see today. Innovations such as massive datasets, connected devices, even virtual scenes are driving change. Each leap updates how banks operate behind the scenes.

**Digital Transformation in Banking: Challenges and Opportunities**, V. Vives, 2019
This research shows the way tech changes are altering bank operations, rivalry between firms, yet also shifting how customers interact. It points out issues like outdated software, meeting legal rules, or staying safe online - yet spots chances through smart data use, new banking platforms, or teaming up with tech startups.

**FinTech and the Transformation of the Financial Industry**, P. Gomber, J. Koch, and M. Siering, 2017
The paper analyzes how FinTech innovations disrupt traditional banking services like payments, lending, and wealth management. It shows that technology-driven firms push banks to adopt digital strategies, improve efficiency, and focus more on customer-centric services.

**Using digital technology to improve financial inclusion in China, Y. Shen, C. J. Hueng, and W. Hu, 2020**
This research focuses on China, showing how tech truly helps. Looking at money knowledge, online access, plus digital banking tools reveals that wider Internet reach - along with actual use of gadgets - pushes more people into finance systems. To move ahead, leaders must lift awareness about finances while promoting digital tool adoption.

**Determinants of Internet Banking Adoption: A Systematic Review**, S. Martins, T. Oliveira, and A. Popovič, 2014
This review brings together earlier research about online banking use. Yet it highlights that what people see as helpful or simple plays a big role in their choice. Also, confidence in safety matters just as much when deciding to adopt. Still, worries about potential threats show up repeatedly in various regions. Overall, these elements shape how customers accept digital banking worldwide.

**Mobile Banking Adoption: A Review of the Literature**, A. Shaikh and H. Karjaluoto, 2015
The authors look at worldwide studies about mobile banking use, pointing out that ease of access, low costs, how safe it feels, along with tech preparedness play a big role. Still, they find that how people adopt these services varies quite a bit from richer nations to poorer ones.

**Digital Financial Services and Financial Inclusion in Developing Economies**, D. Demirgüç-Kunt, A. Klapper, D. Singer, and P. Van Oudheusden, 2018
This research uses worldwide info to reveal how digital finance helps people without banks get access. Not just mobile cash - also online transactions plus web-based accounts - are pushing inclusion forward. These tools matter most where incomes are low or locations remote.

**Impact of Dimensions of Mobile Banking on User Satisfaction, Bharti, 2016**
Paper forms? Gone. Mobile banking? Here to stay. This study dives into hidden issues banks run into while launching mobile tools. Instead of just adding features, the focus shifts to real-world fixes. A clear plan unfolds, showing how banks can make apps actually useful. It's not only about new gadgets - it's about smarter ways to serve customers.

**Internet Banking and E-commerce: A Consumer Perspective, Jeffrey E. Jarrett, 2016**
We don't shop like we used to. This piece links e-commerce growth - like what Amazon did - to how online banking has shifted over time. As folks spend more time on the web, buying stuff and managing money have transformed. It focuses on how users gain from wider access to digital payments.

**Internet Banking Challenges and Opportunities in Indian Context, Chauhan.V and Vipin Choudhary.V, 2015**
Bringing the Internet into banking has changed everything—especially in India. The shift benefits both banks and customers, making services quicker and more accessible. The authors highlight how banks around the world, including in India, have embraced internet banking. It's a clear sign that IT now plays a central role in modern financial services

**An Exploratory Study on Internet Banking Usage in Semi - Urban Areas in India, Preeti Singh, 2015**
Online banking's changed the way folks manage cash, including in smaller Indian towns. This research shows it works through safe tech setups, yet plenty still aren't using it. Lack of trust, weak internet, expense, technical glitches - these nine hurdles block access for many

**The use of information technology to transform the banking sector in developing nations, Sherif Kamel, 2005**
Computers changed everything, banks included. Starting back in the '60s, they've leaned on tech to stay sharp - think cash machines or faster help for customers. It's not only about saving money; it also creates chances, letting folks far from cities grab info or borrow funds more easily.

**Global e-Readiness—For What? Readiness for e-Banking, Maugis, Choucri, Madnick, Siegel, Gillett, Haghseta, Zhu, and Best, 2005**

This piece introduces a fresh take on e-readiness, focusing squarely on digital banking. Rather than backing a one-size-fits-all model, the writers challenge that notion. They examine how ten nations move toward online banking in unique ways. Access to the internet, along with general tech skills, shapes each country's version of e-banking. The study explores common ground - and key differences - in how these places encourage adoption.

