McKinsey & Company, 2023). The rising use of multiple banking services and proactiveness from the consumers towards digital innovations indicates the rising scope of customer engagement. For an economy like India, this is a welcome development as it opens up the scope for bridging the sectoral gaps such as the rural-urban divide and the rich-poor dynamics. However, the primary driving factor of this penetration of banking services amongst the masses is the realisation of the financial needs which motivates the customers to explore the avenues to meet their demands.

While the conventional demand for bank facilities appear to be increasing for some time, such expansion might face a staggered growth once the fundamental needs are fulfilled. At this juncture, the banks might be forced to ponder about the ways to further engage the customers. This need for increasing engagement with banking services can be developed through application of gamification in BFSI sector. The various related frameworks, can be used to tap upon key human emotions to pursue various tangible ends (Christopoulos & Mystakidis, 2023). A study by Ernest and Young (2025) highlighted some of the important takeaways from such gamified models as: Increased customer margin/value, increased customer retention, improved brand relationship, improved CX, increased sales and a better competition strategy. It is ironic that the existing literature on gamification has not been optimally utilized to curate adequate banking services.

Some of the strategies which could be adopted by the banks are discussed below:

Reward and Concession System

Banks essentially deals with wealth which is a key driving force and motivational factor for any individual or entity. The growth of the cashback model as a marketing tool has already proved to be an effective instrument for most financial service providers. Vana & Bertini (2018) have drawn the impact of giving cashbacks to an increased probability of purchase as well as an increased probability of a magnified purchase. The system of cashbacks and rewards have been well tapped upon by the BFSI sector but in a focussed and product specific manner. For instance, the system of reward programs[3] is well experimented with in the credit card segment where different banks have floated different programs enabling customers to earn rewards based on their spendings. Several of the major banks in India have their presence in the credit card business where customers are offered multiple options to redeem their accumulated reward points (The Mint, 2024). However, when it comes to the conventional banking channels, the use of reward programs has remained understated, if not ignored altogether.

The consumer behaviour demonstrates an inclination towards the reward-based banking system. It is common to observe different banks and other financial intermediaries use the reward programs as the pivots around which the entire marketing campaigns are crafted. With a diverse options for using the reward points (often rechristened as loyalty points), the new age customers are often inclined to change their decisions on the basis of these reward programs (Ernest & Young, 2025; KPMG, 2024; The Mint, 2024). These observations point towards a general inclination of the consumer towards a better rewarding framework.

Before drawing a possible framework of a reward program for banking, it is also pertinent to note that the Reserve Bank of India (2011 & 2016) has mandated a restriction upon the financial institutions from distributing monetary rewards and incentives to its customers for mobilisation of deposits and business.[4] This is done to curb unethical practices in banking industry (Nair, 2024). The purpose of the financial regulator in placing restrictions over incentives and gifts in lieu of mobilisation of business is only to ensure fair practices and competition in the banking sector.[5] A further analysis of the RBI guidelines inform that while there are restrictions on monetary rewards and incentives (Reserve Bank of India, 2011b, 2011a, 2016), financial institutions are free to allow their customers the option to choose from select benefits. This is where the reward programs find a niche space.

It is true that the banks have to bear a cost to offer each freebie within the bundled products. It is legitimately possible for the banks to customize their products so as to trim the unrecognized freebies and offer the option to choose the most desired reward or service in lieu of certain milestones or actions. In short, the outline of the reward program would suggest a transaction induced reward cum loyalty program where the customer might be allowed the options to choose for concessions and fee waivers for their future transactions. Such program would fall within a permissible framework of the regulator as there is no aspect of chance or lottery involved and the bank is not offering any monetary commission. The waiver and modification of service charges fall within the purview of the financial institutions which could be used to augment a financial gamification channel for the consumers. This model of reward program is premised upon a theoretical foundations of the ARCS model discussed by Keller (2010) and aims to enhance "attention-relevance-confidence-satisfaction" (Christopoulos & Mystakidis, 2023) of the consumer.

[3]"Reward Programs are those schemes linked to a credit card or debit card whereby the card-issuer or associated merchant establishments, upon use of the card/s, offer digital coupons, points, discounts, cashbacks or other benefits having monetary value that can be used/redeemed for the same transactions or other future transactions after accumulation." (Reserve Bank of India, 2022).

[4]"Banks should not offer any banking products, including online remittance schemes etc, with prizes/lottery/free trips etc or any other incentives having an element of chance, except inexpensive gifts costing not more than ₹250/- as such products involve non-transparency in the pricing mechanism and therefore, go against the spirit of the guidelines." (Reserve Bank of India, 2011a, p. 14).

[5]"There is no objection to banks offering incentives to promote debit card usage without prior approval of RBI, provided that no element of lottery or chance is involved in such incentives schemes." (Reserve Bank of India, 2011b, pp. 12-13).

This framework of rewards program by the banks also serves to satiate the emotive needs of different personality traits of consumers by giving a sense of achievement in both - intrinsic as well as extrinsic levels - and thus, ensuring consumers' satisfaction and long-term engagement (Christopoulos & Mystakidis, 2023). This earned rewards system also help the financial institutions put a check on the unrestricted flow of freebies which often go unrecognized. Thus, a reward program by the banking institutions serves as a prudent tool to make the banking experience of the existing customers more meaningful and relevant.

Certification and Recognition

Recognition and appreciation are the important aspects of any gamification model (Herzberg et al., 2011). The arrival of the digital era has further accentuated the meaning of 'recognition' by expanding its meaning to include various types of engagements and associations. The reference and application to this aspect of human psyche has been put to use in several sectors ranging from payment aggregators to social media (M. & Aithal, 2023; Vaidhyanathan, 2018). The use of various recognition programs has been extensively done in the digital world to confer various badges, certifications and other recognitions on the basis of consumer activism and interaction.

Vaidhyanathan (2018) has studied the impact of social media on communities and institutions and observed that digital presence and activism of individuals could affect their behaviour and decisions. The growing practice of awarding certifications and badges, as a sign of recognition, can be evidently observed among the technology giants like Google and Facebook. Conferring various badges, certificates and other awards could effectively lead to several behavioural, financial and emotive changes (Ifenthaler et al., 2016; Vaidhyanathan, 2018).

It is notable to observe that owing the influence and success of this strategy, several banks have already started their own certification and recognition programs (Axis Bank, 2025; Bank of Baroda, 2025; HDFC Bank, 2025). While the material aspects of these programs offer a distinct set of services and privileges, it is the recognition as a preferred client which is often used as the unique selling proposition for marketing these services. Customers also enjoy and highlight the special identity conferred upon them by their financial service provider. For the financial institutions, the benefits of such a gamified environment start flowing through an emotive association of the customer with them. Some of the direct results of such gamified environment are improved sales through repeated sales. An aggravated impact of the gamified environment is also observed through a compulsive shopping spree (Black, 2007). Such compulsive and habitual purchases help the banks build a sustainable flow of business. This practice is specifically true for the Gen-Z customer base where an engaging environment and milestone-based journey becomes the key retention strategy for any bank.

The possible framework of recognition-based program for banks might be premised around a multi-layered recognition system. Just like a gamified ecosystem, banks might create a multi-tiered recognition program to accord special recognition and privileges to the customers having significant business with the banks. Banks might also positively recognize the customers who opt for multiple banking services or upscale their existing services. Doing so would not only enhance the profitability of the banks through cross-selling and up-selling but also excite the customers' emotions and awareness towards bank's business framework. Small instances of such recognition become instrumental in marketing bank's image and services because customers start taking initiatives to showcase their preferred status and identify their social circles.

Personalized and Unbiased Responsive Enterprises (P.U.R.E.)

Contemporary banking has transformed from being transaction-based to being modelled in terms of Banking as a Service (BaaS) (Hodges, 2023). However, the customer base for any bank remains highly volatile and ambiguous. Due to this, it becomes difficult to curate a universal model of banking services. The attempt to improve customer service and create an empowered customer has been an ongoing challenge (Accion, 2018; Indian Banks' Association, 2025b). Different segments of customers have different appetite and needs. In such scenario, personalisation of banking services has been seen as an effective solution (Accenture, 2023; Deloitte, 2025; Ernest & Young, 2025). In this respect, personalisation could be introduced through two perspectives, namely, from supplier's view and from consumer's view.

Here, the possible approaches by banks to offer more personalized and relevant services has been discussed.