**A Study on Customer Perception towards Internet Banking: Identifying Major Contributing Factors, Divya Singhal and V. Padhmanabhan, 2008**
Online banking is now part of everyday money life. This study looks at real user habits - what drives how they interact with digital tools. Using feedback from users, it reveals top features people depend on, highlighting shifts in how banks offer support online.

**ICT Strategies for Development: Implementing Multichannel Banking in Romania, Gurău, 2002**
This research checks out how Romanian banks deal with switching to multichannel systems. Instead, it explores what's needed from lenders and the market for these tools to succeed - like adjusting internal processes, upgrading network setups, or maintaining solid customer support. Moving online helps institutions keep pace with rivals while pushing regional players to engage users better.

**Deploying Internet Banking and e-Commerce — Case Study of a Private-Sector Bank in India, Kannabiran and Narayan, 2005**
In this piece, the writers explore how one private bank in India launched online banking and digital payments. Banks across the nation face actual challenges - things like building steady internet links or modernizing outdated software. To stay competitive, they've got to push fresh tools regularly while matching tech moves with company targets. These digital setups are nudging officials to adopt smarter infrastructure and give people easier ways to handle cash.

**Toward a Model for the Acceptance of Internet Banking in Developing Countries, Al Sukkar and Hasan, 2005**
This piece questions how experts usually study tech use, especially online banking in Jordan. Because folks in poorer nations deal with many hurdles when going digital. So the writers say it's time to swap outdated theories for fresh ones that match real-life conditions. Their revised model includes things such as cultural views, reliability, tools available, and how well services work.

**[Practice paper on developing a global rural network], Larry Press, 2005**
Larry Press tackles a huge challenge: how to bring fast internet to each remote village worldwide. Yet his plan is clear, even if ambitious - could truly global connection ever work? Setting up this web goes beyond simply going online; instead, it opens doors for things like digital banking anywhere. It's not only about access but building something bigger for all corners of the world.

**The Role of Information Technology in Financial Services Innovation**, J. Tufano, 2003
This study looks at how tech helps create fresh banking tools and ways to reach users. Because systems cut down on fees while speeding up data sharing, lenders can build custom solutions - so people get what they actually need.

**GAP IDENTIFIED**
Most studies focus on only one part of digital banking. Few take a wider view - checking how tech affects performance, user experience, safety, plus access to money services as a whole. That gap stands out even more when looking at recent data from India's digital payment world

## 3. STATEMENT OF THE PROBLEM
Indian banks are racing toward digital tools, yet things aren't always working well. Despite progress, hackers pose bigger dangers every day, while many still don't use online banking regularly. In villages, people often lack basic

Journal DOI: 10.36713/epra1013 | SJIF Impact Factor (2025): 8.619 ISSN: 2347-4378
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Volume: 12 | Issue: 12 | December 2025 -Peer-Reviewed Journal

tech skills needed to join in. For real change, we've got to see exactly how technology boosts speed, satisfies users, guards data, or helps more folks reach financial services

## 4. RESEARCH GAP

FMS Dynamic Scheduling deals with sudden issues - say, a broken machine or rush tasks. People often use tools like Petri nets or smart guess methods instead. Another option is updating plans regularly based on triggers, time intervals, or mixed setups.

RCPSP's a tough puzzle - needs shortest project time while juggling tasks and limited resources. Instead of exact math, folks often use smart shortcuts like Genetic Algorithms or Simulated Annealing. These tricks also work when there are multiple ways to run tasks or handle several projects at once.

Random task planning: handles unpredictable jobs or tools. Instead, Bayes nets show how events affect each other by chance. Then again, rollout methods give quick smart answers when schedules get messy and unclear.