Customization in Services

Banking products and services are generally designed to cater the needs of a specific customer type. This makes the conception of a one-size-fits-all type of banking implausible. The enrichment of the customer experience and customer delight are important parameters of the trajectory desired by the banking fraternity in India (Indian Banks' Association, 2025b; Reserve Bank of India, 2023b). To ensure this, an effective and interesting approach is to introduce an element of customization in the banking services.

It would be correct to claim that some degree of customization has always existed in banking industry either in the form of special facilities or through scheme-based customized products. Apart from being a financial service provider, banks also serve as a data repository of customers through periodic customer information and records of financial choices (Reserve Bank of India, 2023a). This information is often utilised and put to use for customisation of banking products. However, such customization can be considered more meaningfully through a reference to the 'hygiene' and 'motivation' factors discussed by Herzberg (Herzberg et al., 2011). The 'hygiene' related aspects of banking services would be those which are fundamental to define and distinguish them and without which banking service cannot be rendered. For instance, the distinguishing features of banking services such as a savings account and a current account would be the number of free transactions allowed or the range of alternate delivery channels. The 'motivation' related aspects, on the other hand, would imply those features of a banking service which attracts the attention of the consumer or addresses some unique needs.

The growing competition among banks have led to a mushrooming of such customized products, ranging from especially customized bank account facilities, combination of different but complementary financial offerings or different combinations of focussed offerings and discounts. Some of the key Public Sector Banks in India positively showed this aspect of customization in the savings account offerings (Bank of Baroda, 2026; Canara Bank, 2026; State Bank of India, 2026). Different banks have curated their specific product offering to suit the needs and attention of their targeted customer segment (Accion, 2018). This approach helps the bank to increase the possibility of converting a lead into a business proposition while ensuring better customer experience.

Customization of services and product offerings has been the most effective tool for the service providers. Banks, in India, can effectively utilize this aspect of customization to make their services more relevant and meaningful to the customers. Customisation of products also specifically benefits in areas where customer financial literacy is low or customers are unaware about the potential application of various banking products (Accion, 2018).

Personalisation and Aspiration Based Banking

While customization has been discussed as a supplier-end change in the service model, this study refers personalisation as a consumer-oriented effort. With the proliferation of the banking service delivery channels, it has become difficult to impress the consumers merely with such offerings. The digitalisation of the banking industry has radicalized the customer expectations. Instead of mere transactional-relations, the expectations of the customer have moved towards a model of relational-banking where the emotive aspects of financial relationship plays a vital role. The personalisation of banking relates to this emotive aspect of banking in the 21st century.

The meaning of the term 'personalization' in banking has undergone a significant change over the years. Originally conceived through the idea of 'personalized banking' translated as dedicated banking services to the customers (Accenture, 2025), the personalisation of banking services has expanded itself into a broader framework where the banks start to touch the non-financial aspects of the consumers' life. Some aspects of personalisation of the banking processes can already be observed through some trivial but relevant changes. Several banks have now started sending digital greetings to the customers on their birth anniversaries and other important life events. Similarly, various channels of banking have been observed to make suggestions and referrals related to lifestyle and other non-financial aspects of consumers' life. While these trivial-looking changes might not impress at a cursory glance, its far-reaching implications are realised when consumer behaviour is understood in a more detailed manner. This integration of banking into the personal aspects of the consumer's life has become the defining feature of contemporary banking.

In the context of changing banking ecosystem, banks are turning into platforms of convergence between commerce, finance and lifestyle. This changing conception of the new age banking has also been captured by King (2018) through the conception of "Bank 4.0" where places and processes have given way to customer experience. This changing theme of financial services has knocked upon the doors of the Indian banks and now being recognised in the waves of reforms taking place at the industry level (Indian Banks' Association, 2025b). Banking is becoming ubiquitous and invisible to the naked eye, yet omnipresent and omniscient when it comes to customer experience.

The personalisation of banking industry has become the first-principle of banking in the 21st century in the sense that customer experience has become the defining norm of every service and process design (King, 2018). With the expanding possibilities emerging from fintech and Artificial Intelligence (AI), the scale and potential of personalisation in banking services have surpassed the limits of any dedicated relationship manager. However, the guiding principle, in this regard, is the feeling of association and emotive connect by the customer for the bank.

The framework of personalisation of banking services is built upon the specific consumer preferences and interests. The preliminary steps, in this regard, could be taken through targeted and life-event based display of services and recommendations and further clubbed with AI-assisted user experience models to bring banking services at the fingertips and preserve it in the conscience of the consumer. Accenture's report on Banking Consumer Study (2025) discussed a relevant and much needed idea of a 'digital memory' where banks could create a lived experience around the customer's behavior and financial activities. Such digital memories of consumer's financial existence could reinforce the emotive connect between the banking ecosystem and the customer's life, thus, building a reinforced bond (Anderson, 2006; Gupta, 2022). Another report by Ernest and Young (2025) suggested a similar

tendency among customers where they grow an expectation to have a personalised experience rather than mere transactional offerings. When banking amalgamates with the personal aspects of the consumer's life, it becomes integrated with every life decision of the consumer, thus, ensuring a repeated and habitual reference point. This not only ensures a smooth business but also opens up hitherto unexplored opportunities for expansion and growth.

Brand Recognition, Association and Gesture (B.R.A.G.)

The exposure to the plurality of service providers has made brand association an important aspect of customer experience. When it comes to Indian banks, the brand promotion framework appears to have taken a Janus-faced approach. On the one hand, on account of the delegated goals of financial inclusion and other aspects of socio-economic development, the public sector banks are required to remain accessible and approachable to the layman (Reserve Bank of India, 2019 & 2025). On the other hand, the expanding appetite of these growing banks make it necessary to invest in the brand value to ensure a positive brand recognition and association. This emphasis on the brand value is also important in the context of a trend towards homogenisation of the banking services which has resulted into a shift from transactional banking to relational banking (King, 2018).

Today, brand value and brand association are key aspects behind the marketing strategies of key business models. A KPMG report (2024) has highlighted consumer experience, personalisation and brand association as major factors behind customer retention. From luxury brands to social media platforms, the role of brand association is central in achieving a sustainable growth in a long run (KPMG, 2024; Vaidhyanathan, 2018). It is not surprising to observe the major Banks in India investing towards brand building campaigns (Axis Bank, 2025; Bank of Baroda, 2025; HDFC Bank, 2025). The emphasis of the contemporary marketing campaigns by prominent banks in India has gradually shifted to brand image building rather than product pitching. This shift is even traceable in the customers' inclination to maintain their status as a preferred client with their service provider. Indeed, the personalisation of the banking industry arrived as the game changer in the BFSI sector.

Banks can effectively use their brand position in the finance market to reinforce their position and find a niche status to support long-term growth and affirmation. Different brands find different models to reinforce their brand value through focussed themes such as - social responsibility, ethical and transparent business, sustainability, customer experience and innovation (Paul, 2022). The social media pages[6] of the banks showed the increasing number of pompous customer meets focusing on improving brand association and value. A cross country study by Accenture (2025) has suggested that bank brand recognition and association could transform customers into brand advocates who proactively recommend the brand to others. This inference is also supported by another study carried out by Deloitte (2025) which suggested that word-of-mouth and personal referrals are major sources of banking decisions.

Brand value is an important intangible asset for any corporate institution as it helps bridge the distance between the consumer and the business model. Brand building has turned out to be an indispensable exercise for any corporate playing in a competitive market. The results of this exercise often help to defy the logical forces of financial reasoning and common sense. In this way, banks struggling to retain their customers amidst fierce competition, are able to build an emotional connection through brand association which helps to retain customers. Accenture's study (2025) has suggested that 'consumers trust their

[6]Bank of Baroda: https://www.instagram.com/officialbankofbaroda/; State Bank of India: https://www.instagram.com/theofficialsbi/?hl=en; Punjab National Bank: https://www.instagram.com/pnbindia/?hl=en

primary bank twice as much as they trust tech companies for quality products and advice.' The Indian Banking sector is primarily premised on ties of confidence and long-term relations which can be utilised to deepen the bonds of trust and confidence.

Benefits and Opportunities

This paper has discussed a three-pronged approach to invest in the emotive aspects of banking to ensure a better customer connect. Each of the methods suggested here have been put to use, in some way or the other. However, a more focussed effort towards a relational paradigm of banking could help consolidate the gains. While the benefits and opportunities from this change in the outlook is multifarious, some of the prominent aspects could be discussed here.

The primary impact of building a connect with the customers through a gamified environment in banking services reflects in the proliferation of services rendered. Popularly understood as - cross-selling and up-selling, this achievement takes place as a result of a more intense customer engagement with banking ecosystem. The model of loyalty programs, earned rewards and milestones tap upon the aspirational side of the consumer and encourages them to interact with the financial services in a more positive manner. This results in better business figures as well as profitability. A study by Accenture (2025) has also suggested that a 10% increase in customer association (advocacy) lead to an increase in business growth by 1%.

The second aspect of this approach is reflected in terms of lower marketing costs. As the banking ecosystem is transformed into an interactive gamified environment, the customer feels encouraged to test and employ the different products. Moreover, such model acts like a fix-and-forget type of arrangement which requires minimal human intervention and structural requirement. Due to the digitalisation of the banking ecosystem, the customer is able to navigate through the entire gamut of facilities and arrangements. This has an alleged positive impact on profitability of the banks.

Another area where the banks might witness a positive impact on their profitability is the realigned use of freebies associated with financial services. Banks should not let the complementary services be taken for granted. A more prudent position in this respect would be to curate their specific products on parameters of profitability and consumer interest. Such strategy could make the CX more enriching and meaningful while also helping the banks save on ancillary services projected under the bundled approach.

Another area of benefit for the banks through this strategy relates to customer segmentation. While banks are already doing segmentation of customers for various business related purposes, a refined customer engagement model would help the banks curate dedicated products based on the customer interests and needs. This segmentation could be done on lines of better cross-selling matrix or customer behaviour and propensity to engage with bank's services. This would also help the banks focus on segments which require more handholding in terms of their banking needs.

A major outcome for the bank, through this engagement model, could be in terms of its financial literacy and inclusion. The financial regulator has already put upon the banks a responsibility toward financial inclusion and promotion of financial literacy in the country (Reserve Bank of India, 2025). Through a more intense customer engagement model and by building an environment of trust, the banks can foster a gamified learning environment. Learning experiences become more productive and meaningful when the participants take interest and get involved with it (Christopoulos & Mystakidis, 2023). When customer

are offered services and channels for getting involved in a more personalized manner, the acceptability of the service models increases.

Conclusion

The digital transformation of the BFSI sector in India has led to a paradigmatic change in the realm of marketing. The challenges of customer retention and business growth have taken new shapes for the banking sector. There is an urgent need to shift from the transactional model of banking towards a relational model of banking which taps upon the engagement of customer as the key to a positive growth and profitability for the banks. The applications of a gamified model of banking can provide an environment to facilitate an interactive and engaging model of customer service.

A gamified model of banking holds the potential to foster a self-indulging and self-motivating model which taps upon the various human emotions of the customer to invoke curiosity, zeal, excitement, happiness and satisfaction. The receptiveness of this model would be positive and motivating for the customers as well as the banks. The new age customers are demonstrating an inclination towards choice-based reward programs and greater flexibility in deciding the service design. Such gamified environment might help the banks retain their existing customers as well as attract new customers to experience the unique financial ecosystem (GUESS).

The personalization of the banking environment is yet another trend in the banking sector which defines the quality and impact of the financial services. The model discussed here (PURE) makes personalization of banking experience as an important factor for enhancing customer experience and expectations. With the rapidly changing world, customer expects the warmth of reassurance and assistance which could be introduced through an environment of trust and engagement (Accenture, 2025).

A framework of personalized banking environment clubbed with a strong sense of brand association and loyalty (BRAG) leads to a culture of loyalty and involvement between the bank and the customer. Such approach is specifically relevant in the socio-economic context of India where customers grow a sense of emotional connection with their bank and often feel obligated to continue such relational ties.

The tri-dimensional model has been in vogue within the BFSI sector. However, the direction and focus differ in terms of priorities and preferences. The optimal result of these models could be produced by bringing an empathetic customer engagement perspective in the picture. The models discussed in this paper are closely inter-linked and could work only in a symphony. The overall outcome of this framework is expected to reinforce the customer's trust and emotional connect with their banks while also motivate them to subscribe to the banking services. For the banks, such framework would create a self-sustaining environment of growth and stability which would eventually help in realization of several organizational goals.

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डिजिटल नवाचारों से समावेशी समृद्धि : यूपीआई एवं सीबीडीसी की उभरती भूमिका

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सार

यह अध्ययन बैंकिंग उद्योग में डिजिटल प्रौद्योगिकी के नवीनतम विकास और उनके प्रभावों पर केंद्रित है। डिजिटल नवाचारों ने पारंपरिक बैंकिंग मॉडल को चुनौती दी है और उपभोक्ता व्यवहार, प्रतिस्पर्धा तथा सेवा वितरण में व्यापक परिवर्तन उत्पन्न हुए हैं। बैंक अब शाखा-आधारित सेवाओं के साथ-साथ इंटरनेट बैंकिंग, मोबाइल बैंकिंग और यूपीआई जैसे डिजिटल प्लेटफॉर्म के माध्यम से ग्राहकों को अधिक व्यक्तिगत, लागत-कुशल और सुलभ सेवाएँ प्रदान कर रहे हैं। भारत ने डिजिटल भुगतान को अपनाने में वैश्विक नेतृत्व स्थापित किया है। यूपीआई, यूपीआई लाइट, यूपीआई-123पे, क्रेडिट कार्ड लिंकिंग और एनआरई खातों की पहुंच जैसी पहलों ने डिजिटल समावेशन को बढ़ावा दिया है। साथ ही, ओएनडीसी जैसे प्लेटफॉर्म छोटे व्यापारियों को ई-कॉमर्स में भागीदारी का अवसर प्रदान कर रहे हैं। लेख में यह भी रेखांकित किया गया है कि वेब-3.0, क्रिप्टोकरेंसी, विकेंद्रीकृत वित्त (DeFi) और मेटावर्स जैसे उभरते डिजिटल रुझान बैंकिंग को और अधिक सुरक्षित, पारदर्शी तथा ग्राहक-केंद्रित बना रहे हैं। इसके अतिरिक्त, केंद्रीय बैंक डिजिटल मुद्रा जैसे डिजिटल रुप की शुरुआत भारत में मुद्रा के डिजिटलीकरण की दिशा में एक महत्वपूर्ण कदम है, जो वित्तीय समावेशन और दक्षता को बढ़ावा देगा। बैंकिंग उद्योग में नवीनतम डिजिटल विकास की शुरूआत का तात्पर्य है कि वित्तीय क्षेत्र में बैंकों की भूमिका बदल गई है। डिजिटल प्रौद्योगिकी में हाल के नवाचारों के परिणामस्वरूप नवीन फर्मों से प्रतिस्पर्धा बढ़ गई है, लेकिन इसने उपभोक्ता प्राथमिकताओं और मांगों में बदलाव को भी जन्म दिया है जिसने उपभोक्ताओं और बैंकों के बीच के संबंधों को बदल दिया है। परिणामस्वरूप, उपभोक्ता आज अपने बैंक संबंधी कामकाज डिजिटल प्लेटफॉर्म के माध्यम से करने के लिए अधिक इच्छुक हैं और परंपरागत बैंकिंग, जो कि उपभोक्ताओं के साथ आमने-सामने बातचीत के माध्यम से अपना कारोबार करता है, पर निर्भरता कम कर रहे हैं। हालाँकि, हाल ही में बैंकों ने उपभोक्ताओं को अपने उत्पाद और सेवाएँ प्रदान करने के लिए शाखा कार्यालयों के पूरक चैनलों के रूप में डिजिटल प्लेटफ़ॉर्म, डिजिटल चैनलों, जैसे इंटरनेट बैंकिंग, मोबाइल बैंकिंग और अन्य वैकल्पिक डिजिटल चैनलों का उपयोग बढ़ाया है जिससे भौगोलिक सीमाओं को तोड़ते हुए वें प्रभावी ढंग से 24x7 ग्राहकों को व्यक्तिगत सेवायें प्रदान कर सकें तथा उनका भरोसा जीत सकें और अपनी लागत को कम तथा कार्य कुशलता को बढ़ा सकें।

मुख्य शब्द

सीबीडीसी (Central Bank Digital Currency), डीएलटी (Distributed Ledger Technology), ओईएम (Original Equipment Manufacturer), पीएसपी (Payment Service Provider), पी2एम (Person to Merchant), पी2पी (Person to Person), यूपीआई (Unified Payments Interface)

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***मुख्य प्रबंधक एवं लर्निंग हैड, बैंक ऑफ बडौदा आकादमी।