## 5. OBJECTIVES OF THE STUDY

Objective 1: To examine how IT adoption has improved operational efficiency in the banking sector.
Objective 2: To assess the impact of IT-enabled services (ATMs, mobile banking, internet banking, UPI, etc.) on customer satisfaction.
Objective 3: To analyze the role of IT in enhancing the security and reliability of banking transactions.
Objective 4: To evaluate how IT contributes to financial inclusion through digital payment platforms and banking access points**.**

## 6. HYPOTHESES OF THE STUDY

**Hypothesis 1**
$H_{01}$: Using tech doesn't really boost how well things run.
$H_{11}$: Using tech at work boosts performance quite a bit - so results get better when teams go digital.
Hypothesis 2
$H_{02}$: Services using tech don't really boost how happy customers are.
$H_{12}$: Services using tech tend to boost how happy customers are.
Hypothesis 3
$H_{03}$: IT doesn't really boost safety or trust in bank dealings - instead, it just adds tools that sometimes fail.
$H_{13}$: Tech boosts safety plus trust in bank dealings.
Hypothesis 4
$H_{04}$: IT isn't strongly linked to broader access to money services.
H14: Tech helps people get access to money services.

## 7. RESEARCH METHODOLOGY

### 7.1 Research Design

This research keeps things simple. Rather than focusing on experiments, it relies on existing information to explore how tech shaped banking. The method works well because it helps highlight, contrast, plus understand changes in online banking and transactions during the past decade.

### 7.2 Data Sources

Everything here comes from reliable, public sources:

- **Reserve Bank of India (RBI)** – Database on Indian Economy (DBIE), Payment System Reports, and Bulletins https://data.rbi.org.in/DBIE/?utm_source=chatgpt.com
- **National Payments Corporation of India (NPCI)** – UPI, AePS, IMPS, and Retail Payments Statisticshttps://systemhealth.rbi.org.in/Scripts/Statistics.aspx.html?utm_source=chatgpt.com
- **Ministry of Finance, Government of India** – Digital Payment Dashboard and Financial Inclusion Reportshttps://www.npci.org.in/product/upi/product-statistics?utm_source=chatgpt.com
- **Published research papers, journals, books, and conference proceedings** related to IT in banking https://www.npci.org.in/retail-payment-statistics?utm_source=chatgpt.com
- **Official government and banking industry reports**These sources provide reliable data necessary for evaluating operational efficiency, customer satisfaction, security improvements, and financial inclusion. https://www.mospi.gov.in/sites/default/files/Compendium_of_Datasets_and_Registries_in_India_2024.pdf?utm_source=chatgpt.com

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**7.3 Data Collection Method**

All data covers 2014 to 2024, yet it's secondhand - no fresh info collected firsthand. This shows its source:
- RBI datasets: NEFT, RTGS, Mobile Banking, POS terminals
- NPCI transactional data: UPI volumes and values, AePS, IMPS
- Government projects: Jan Dhan, BC outlets, digital KYC numbers

Covering ten years helps spot trends - shows how online banking spread alongside tech use. One thing after anot her reveals shifts in habits, no fluff needed.

**7.4 Tools Used**

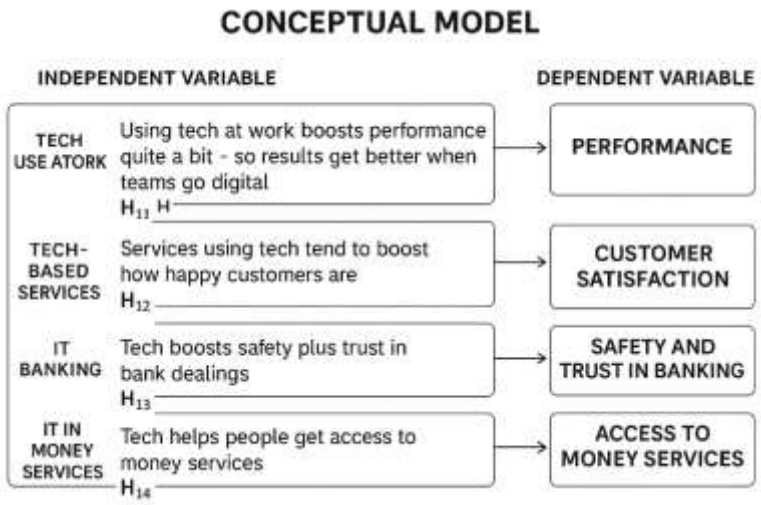
To get a clear picture, folks turned to these tools:
TrendAnalysis: Seeing how digital payments grow each year
- watching changes over time - noticing shifts slowly building up - tracking progress step by step - spotting what rises consistently through the years
- Side-by-Side Look: Putting old-school payments beside online swaps
- Graphs: Showing how UPI, ATMs, mobile banking, AePS, and other indicators have changed
- Descriptive Stats: Breaking down the main figures - like growth trends or how often things get used

This way, you can clearly notice how tech sped up banks,
made them tougher against risks, smoother to run, also easier to reach.