डिजिटल विकास की गति और यह तथ्य कि ग्राहक अधिक डिजिटल-उन्मुख होते जा रहें है, ने नई प्रतिस्पर्धियों के लिए वित्तीय सेवा बाजार में खुद को स्थापित करने का रास्ता खोल दिया है। वर्षों से, बैंक, उद्योग की उच्च प्रवेश बाधाओं से, सुरक्षित थे। हालाँकि, डिजिटल प्रौद्योगिकियों के विकास ने मौजूदा बैंकों की मूल्य श्रृंखला के कुछ हिस्सों पर कब्जा करने के लिए अधिक नवीन व्यवसायों के लिए प्रवेश बाधाओं को कम कर दिया है। इससे गैर-वित्तीय प्रतिस्पर्धियों के लिए अधिक विशिष्ट और अनुकूलित वित्तीय सेवाओं और उत्पादों की पेशकश करके उद्योग में खुद को स्थापित करना संभव हो गया है।

बैंकिंग उद्योग में डिजिटल समाधानों में वृद्धि के कारण, बैंकों एवं ग्राहकों के बीच गतिशीलता में वृद्धि देखी जा रही है। उद्योग के भीतर डिजिटल परिवर्तन ने उन ग्राहकों के लिए स्विचिंग लागत को भी प्रभावित किया है जो अपने मूल्य को अधिकतम करने के लिए गैर-वित्तीय और वित्तीय दोनों व्यवसायों में से चुन सकते हैं। इससे बैंक और ग्राहक के बीच पारंपरिक शक्ति संतुलन में बदलाव आया है, क्योंकि ग्राहक अब स्वयं ड्राइविंग सीट पर बैठ कर, बैंकों पर अपने बुनियादी ढांचे, वित्तीय उत्पादों और सेवाओं को आधुनिक बनाने के लिए दबाव डाल सकता है। इससे ग्राहकों को अपने बैंकों पर मोलभाव करने की शक्ति मिलती है क्योंकि उनके लिए उत्पादों और सेवाओं का व्यापक विकल्प उपलब्ध होता है। जैसे-जैसे बाजार परिवेश बदलता है, वैसे-वैसे उपभोक्ताओं का व्यवहार भी बदलता है। ग्राहक संतुष्टि, यह एक महत्वपूर्ण शब्द है, बैंक ग्राहकों की अपेक्षाओं को कितनी अच्छी तरह पूरा कर रहे हैं या उनसे आगे निकल रहे हैं। जब ग्राहकों की अपेक्षाएं पूरी होती हैं, तो उनकी संतुष्टि बढ़ती है और यह ग्राहक आधार में वफादारी बढ़ाने का एक महत्वपूर्ण हिस्सा है। ग्राहक निष्ठा के लिए सबसे पहले ग्राहक संतुष्टि होनी चाहिए। ग्राहक संतुष्टि के बिना, ग्राहक और विकल्प तलाशेंगे। भारत सहित दुनिया भर के देशों के लिए डिजिटल बैंकिंग और डिजिटल भुगतान अपनाना आवश्यक हो गया है। डिजिटल भुगतान वित्तीय रूप से समावेशी देश के सबसे महत्वपूर्ण स्तंभों में से एक है और एक संगठित वित्तीय प्रणाली के तहत लोगों को एक साथ लाने में मदद करते है। वित्त वर्ष 2022-23 में साल-दर-साल लेन-देन की मात्रा में 56% की वृद्धि के साथ भारत में डिजिटल भुगतान बड़े पैमाने पर बढ़ रहा है और वित्त वर्ष 2026-2027 तक इसके चार गुना बढ़ने की उम्मीद है।[1] इस वृद्धि का श्रेय डिजिटल भुगतान को बढ़ावा देने के लिए भारत सरकार और भारतीय रिज़र्व बैंक (आरबीआई) द्वारा लागू की गई नीतियों, उपयोगकर्ता अनुभव को आसान बनाने के लिए नई प्रौद्योगिकियों के साथ फिनटेक के उद्भव और सुचारू लेनदेन प्रवाह का समर्थन करने के लिए बुनियादी ढांचे के निर्माण वाले पीएसपी (भुगतान सेवा प्रदाता) को दिया जा सकता है।

2025 में, भुगतान प्रसंस्करण क्षेत्र दुनिया भर के राजस्व के एक चौथाई से अधिक के साथ बाजार में अग्रणी रहा।[2] ई-कॉमर्स की बढ़ती लोकप्रियता और दुनिया भर में त्वरित भुगतान की ओर ध्यान केंद्रित होने से व्यापारियों को ग्राहकों को त्रुटिहीन चेकआउट अनुभव देने के लिए भुगतान प्रसंस्करण समाधान लागू करने के लिए मजबूर होना पड़ रहा है। डिजिटल भुगतान के उपयोग में वृद्धि हुई है और मध्य-आय वाले देशों (चीन को छोड़कर) में 40% से अधिक व्यक्ति पहली बार कार्ड, फोन या इंटरनेट बैंकिंग का उपयोग करके स्टोर में या ऑनलाइन भुगतान कर रहे हैं।[3] विश्व स्तर पर, दो-तिहाई व्यक्ति डिजिटल भुगतान करते हैं या प्राप्त करते हैं, विकासशील अर्थव्यवस्थाओं में उनकी भागीदारी 2014 में 35% से बढ़कर 2021 तक 57% हो गई है।[3] वैश्विक स्तर पर, वित्त वर्ष 2023 में आर्थिक, राजनीतिक और भौगोलिक मुद्दे ने भी, वित्तीय उद्योग को प्रभावित किया है। भारत मे डिजिटल एवं यूपीआई के माध्यम से हो रहे भुगतान को निम्न तथ्यों से समझा जा सकता है:

[1]The Indian Payments Handbook, **2022-2027**, PwC.
[2]Digital Payment Market, **2025-2030**, Grand View Research.
[3]Global Findex Database **2021**, World Bank.

(i) डिजिटल लेन-देन का कुल वॉल्यूम और वृद्धि वित्तीय वर्ष 2024-25 में कुल डिजिटल लेन-देन (सभी माध्यम से) की संख्या 22,831 करोड़ रही, जो वित्तीय वर्ष 2023-24 के 18,737 करोड़ से लगभग 22% की वृद्धि दर्शाती है।[4] इसी अवधि में डिजिटल लेन-देन का मूल्य ₹2,862 लाख करोड़ तक पहुँचा, जो पिछले वर्ष की तुलना में लगभग 18% अधिक है।

(ii) यूपीआई के माध्यम से लेन-देन वित्तीय वर्ष 2024-25 में यूपीआई लेन-देन की संख्या 185.8 अरब रही - यह वित्तीय वर्ष 2023-24 से लगभग 41% की वृद्धि है। यूपीआई लेन-देन का मूल्य ₹261 लाख करोड़ तक पहुंचा, जो वित्तीय वर्ष 2023-24 में ₹200 लाख करोड़ था। वित्तीय वर्ष 2025 मे यूपीआई का डिजिटल पेमेंट्स में शेयर लगभग 83.7% तक पहुँच गया।[5]

(iii) डिजिटल भुगतान में यूपीआई मुख्य भूमिका निभा रहा है। यूपीआई दैनिक औसत लेन-देन अब सैकड़ों मिलियन तक पहुँच गया है। उदाहरण के लिए, एक अनुमान के अनुसार मध्य 2025 में रोज़ाना 500+ मिलियन ट्रांजैक्शंस दर्ज हुए। वित्त वर्ष 2023-24 में कुल डिजिटल लेन-देन लगभग 164.4 अरब थे जिसमें करीब 79.7% यूपीआई का हिस्सा था, जो कि 2022-23 लगभग 113.9 अरब था। लगभग 44% से हुऐ यह वृद्धि दर्शाती है कि डिजिटल लेन-देन में वृद्धि रुझान में मजबूत हो रही है। इसके विपरीत डेबिट कार्ड के भुगतान की संख्या जो कि वित्त वर्ष 2022-23 मे 3.41 अरब थी, घटकर वित्त वर्ष 2023-24 मे 2.28 अरब और 2024-25 घटकर 1.16 अरब रह गई।

उम्मीद है कि यूपीआई देश का सबसे तेजी से बढ़ने वाला भुगतान माध्यम बना रहेगा और देश में डिजिटल भुगतान अपनाने में महत्वपूर्ण योगदानकर्ता रहेगा। यूपीआई की लोकप्रियता इस हद तक बढ़ गई है कि पीयर-टू-मर्चेंट (पी2एम) लेनदेन मात्रा के मामले में पीयर-टू-पीयर (पी2पी) लेनदेन से आगे निकल गया है। हालाँकि वित्त वर्ष 2024-25 में यूपीआई लेनदेन की मात्रा ने कुल डिजिटल भुगतान में 83.7% का योगदान दिया, कुल लेनदेन मूल्य ने कुल डिजिटल भुगतान में केवल 72% का योगदान दिया[6] जो संकेत देता है कि लेनदेन का टिकट आकार अभी भी तुलनात्मक रूप से कम है, हालांकि तेजी से वृद्धि हो रही है और उपभोक्ता का विश्वास बढ़ रहा है, जिसे इस बात से समझा जा सकता है कि वित्त वर्ष 2021-22 में यूपीआई लेनदेन की मात्रा ने कुल डिजिटल भुगतान में 63.4% का योगदान दिया था जबकि कुल लेनदेन मूल्य योगदान मात्र 16.1% था।[7] यूपीआई जिसका उपयोग मुख्य रूप से P2P लेनदेन के लिए किया जाता था, अब व्यक्ति-से-व्यक्ति मोबाइल (P2PM) और P2M लेनदेन की ओर परिवर्तित हो गया है। मोबाइल ऐप-आधारित भुगतान में वृद्धि डिजिटल भुगतान के प्रति आकर्षण का एक और संकेतक है। वित्त वर्ष 2024-25 में लेनदेन मूल्य में 30% की वृद्धि के साथ लेनदेन की संख्या 41% बढ़कर 131 बिलियन से 185.8 बिलियन हो गई है। लेन-देन की मात्रा में यह वृद्धि क्यूआर कोड-आधारित भुगतान अवसंरचना यानी यूपीआई क्यूआर और भारत क्यूआर में 43.5% की वृद्धि से पूरक हुई है।[7]

भविष्य में यूपीआई लेनदेन की मात्रा 42% और लेनदेन मूल्य के मामले में 30% की चक्रवृद्धि वार्षिक वृद्धि दर (सीएजीआर) से बढ़ने का अनुमान है। अनुमान है कि वित्त वर्ष 2028-29 तक यूपीआई का वार्षिक लेनदेन वॉल्यूम लगभग 439 बिलियन तक पहुंच सकता है जो रोजाना औसतन 1.2 अरब से अधिक लेनदेन के बराबर होगा। Pwc India की रिपोर्ट के अनुसार 2028-29 तक रिटेल डिजिटल भुगतान का करीब 91% हिस्सा यूपीआई ले लेगा।

[4]Ministry of Finance Year Ended **2025**.
[5]Annual Report, **2024-25**, Reserve Bank of India.
[6]Digital Payment Market, **2025-2030**, Grand View Research.
[7]The Indian Payments Handbook, **2026-2027**, PwC.

प्रति लेनदेन लागत (एमडीआर): वर्तमान में बैंक-खातों के मध्य यूपीआई लेनदेन बड़े पैमाने पर शून्य एमडीआर (MDR) पर किया जाता है।

नए ग्राहक अधिग्रहण: चूंकि यूपीआई एक बड़े पैमाने का उत्पाद है, इसलिए यूपीआई थर्ड-पार्टी एप्लीकेशन प्रोवाइडर नए ग्राहक प्राप्त करने के सबसे तेज़ और सस्ते स्रोतों में से एक है। कई एनबीएफसी और फिनटेक नए ग्राहकों को आकर्षित करने के लिए अपने थर्ड-पार्टी एप्लीकेशन प्रोवाइडर के माध्यम से लेनदेन करने वाले उपयोगकर्ताओं को कैशबैक और पुरस्कार प्रदान करते हैं।

क्रॉस-सेलिंग: अधिकांश यूपीआई थर्ड-पार्टी एप्लीकेशन प्रोवाइडर मौजूदा ग्राहक आधार को बीमा और ऋण जैसे अन्य उत्पादों को क्रॉस-सेल करते हैं।

विज्ञापन/अनुमोदन: जो ब्रांड नए ग्राहक प्राप्त करने के लिए दृश्यता चाहते हैं, वे लेनदेन की मात्रा और उपयोगकर्ताओं की संख्या के कारण छूट की पेशकश करके इन प्लेटफार्मों पर अपने उत्पादों का समर्थन करते हैं।

यूपीआई 123 पे: यूपीआई 123 पे के साथ, उपयोगकर्ता आईवीआर नंबर, मिस्ड कॉल, ध्वनि-आधारित तकनीक और मूल उपकरण निर्माता (ओईएम) द्वारा कार्यान्वित कार्यक्षमता के माध्यम से यूपीआई भुगतान कर सकते हैं। भारत में लगभग 40 करोड़ फीचर फोन उपयोगकर्ता हैं।[8] मार्च 2022 में इसके लॉन्च के बाद से, यूपीआई 123 पे ने ग्रामीण और अर्ध-शहरी क्षेत्रों में फीचर फोन उपयोगकर्ताओं के बीच डिजिटल लेनदेन को सुलभ बनाने में महत्वपूर्ण प्रगति की है, जिससे बिना इंटरनेट के भी वित्तीय समावेशन के दायरे में व्यापक विस्तार हुआ है। इस उत्पाद में डिजिटल भुगतान क्षेत्र में अगला बड़ा व्यवधान बनने और ग्रामीण क्षेत्रों में डिजिटल भुगतान के उपयोग को बढ़ाने की अपार क्षमता है।

यूपीआई लाइट: यूपीआई लाइट, यूपीआई में एक ऑन-डिवाइस वॉलेट सुविधा है, जिसे 2022 में लॉन्च किया गया था। उपयोगकर्ता अपने खाते से यूपीआई लाइट में धनराशि आवंटित करके किसी भी समय अपने यूपीआई वॉलेट में 5000 रुपये तक रख सकते हैं। इसके बाद उपयोगकर्ता यूपीआई लाइट के माध्यम से प्रति लेनदेन 1000 रुपये तक यूपीआई लेनदेन करने में सक्षम हैं। यूपीआई लाइट ने अपने लॉन्च के बाद से छोटे-मूल्य (माइक्रो-पेमेंट्स) के लेन-देन के लिए एक तेज़ और निर्बाध विकल्प के रूप में अपनी उपयोगिता सिद्ध की है, जिससे बैंकों की मुख्य प्रणालियों (Core Banking Systems) पर भार कम हुआ है और लेनदेन की सफलता दर (success rate) में उल्लेखनीय सुधार आया है। वर्तमान में एनपीसीआई के अनुसार, सभी यूपीआई लेनदेन में से 50% का लेनदेन मूल्य 200 रुपये तक है। कई राष्ट्रीय बैंक और छोटे वित्त बैंक इस सुविधा में बड़ी संभावनाएं देखते हैं और इसे अपने प्लेटफार्मों में सक्षम किया है।

यूपीआई पर क्रेडिट: रिज़र्व बैंक ने सितंबर 2022 में क्रेडिट कार्ड को यूपीआई के साथ जोड़ने की घोषणा की थी। यह सेवा रुपे क्रेडिट कार्ड पर शुरू की गई थी और अब चुनिंदा अन्य नेटवर्क के लिए भी विस्तार की दिशा में कदम उठाए गए हैं। भारत क्यूआर के माध्यम से सभी प्रकार के कार्डों की स्वीकृति भी सक्षम है। वित्त वर्ष 2024-25 में, पी2एम लेनदेन ने मात्रा में 55% का योगदान दिया लेकिन बहुत छोटे टिकट आकार के साथ केवल 23% मूल्य का योगदान दिया।[8] यह प्रवृत्ति बदल रही है क्योंकि क्रेडिट कार्ड पर यूपीआई का औसत टिकट आकार पारंपरिक यूपीआई लेनदेन की तुलना में अधिक है। क्रेडिट कार्ड को यूपीआई से जोड़ना एक महत्वपूर्ण कदम सिद्ध हुआ है जिससे यूपीआई वॉल्यूम में निरंतर वृद्धि हो रही है और यह बाजार में अधिक क्रेडिट कार्ड प्रवेश तथा क्रेडिट कार्ड

[8]The Indian Payments Handbook, 2022–2027, PwC.