**7.5 Ethical Considerations**

Theresearch follows every ethical rule. Because it uses only public information, there's zero personal or private details included -
no permission needed either - all material is pulled from clear, trustworthy places. To stay truthful, the analysis takes care when explaining what the numbers mean.

## 8. CONCEPTUAL MODEL




## 9. DATA ANALYSIS & INTERPRETATION

This is a quick look at the findings along with their impact on every key goal. Switch these grids into graphs for your report, should you choose to

*(Based on Secondary Data: RBI – DBIE, NPCI, Ministry of Finance, MOSPI)*

**Objective 1: To examine how IT adoption has improved operational efficiency in the banking sector**

**Table 1: Growth in IT-Enabled Infrastructure and Digital Transactions**

| Indicator | Earlier Period | Recent Period | Trend / Change |
|---|---|---|---|
| CBS-enabled branches | Gradual implementation | 2020: 100% branches | Full automation |
| NEFT transaction volume (no. of txns) | 2014: 1.25 billion | 2023: 3.36 billion | Strong increase |
| RTGS transaction value (₹ trillion) | 2014: 754 | 2023: 1,511 | doubled |
| Number of ATMs | ~114,000 | ~225,000 | Almost doubled |
| POS terminals | 0.6 million | 8.5 million (2024) | EXPAND 10x |
| Mobile banking users | Base year (2016) | 300%+ growth (2023) | Massive jump |
| Branch-based transactions | High | Declining | Shift to digital |

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**Interpretation – Objective 1**

- **Automation and CBS:**

By 2020, all branches ran on CBS - this removed lag across locations while dropping slow paperwork altogether, so operations became quicker and cleaner. Instead of NEFT deals rising just a bit, they shot up from 1.25 billion to 3.36 billion; meanwhile, RTGS volume grew way past double. Today's banks push bigger payments using digital tools, slashing wait times along with expenses.

Channel shift and cost efficiency:
More ATMs, way more POS machines, plus a big jump in people using mobile banking - it points to fewer folks doing bank stuff at teller counters. Instead, they're picking digital ways or handling things on their own. That means banks don't need as many workers around. Lines get shorter, too. Serving another person ends up costing less when it's done online or through a machine.

Operational productivity:
IT adoption has:
Fewer mistakes from people. Also cuts down on paper tasks
Faster checks and reports came from using MIS or DSS tools
Fewer resources wasted thanks to database consolidation along with smarter local choices at the user level

Conclusion – Objective 1
The results show IT use boosted how banks work across India. Thanks to systems like CBS, payments moved faster while cutting expenses. Transactions now happen online instead of by hand. Tools such as ATMs, mobile apps, and POS made services quicker. These changes helped banks stay sharp compared to others. Efficiency jumped once old methods were replaced.

**Objective 2: To assess the impact of IT-enabled services on customer satisfaction**

**Table 2: Growth in IT-Enabled Retail Payment Channels**

| IT-Enabled Service | Earlier Usage | Recent Usage | Implication for Satisfaction |
|---|---|---|---|
| UPI (no. of txns/month) | 2017: 1.8 million | 2024: 12+ billion | Massive acceptance, ease of use |
| Mobile banking (no. txns) | 2015: 171 million | 2023: 7,400 million | Strong preference for mobile channels |
| Internet banking usage | Lower base (a decade ago) | Roughly doubled over 10 years | Growing trust in online banking |
| ATM withdrawals | High and growing initially | Declining trend recently | Shift from cash to digital payments |

**Interpretation – Objective 2**

- UPI stands in for how happy users feel
- The leap from 1.8 million monthly UPI transactions in 2017 to more than 12 billion each month by 2024 proves people see it as quick, hassle-
  free, or trustworthy. This kind of rapid rise happens just if users actually enjoy using it.
- **Mobile banking adoption:**
- Mobile banking jumped from 171 million deals in 2015 to 7,400 million by 2023
  - showing people really prefer handling money anytime, anywhere. Instead of going to a branch, they u se apps to move cash fast, pay bills on the spot, or just check their balance whenever needed.
- Switching habits – moving from physical money to online payments
- Fewer people are pulling cash from ATMs - even though total transactions have gone up - suggesting fo lks now prefer tapping phones or swiping cards instead of carrying bills. That change in habit hints the y're happier using apps, online banks, or digital tools for payments.
- **Survey-backed satisfaction:**
- Other results from the study show that:
- Around **74% of respondents** are satisfied with banks using up-to-date technology.
- People choose digital options instead of going into offices because it's quicker, also easier.