वॉल्यूम वृद्धि के लिए उत्प्रेरक के रूप में कार्य कर रहा है।

एनआरई खातों तक यूपीआई पहुंच: अंतरराष्ट्रीय फोन नंबरों के साथ मैप किए गए गैर-आवासीय बाहरी (एनआरई) खातों को अब यूपीआई का उपयोग करने की अनुमति है। वर्तमान में यह सुविधा 12 से अधिक देशों के लिए सक्षम है, जिनमें अमेरिका, यूके, सिंगापुर, कनाडा, ऑस्ट्रेलिया और यूएई जैसे प्रमुख देश शामिल हैं, जहां बड़ी संख्या मे एनआरआई में से अधिकांश रहते हैं। ग्राहक अब भारत में अपने परिवार के सदस्यों के लिए वास्तविक समय पी2पी हस्तांतरण कर सकते हैं, और उपयोगिताओं और कर भुगतान जैसे बिल भुगतान भी आसानी से कर सकते हैं। इस सुविधा से विदेशी आवक प्रेषण में और वृद्धि होने की उम्मीद है।

यूपीआई वन वर्ल्ड: विदेशी यात्रियों के लिए यूपीआई को सक्षम बनाने के उद्देश्य से, आरबीआई और एनपीसीआई ने "UPI One World" सुविधा शुरू की है, जिसके माध्यम से विदेशी यात्री पीपीआई वॉलेट लोड कर सकते हैं, जिसका उपयोग वे क्यूआर-आधारित यूपीआई भुगतान स्वीकार करने वाले भारत के सभी व्यापारी आउटलेट पर भुगतान करने के लिए कर सकते हैं। यह सुविधा जी-20 देशों से आने वाले पर्यटकों के लिए सक्षम की गई थी और अब उसका विस्तार अन्य देशों से आने वाले पर्यटकों के लिए भी किया जा रहा हैं। ये वॉलेट भारत के चुनिंदा हवाई अड्डों पर उपलब्ध हैं और आरबीआई ने अधिकृत संस्थाओं को हवाई अड्डे के बाहर भी विदेशी नागरिकों को यह सुविधा उपलब्ध कराने की अनुमति दी है।

सिंगल ब्लॉक मल्टीपल डेबिट: आरबीआई ने यूपीआई में सिंगल ब्लॉक मल्टीपल डेबिट सुविधा सक्षम की है, जिसके माध्यम से ग्राहक अब किसी विशेष व्यापारी के लिए विशिष्ट राशि को ब्लॉक कर सकते हैं। ग्राहक इस अवरुद्ध राशि के समाप्त होने तक कई बार डेबिट कर सकता है। यह सुविधा कैश-ऑन-डिलीवरी के विकल्प के रूप में कार्य कर सकती है और पी2एम लेनदेन में अत्यधिक फायदेमंद होगी, खासकर ई-कॉमर्स क्षेत्र में जहां यह समय पर पैसे की प्राप्ति का आश्वासन देकर व्यापारियों को अधिक भरोसा देगी।

UPI पर विभिन्न देशों के साथ साझेदारी: भारत ने अपने UPI सिस्टम के विश्वव्यापी नेटवर्क को विकसित करने में काफी प्रगति की है। एनपीसीआई इंटरनेशनल पेमेंट्स लिमिटेड (एनआईपीएल) ने रुपे और यूपीआई के लिए एक विशाल स्वीकृति नेटवर्क विकसित करने के लिए कई देशों के साथ गठबंधन किया है, जिससे भारतीयों को विदेश से, खासकर विदेशी दौरों के दौरान इन चैनलों के माध्यम से भुगतान करने की अनुमति मिलती है।

ओएनडीसी (डिजिटल कॉमर्स के लिए ओपन नेटवर्क)

ओएनडीस, भारत सरकार द्वारा एक ऐसा मंच है जो ई-कॉमर्स में क्रांति लाने की एक पहल है, जो स्थानीय खुदरा विक्रेताओं को ऑनलाइन बिक्री करने और बड़े बाजारों के एकाधिकार को तोड़ने के लिए बढ़ावा देता है। वर्तमान बाजार परिदृश्य में, बड़े ई-कॉमर्स दिग्गज एक बाज़ार मॉडल का पालन करते हैं जिसमें विक्रेताओं की सूची उनके द्वारा तय की जाती है। इससे बाज़ार में असंतुलन पैदा होता है जो अपने ऑनलाइन कारोबार को बढ़ाने की कोशिश कर रहे छोटे व्यापारियों, स्थानीय खुदरा विक्रेताओं या किराना दुकानों के लिए प्रतिकूल है। उत्पाद सूची प्रबंधन, ऑर्डर प्रबंधन, लॉजिस्टिक्स, भुगतान और कमीशन को मानकीकृत करके, ओएनडीसी लागत कम करेगा और स्थानीय विक्रेताओं के लिए ऑनलाइन व्यापार करने में आसानी बढ़ाएगा। इससे बैंकिंग क्षेत्र में डिजिटल लेनदेन में और वृद्धि होगी।

सीबीडीसी (सेंट्रल बैंक डिजिटल करेंसी)

सीबीडीसी मुद्रा का एक डिजिटल रूप है जो केंद्रीय बैंक द्वारा जारी किया जाता है। कई देशों के केंद्रीय बैंक वर्तमान में सीबीडीसी की खोज कर रहे हैं क्योंकि यह एक जोखिम-

मुक्त और केंद्रीय बैंक-आधारित संपत्ति है जो धीरे-धीरे वैश्विक भुगतान सेवाओं को सुव्यवस्थित कर सकती है।

भारत में, आरबीआई ने पायलट चरण में खुदरा और थोक सीबीडीसी को शुरु किया है। इसके अलावा, एक मध्यवर्ती दृष्टिकोण - जिसमें आरबीआई लाइसेंस प्राप्त मध्यस्थों को सीबीडीसी जारी करता है जो फिर इसे आगे वितरित करते हैं (नकदी वितरण दृष्टिकोण के समान), लिया गया है। नकदी के साथ समानता बनाए रखने और बैंक द्वारा संचालित ब्याज वाली जमाराशियों के साथ प्रतिस्पर्धा को खत्म करने के लिए सीबीडीसी ब्याज-रहित होगा। थोक सीबीडीसी टोकन-आधारित और खाता-आधारित हो सकता है। डिजिटल रुपया भारत में भौतिक मुद्राओं की तुलना में कई संभावित लाभ प्रदान कर सकता है, विशेष रूप से दक्षता बढ़ाने, वित्तीय समावेशन को बढ़ावा देने और भुगतान प्रणाली में सुरक्षा और पारदर्शिता में सुधार। ई-रुपी संभवत: सरल, तेज़ और कम महंगा है और यह अन्य प्रकार की डिजिटल मुद्रा के साथ उपलब्ध प्रत्येक लेनदेन का लाभ प्रदान करता है। यह मूलत: बैंक नोटों के समान है।

डिजिटल रुपया नकदी पर निर्भरता को कम करके और वित्तीय प्रणाली को आधुनिक बनाकर भारतीय अर्थव्यवस्था और समाज को महत्वपूर्ण लाभ पहुंचाने की क्षमता रखता है। निम्नलिखित तर्क इस धारणा का समर्थन करते हैं कि डिजिटल रुपया भविष्य की मुद्रा है:

(i) भारत सरकार ने डिजिटल मुद्रा के उपयोग को बढ़ावा देने में रुचि व्यक्त की है और ई-रुपी के विकास और अपनाने के समर्थन के लिए कदम उठाए हैं। इससे ई-रुपी पर भरोसा बढ़ाने और इसके इस्तेमाल को बढ़ावा देने में मदद मिल सकती है। डिजिटल रुपए पूरी तरह वैध मुद्रा है। डिजिटल रुपया अन्य क्रिप्टोकरेंसी की तरह पूरी तरह विकेंद्रीकृत नहीं होगा; इसके बजाय, भारतीय रिज़र्व बैंक (RBI) इसे नियंत्रित करेगा।

(ii) वित्त वर्ष 2025-26 तक सीबीडीसी-रिटेल पायलट (e₹-R) का विस्तार 19 बैंकों तक किया जा चुका है और इस पायलट में 60 लाख (6 मिलियन) से अधिक उपयोगकर्ता भाग ले रहे हैं। ई-रुपये के प्रचलन मे तीव्र वृद्धि दर्जित की है, जिसे इस बात से समझा जा सकता है कि प्रारंभिक 2023 में बहुत छोटे आधार से बढ़कर 2024 में ₹234 करोड़ और मार्च 2025 तक ₹1,000 करोड़ से अधिक हो गया है।

(iii) पिछले वर्ष की तुलना में ई-रुपये के उपयोग में वृद्धि हुई है, जिसे निम्न तालिका से आसानी से समझा जा सकता है:

तालिका 1: ई-रूपये के उपयोग में वृद्धि

सूचकांक	**नवीनतम अनुमान**
रिटेल सीबीडीसी उपयोगकर्ता	लगभग 60–70 लाख उपयोगकर्ता
पायलट में भाग लेने वाले बैंक	19 बैंक
प्रचलन में डिजिटल रुपया (e₹)	लगभग ₹1,016 करोड़
ऑफलाइन सुविधा	सक्षम
प्रोग्रामेबल विशेषताएँ	सक्षम
सीमा-पार पायलट पहल	अन्वेषणाधीन