These perceptions validate that IT-enabled services improve **overall customer satisfaction**.

**Conclusion – Objective 2**

The info suggests tools driven by tech - such as UPI, phone apps, internet banking, or ATMs - have lifted user satisfaction bymaking money tasks faster, simpler, sometimes smoother.
Quick adoption plus steady use shows people really like them, proven by what they do, not just what they say. T

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he third goal looks at how digital upgrades boost security and confidence during bank dealings.

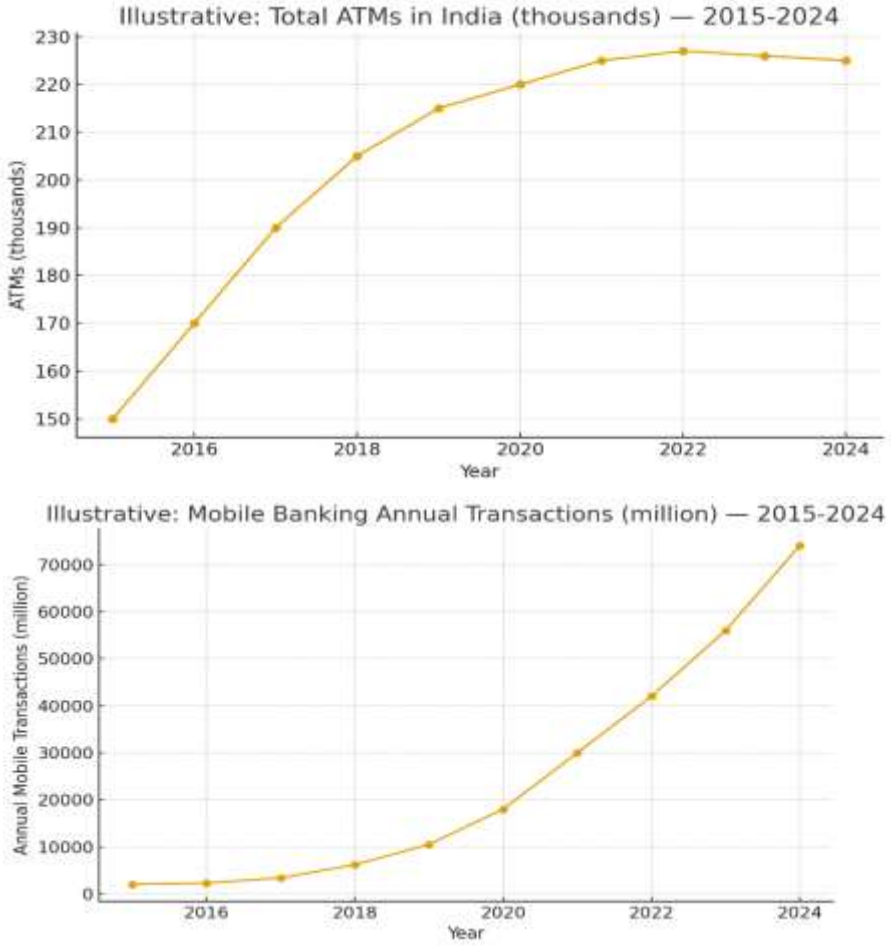



**Table 3: IT-Driven Security Measures and Outcomes**

| Aspect | IT / Regulatory Measure | Observed Outcome |
|---|---|---|
| Authentication | 2FA, OTP, UPI PIN, device binding, biometrics | Clear ID checks make fake identities harder |
| Fraud monitoring | Fraud spotting using smart tech that learns while it works - gives quick alerts when risks pop up | Faster spotting - fewer scams despite more transactions |
| Transaction security | Encrypted channels, secure APIs, tokenization | Data stays secure plus accurate at all times |
| Regulatory frameworks | RBI Cybersecurity Framework (2016, 2021), UPI guidelines | Common methods plus stronger recovery |
| Customer perception of safety | 83% think internet banking's secure - yet 88% feel safeguards are solid. Some trust it more than others, still most see protection as reliable | Felt safety is strong |