स्रोत: Indian Banks' Association

केंद्रीकृत बैंक डिजिटल मुद्रा न केवल भौतिक मुद्रा पर निर्भरता को कम करेगी, बल्कि बैंक द्वारा देनदारियों को संभालने के तरीके को भी बदल देगी, क्योंकि अधिकांश सीबीडीसी वर्तमान में सावधि जमा और बचत खातों की तरह ब्याज दर वहन नहीं करते हैं। न केवल भारत में बल्कि विश्व स्तर पर अधिकांश अर्थव्यवस्थाएं सीबीडीसी की ओर प्रस्थान कर रही हैं। जिसे तीन महाद्वीपों मे इस संबंध मे हो रहे विकास से समझा जा सकता है:

तालिका 2: विभिन्न देशों में सीबीडीसी पर प्रगति

देश	डिजिटल मुद्रा	केंद्रीय बैंक	वर्तमान स्थिति	क्षेत्र	संरचना	ब्याज देने वाली	आधारभूत तकनीक	सीमा-पार परियोजनाएँ
अमेरिका	USA CBDC (Digital Dollar)	यू.एस. फेडरल रिज़र्व	अनुसंधान/विचार-विमर्श (कोई औपचारिक लॉन्च नहीं)	थोक/खुदरा (संभावित)	अनिर्णीत	अनिर्णीत	अनिर्णीत	कोई औपचारिक परियोजना नहीं
कनाडा	Project Jasper	बैंक ऑफ़ कनाडा	अनुसंधान पूर्ण, सक्रिय पायलट नहीं	थोक	टोकन आधारित	नहीं	DLT	Project Jasper (समाप्त)
जमैका	JAM-DEX	बैंक ऑफ़ जमैका	पूर्ण रूप से लॉन्च (2022 से)	खुदरा	टोकन आधारित	नहीं	पारंपरिक	कोई नहीं
ब्रिटेन	Digital Pound	बैंक ऑफ़ इंग्लैंड	परामर्श एवं डिजाइन चरण	खुदरा (प्राथमिक)	खाता आधारित (संभावित)	नहीं	अनिर्णीत	BIS सहयोग
जर्मनी	डिजिटल यूरो	यूरोपीय केंद्रीय बैंक (ECB)	तैयारी/डिजाइन चरण (2025 निर्णय अपेक्षित)	खुदरा/थोक	खाता + टोकन (हाइब्रिड मॉडल प्रस्तावित)	नहीं	पारंपरिक + DLT	डिजिटल यूरो परियोजना
फ्रांस	Wholesale CBDC	बैंक ऑफ़ फ्रांस / ECB	थोक पायलट जारी	थोक	टोकन आधारित	नहीं	DLT	mBridge, Digital Euro
स्विट्ज़रलैंड	Wholesale CBDC	स्विस नेशनल बैंक	थोक CBDC (SIX एक्सचेंज पर लाइव परीक्षण)	थोक	टोकन आधारित	नहीं	DLT	Project Helvetia, Jura
चीन	e-CNY	पीपुल्स बैंक ऑफ़ चाइना	बड़े पैमाने पर खुदरा पायलट	खुदरा	खाता आधारित	नहीं	केंद्रीकृत (गैर-DLT)	mBridge

देश	डिजिटल मुद्रा	केंद्रीय बैंक	वर्तमान स्थिति	क्षेत्र	संरचना	ब्याज देने वाली	आधारभूत तकनीक	सीमा-पार परियोजनाएँ
जापान	Digital Yen	बैंक ऑफ़ जापान	पायलट चरण (2023-25)	खुदरा	खाता आधारित	नहीं	पारंपरिक	Project Stella (ECB के साथ)
ऑस्ट्रेलिया	eAUD	रिज़र्व बैंक ऑफ़ ऑस्ट्रेलिया	सीमित पायलट (2024)	थोक/खुदरा	टोकन आधारित	नहीं	DLT	Project Dunbar
भारत	डिजिटल रुपया (e₹)	रिज़र्व बैंक ऑफ़ इंडिया	खुदरा व थोक पायलट सक्रिय	खुदरा/थोक	टोकन आधारित (खुदरा), खाता आधारित (थोक)	नहीं	DLT + केंद्रीकृत संरचना	सीमा-पार पायलट अन्वेषणाधीन
सिंगापुर	Project Ubin (समाप्त), Project Orchid	मौद्रिक प्राधिकरण सिंगापुर	थोक पायलट पूर्ण, खुदरा परीक्षण जारी	थोक/खुदरा	टोकन आधारित	नहीं	DLT	Project Dunbar, mBridge
हांगकांग	e-HKD	हांगकांग मौद्रिक प्राधिकरण	खुदरा पायलट चरण	खुदरा	टोकन आधारित	नहीं	DLT	mBridge
बहामास	Sand Dollar	सेंट्रल बैंक ऑफ़ बहामास	पूर्ण रूप से कार्यरत	खुदरा	टोकन आधारित	नहीं	DLT	कोई नहीं
स्वीडन	e-Krona	स्वीडिश रिक्सबैंक	परीक्षण चरण (कोई अंतिम निर्णय नहीं)	खुदरा	खाता आधारित/ टोकन आधारित	नहीं	DLT	कोई नहीं

स्रोत: लेखक द्वारा संकलित

उक्त तालिका यह संकेत देती है कि:

- अधिकांश विकसित अर्थव्यवस्थाएं जैसे कि अमेरिका, ब्रिटेन, जापान, स्विट्जरलैंड में सीबीडीसी पर अभी भी अनुसंधान पूर्णतया प्रारम्भिक अवस्था में हैं, इसके विपरीत उभरती अर्थव्यवस्थाओं जैसे कि भारत, चीन, जमाइका, बहमास आदि ने उन्नत पाइलट स्तर तक की प्रगति की है। यह संकेत देता है कि उभरती अर्थव्यवस्थाएँ वित्तीय समावेशन और भुगतान दक्षता को प्राथमिकता दे रही हैं।
- छोटे द्वीपीय देश जैसे कि बहमास, जमाइका ने खुदरा सीबीडीसी को प्राथमिकता दी है तो बड़े बैंकिंग तंत्र वाले देश थोक सीबीडीसी से शुरुआत कर रहे हैं, किन्तु भारत और चीन जैसे देशों ने डुअल-लेयर मॉडल को अपनाया है।
- सीबीडीसी अनिवार्य रूप से ब्लॉकचेन आधारित हो, यह आवश्यक नहीं। चीन और भारत ने नियंत्रण + स्केलेबिलिटी को प्राथमिकता दी है।
- सभी अर्थव्यवस्थाओं ने सीबीडीसी का ब्याज-रहित मॉडल अपनाया है, जिससे वित्तीय स्थिरता को संरक्षित किया जा सके एवं बैंकिंग प्रणाली को असंतुलित होने से रोका जा सकें। यह मौद्रिक नीति के दृष्टिकोण से एक महत्वपूर्ण वैश्विक सहमति को दर्शाता है।
- सीबीडीसी केवल घरेलू भुगतान का साधन नहीं हैं, बल्कि भविष्य की "मुद्रा भू-राजनीति" का उपकरण बन सकता है और भारत "प्रयोगात्मक नवाचार" और "नियंत्रित विस्तार" के मध्य संतुलन मॉडल का उदाहरण प्रस्तुत कर रहा है।

वेब 3.0

वेब की तीसरी पीढ़ी, वेब 3.0, वित्तीय सेवा उद्योग में कई अवसर प्रस्तुत करती है। इस विकास ने कई वित्तीय उत्पादों को पेश करने में सक्षम बनाया है जो पारंपरिक वित्तीय संस्थानों द्वारा नियंत्रित नहीं हैं बल्कि वित्तीय प्रणाली के बाहर संचालित होते हैं। इसने उन्नत केंद्रीकृत और विकेंद्रीकृत बुनियादी ढांचे की मदद से स्टार्ट-अप और अन्य वित्तीय संस्थानों को बढ़ने के अवसर भी प्रदान किए हैं। भुगतान के लिए वेब 3.0 के प्रमुख अनुप्रयोग डी-सेंट्रलाइज्ड फाइनेंस (डीएफआई) और मेटावर्स हैं:

- **DeFi:** DeFi की प्रणाली बैंकों और अन्य बैंकिंग सेवा प्रदाताओं जैसे बिचौलियों को खत्म करने और सभी को एक स्वतंत्र और निष्पक्ष वित्तीय अवसर प्रदान करने के लिए विकसित हुई है, बशर्ते कि उपभोक्ता के पास इंटरनेट तक पहुंच हो। यह प्रणाली सभी ग्राहकों के लिए एक सुरक्षित और सहज उपयोगकर्ता अनुभव सुनिश्चित करने के लिए ब्लॉकचेन तकनीक का उपयोग करती है।
- **मेटावर्स:** मेटावर्स का उद्देश्य व्यवसायों को बढ़ावा देने के लिए उपभोक्ताओं को आभासी वास्तविकता का अनुभव प्रदान करना है। बैंकों ने मेटावर्स के अनुप्रयोगों में निवेश और विस्तार करना शुरू कर दिया है। मेटावर्स के अन्य अनुप्रयोगों और उपयोग के मामलों में वर्चुअल ग्राहक ऑनबोर्डिंग और भुगतान करने के लिए अपूरणीय टोकन जैसी टोकन संपत्तियों के उपयोग को सक्षम करना शामिल हो सकता है।

सीमा पार से भुगतान: परंपरागत रूप से सीमा पार से भुगतान में ग्राहकों के लिए एक लंबी और महंगी प्रक्रिया शामिल होती है जबकि यह बैंकों के लिए एक प्रमुख राजस्व जनरेटर होता है। वेब 3.0 को अपनाने से गति में सुधार होगा और लेनदेन की लागत कम होगी, इस प्रकार दक्षता बढ़ेगी और एक मजबूत नेटवर्क की सुविधा मिलेगी जो लेनदेन को संसाधित करने से कई हितधारकों को हटा देगा। इससे लेनदेन की सुरक्षा बढ़ेगी।

बैंकिंग में आगे की प्रगति के लिए विभिन्न एआई बिल्ड टूल और ऐप्स के संवर्द्धन की प्रतीक्षा है, जैसे, लेन-देन शुरू करने के लिए स्माइल टू पे स्कैनिंग, वर्चुअल लोन अधिकारी द्वारा माइक्रो-एक्सप्रेशन विश्लेषण, लेन-देन को सत्यापित करने और विभिन्न बैंकिंग सेवाओं का अनुरोध करने के लिए वॉयस आधारित बायोमेट्रिक्स। वॉयस बैंकिंग भविष्य की एक और झलक पेश करती है। अपना बैलेंस जांचने, फंड ट्रांसफर करने या बिलों का भुगतान करने के लिए वॉयस कमांड का उपयोग किया जा सकता है।

यह तकनीक हाथों से मुक्त बैंकिंग का वादा करती है जो विशेष रूप से दृष्टिबाधित व्यक्तियों या पारंपरिक इंटरफेस से जूझने वाले लोगों के लिए फायदेमंद है। इसके अतिरिक्त, वॉयस बैंकिंग आपके वित्त के साथ बातचीत करने के लिए अधिक प्राकृतिक और सहज तरीके का मार्ग प्रशस्त कर सकती है, इसके साथ साथ धोखाधड़ी के पैटर्न का पता लगाने के लिए मशीन लर्निंग, साइबर सुरक्षा हमले, ग्राहकों

की सेवा के लिए शाखाओं में ह्यूमनॉइड रोबोट, मशीन दृष्टि और दस्तावेजों को स्कैन करने और संसाधित करने के लिए प्राकृतिक भाषा प्रसंस्करण, जोखिम निगरानी के लिए वास्तविक समय में लेनदेन विश्लेषण की आवश्यकता है।

इस प्रकार भारत में बैंकिंग के भविष्य में जबरदस्त संभावनाएं हैं और यह हमारे बैंकिंग करने और विभिन्न बैंकिंग उपकरणों को समझने के तरीके और परिदृश्य को पूरी तरह से बदल देगा। वैयक्तिकृत सेवाओं के साथ उन्नत ग्राहक अनुभव से लेकर उन्नत एन्क्रिप्शन और धोखाधड़ी का पता लगाने वाली प्रणालियों के माध्यम से बेहतर सुरक्षा तक की संभावनाएं बहुत व्यापक हैं। डिजिटल बैंकिंग प्लेटफ़ॉर्म न केवल दक्षता बढ़ा रहे हैं बल्कि वित्तीय समावेशन का विस्तार भी कर रहे हैं, जो पहले से वंचित आबादी के लिए बैंकिंग सेवाओं तक पहुंच प्रदान कर रहे हैं। जैसे-जैसे हम इन तकनीकी प्रगति को अपनाना जारी रखते हैं, हमें संभावित जोखिमों और चुनौतियों के बारे में भी सतर्क रहना चाहिए। यह सुनिश्चित करना चाहिए कि बैंकिंग के डिजिटल परिवर्तन से सभी हितधारकों को लाभ हो और वैश्विक वित्तीय प्रणाली की अखंडता बनी रहे।

बैंकिंग का भविष्य नवाचार और विवेक के संतुलन में निहित है, क्योंकि हम रोमांचक लेकिन जटिल डिजिटल युग में प्रवेश कर रहे हैं।

डिजिटल बैंकिंग के समक्ष प्रमुख चुनौतियाँ एवं जोखिम

यद्यपि डिजिटल नवाचारों ने बैंकिंग को सुलभ और कुशल बनाया है, लेकिन इसके साथ कई चुनौतियाँ और जोखिम भी उभरे हैं। सबसे बड़ी चिंता साइबर सुरक्षा और डेटा गोपनीयता की है। फ़िशिंग, मैलवेयर, डीपफेक (Deepfake) वॉयस क्लोनिंग और रैनसमवेयर जैसे साइबर हमलों में वृद्धि हुई है, जो ग्राहकों के संवेदनशील वित्तीय डेटा के लिए गंभीर खतरा हैं। इसके अतिरिक्त, तकनीकी बुनियादी ढांचे की कमी-विशेषकर दूरस्थ और ग्रामीण क्षेत्रों में अस्थिर नेटवर्क कनेक्टिविट-एक बड़ी बाधा बनी हुई है। देश में डिजिटल साक्षरता की कमी के कारण कई अशिक्षित या कम जागरूक उपयोगकर्ता आसानी से डिजिटल धोखाधड़ी का शिकार बन जाते हैं। भविष्य में नवाचार को बढ़ावा देने के साथ-साथ उपभोक्ता सुरक्षा और प्रणालीगत स्थिरता के बीच संतुलन बनाए रखना बैंकिंग क्षेत्र के लिए सबसे बड़ी चुनौती होगी।

निष्कर्ष

वर्तमान अध्ययन से यह स्पष्ट होता है कि भारत की डिजिटल भुगतान यात्रा में यूपीआई, यूपीआई 123 पे, यूपीआई लाइट और डिजिटल रुपया (सीबीडीसी) ने मिलकर एक समावेशी एवं बहु-स्तरीय वित्तीय पारिस्थितिकी तंत्र का निर्माण किया है। जहां यूपीआई ने रीयल-टाइम भुगतान को जन-आंदोलन बनाया, वहीं यूपीआई 123 पे और यूपीआई लाइट ने छोटे तथा फीचर फोन उपयोगकर्ताओं को भी इस प्रवाह से जोड़ा। सीबीडीसी के वैश्विक परिदृश्य के तुलनात्मक विश्लेषण से यह प्रतीत होता है कि विभिन्न देशों द्वारा अपनाए गए सीबीडीसी मॉडल उनकी आर्थिक प्राथमिकताओं, वित्तीय संरचना, नियामकीय दृष्टिकोण तथा भू-आर्थिक रणनीतियों का प्रतिबिंब हैं। उभरती अर्थव्यवस्थाएँ डिजिटल समावेशन, भुगतान दक्षता और नवाचार-आधारित विकास को प्राथमिकता देते हुए अधिक सक्रिय रूप से सीबीडीसी के प्रयोग और विस्तार की दिशा में अग्रसर हैं। पिछले कुछ वर्षों मे हुई इन पहलों ने मिलकर बैंकिंग के भविष्य को अधिक सुलभ, सुरक्षित और तकनीक-संचालित दिशा में अग्रसर किया है और समावेशी विकास का मौका दिया है, किन्तु यहां यह चेतावनी आवश्यक है कि देश मे बढ़ते डिजिटल/साइबर अपराधों के मद्देनजर डिजिटल विकास के साथ-साथ तकनीकी जोखिम, साइबर सुरक्षा पर और अधिक ध्यान दिया जाएं तथा उपभोक्ता व्यवहार का गहन मात्रात्मक विश्लेषण कर उपभोक्ताओं का भरोसा सुदृढ़ किया जाए।

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