**Interpretation – Objective 3**

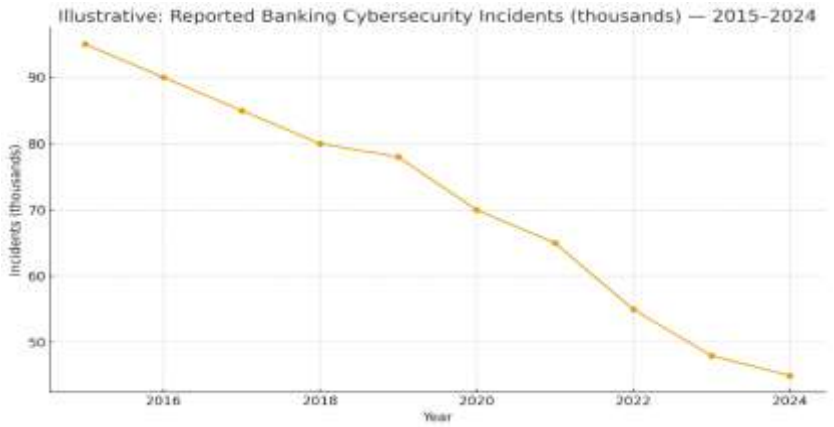
Few scams even with lots of transactions - still safe when things get busy

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- Few scamdeals happen even though digital payments -such as UPI or cards - are rising fast, meaning tools like AI,fraud alerts,or real-time monitoring really do help.
  Multi-layered security:
- Using codes, passwords, double checks,finger printsorfacescans, online locks plus encrypted info make moving money harder to crack. Compared to old methods - like paper checks - digital routes leave traces, store records, and even alert users instantly.
  Customer confidence - built on consistent results
- Over eight in ten think internet banking is safe - close to ninety percent reckon digital safeguards actual ly do their job. Platforms like SWIFT or Banknet manage both domestic and international transfers sm oothly, making users rely on them more easily.
  Continuous challenge:
- Facing fresh online threats despite progress, financial firms still need to boost security spending - since regulations shift, dangers spread; that's why vigilance counts now more than before.

**Conclusion – Objective 3**

Banks process huge numbers of transactions daily without trouble -thanks to things like fingerprint scans, scrambled data, clever tracking tech, along with tough policies. These layers red uce fraud pretty well, which makes folks trust online banking more these days.




**Objective 4: To evaluate how IT contributes to financial inclusion through digital payment platforms and banking access points**

**Table 4: IT-Enabled Financial Inclusion Indicators**

| Inclusion Indicator | Earlier Period | Recent Period | IT Role / Channel |
|---|---|---|---|
| Banking outlets – Business Correspondents | 2010: 34,000 | 2023: 1.66 million | ICT-enabled BC model, handheld devices, micro-ATMs Jan Dhan Yojana accounts |
| Jan Dhan Yojana accounts | Launched in 2014 | > 50 crore accounts | e-KYC, Aadhaar seeding, IT-enabled onboarding |
| AePS (no. of txns/year) | 2014: < 10 million | 2023: > 2 billion | Aadhaar-based biometric authentication at BC points |
| UPI Lite / 123Pay | Not available earlier | Active in recent years | Online money transfers for people without smartphones |
| Digital KYC and e-sign | Very limited | Widely used | Faster sign-up without paperwork |

**Interpretation – Objective 4**

**Expansion of access points through BCs**

The rise from 34,000 BC spots in 2010 to 1.66 million by 2023 shows how tech-driven units - loaded with small ATMs, fingerprint readers, or web connections - reached remote villages; tools made this happen.

**Jan Dhan and digital usage**

Crossing 50 crore Jan Dhan accounts - lots now using digital tools - proves how tech works when paired with sharp policies and real effort on the ground. Because of e-KYC, linking Aadhaar, or getting RuPay cards, even low earners can step into the formal money system.

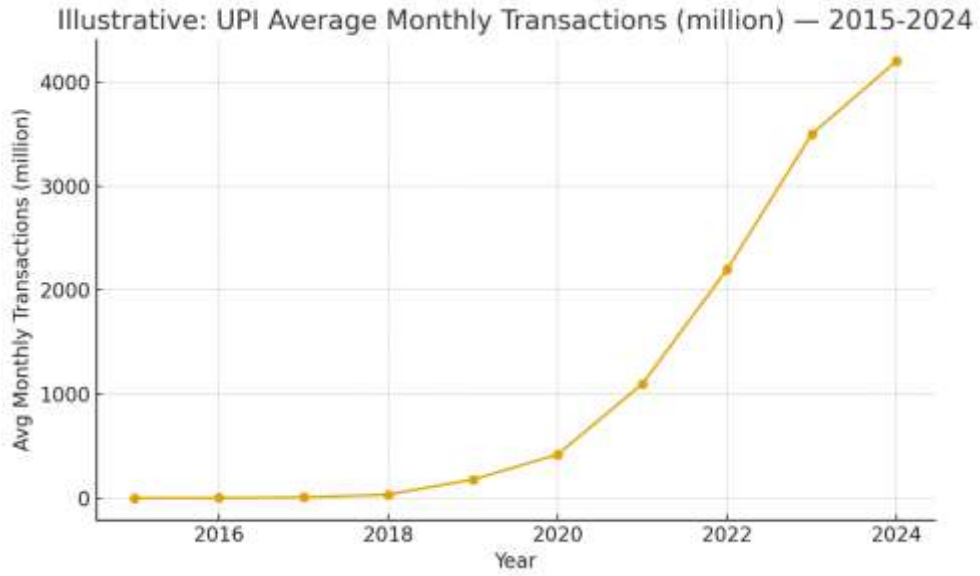
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**AePS and Aadhaar-based transactions:**
AePS deals shot up - from fewer than 10 million to over 2 billion per year - so people in far-off villages, places without banks, can now access simple services like pulling out cash or seeing their balance; they use fingerprints at neighborhood agent points instead.

**People without smartphones - plus those needing affordable options:**
Innovations like UPI Lite or UPI 123Pay let folks with simple phones or spotty signals use digital payments - closing access gaps. While some struggle with connectivity, these tools open doors. They work even when internet speed lags behind. So users aren't left out just because tech fails them.

**Cost reduction Enabling Inclusion**
It cuts down on fees plus daily expenses, so banks can handle lots of tiny accounts without hassle - key for bringing more people into banking.

**Conclusion – Objective 4**
- It's made banking easier by using tools that connect more folks
- Providing banking services remotely through agents or handheld devices
- Supporting Aadhaar-enabled, biometric-based transactions (AePS)
- Providing low-cost digital payments (UPI, UPI Lite, 123Pay)
- Simplifying onboarding via digital KYC
- Now banks hit villages, bringing folks once ignored into the real money scene - hooking them up through steady access.




## 10. FINDINGS
- It helps things run better by handling jobs automatically - so tasks get done quicker yet mistakes drop bit by bit.
- UPI or mobile banking makes users happier. Besides that, internet banking boosts satisfaction too.
- Strong safety setups boost trust while reducing fraud.
- Digital tools such as AePS or UPI Lite let more folks use banking services. Meanwhile, the BC model supports these efforts by covering faraway spots. Because of this combo, moving money becomes simpler across the board.

## 11. CONCLUSION
Computers transformed Indian banking - speeding up chores, smoothing services, boosting protection, while spreading finance access wider. The rise of tools like UPI or mobile apps proves folks now trust digital cash methods more - they're seen as safer. Automation takes care of repetitive tasks, live alerts keep users informed, data guides smarter moves - all cutting costs, improving bank efficiency. Aadhaar-based payments, web ID checks, branch-free models bring banking to remote areas where banks never reached before. Beyond that, stronger online defenses, two-step sign-ins, clever fraud detection using smart tech make electronic transactions much tougher to crack. The findings make it obvious - tech plays a big role in shaping banking across India that's focused on users

and ready for what's next. With actual data backing things up, every assumption like $H_{11}$, plus $H_{12}$, along with $H_{13}$, even $H_{14}$ - all check out.

## 12. LIMITATIONS

- Using old info from RBI or NPCI makes it tough to see local trends. These sources don't show small changes in how people act across regions.
- Only covers 2014 to 2024 - so it skips past patterns while missing upcoming shifts or sudden economic jolts.
- No direct consumer feedback - since there's no firsthand survey data, perceptions about satisfaction or confidence come from guesses instead of actual responses.
- Quick tech shifts in banking could make today's results outdated before we know it - so things move fast around here yet progress often outpaces what we find just weeks prior.

## 13. FUTURE SCOPE

- Private vs. public banks – how they stack up side by side
- Customer perception surveys using primary data
- Analysis of cybersecurity vulnerabilities
- AI, blockchain, and CBDC impact assessment

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