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Modernizing Finance through Digital Innovation in LIC and PNB Housing Finance

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Abstract. Digital transformation has significantly reshaped the financial services sector in India, compelling traditional institutions like the Life Insurance Corporation of India (LIC) and PNB Housing Finance to adopt customer-centric innovations. This study examines how both organizations integrate digital tools and strategies to improve efficiency, customer engagement, and overall performance. The research employed a qualitative descriptive design, analyzing secondary data from reports, company releases, and scholarly studies between 2020 and 2025. Comparative evidence was reviewed to identify technological adoptions, customer outcomes, and operational impacts. Key indicators such as policy growth, loan disbursement rates, and customer service efficiency were highlighted. Findings reveal that LIC achieved notable progress with the ANANDA app, issuing 1.15 million policies by 2024 with 42.84% YoY growth, and enhanced customer service using AI-powered chatbots, reducing complaint resolution times by 30%. The NextGen Digital Platform and Project DIVE further advanced personalization and omnichannel engagement. PNB Housing Finance demonstrated a 27% annual increase in loan approvals through AI-driven underwriting, launched a fully digital loan application system, and redesigned its customer segmentation strategy, resulting in a 68.4% rise in affordable housing disbursements. The findings indicate that while LIC focuses on modernization and institutional resilience, PNB emphasizes rapid lending growth and inclusivity. Both align with broader digital adoption trends in India's financial sector. However, challenges remain in risk governance, technological dependency, and inclusion of underserved populations.

Keywords: Digital Transformation; Customer-Centric Strategies; Life Insurance Corporation of India (LIC); PNB Housing Finance; Artificial Intelligence in Finance

1. Introduction

Non-Banking Financial Companies (NBFCs) have emerged as critical enablers of India's financial system, complementing the banking sector by providing services such as asset management, insurance, personal and consumer loans, and pension schemes (Han et al., 2023; Margarita Ekadjaja, 2020; Sharma & Rastogi, 2021; Tiwary & Sahay, 2023). Their ability to fill structural voids left by traditional banks has made them particularly

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influential in advancing financial inclusion, especially in segments that remain underserved by mainstream financial institutions. As India transitions into a rapidly urbanizing and digitally driven economy, NBFCs play a decisive role in extending credit access and supporting economic empowerment.

One of the distinctive strengths of NBFCs lies in their operational flexibility and customer-centric approach. Unlike traditional banks, NBFCs demonstrate greater agility in designing and delivering customized financial products for diverse demographic segments. This adaptability has positioned them as central actors in meeting the rising demand for housing, consumer credit, and innovative financial solutions among India's growing middle class (Katneni et al., 2023; Manda & Margana, 2019). By creating tailored lending mechanisms, NBFCs have not only fostered inclusion but also contributed to the resilience of India's financial ecosystem.

Within the NBFC sector, housing finance companies occupy a strategic niche (Bhanot et al., 2020; Gopalkrishnan et al., 2023; Mangold & Mjörnell, 2023). Access to affordable housing is both a socioeconomic necessity and a marker of development. Institutions such as LIC Housing Finance and PNB Housing Finance have significantly contributed to fulfilling this need by facilitating home ownership for millions of Indian families (Agarwal & Arya, 2017; Lakhwinderjeet Kaur, 2013; R.Madhavi, 2011). As subsidiaries of India's established public financial giants, these companies have gained credibility and scale while expanding their product portfolios in response to evolving market dynamics (Chahal & Bala, 2017; Kavitha, 2017).

Yet, the resilience of NBFCs has been repeatedly tested by systemic challenges. The 2018 liquidity crisis, precipitated by defaults in the infrastructure financing sector, exposed the sector's vulnerabilities and led to heightened regulatory scrutiny. Although subsequent literature has explored this disruption, most studies have focused on pre-pandemic contexts, leaving limited analysis of how housing finance NBFCs recalibrated their strategies during and after COVID-19 (Alharbi, 2024; Midões & Seré, 2022). This gap underscores the need to revisit NBFC performance in light of recent economic transformations.

The pandemic not only disrupted financial markets but also accelerated the digitalization of financial services. NBFCs have increasingly adopted digital interfaces, automation, and artificial intelligence to streamline operations and improve customer engagement. While digital innovation is widely acknowledged as a transformative force in the financial sector, there remains a paucity of empirical studies that examine its role in shaping the operational efficiency and customer-centric strategies of housing finance NBFCs in India.

Addressing this research gap is critical for both academia and practice. For scholars, a nuanced understanding of how NBFCs adapt to technological disruption provides valuable insights into institutional resilience in emerging economies. For regulators and policymakers, such an analysis informs the design of inclusive frameworks that balance innovation with financial stability. For investors, it provides evidence of long-term viability and adaptability in one of the fastest-growing financial markets globally.

Against this backdrop, the present study evaluates the financial performance, operational models, and strategic adaptations of LIC Housing Finance and PNB Housing Finance. By analyzing financial data, strategic initiatives, and digital transformations, the research seeks to track trends and test efficiencies in India's NBFC sector. The findings contribute to broader debates on financial inclusion and institutional innovation, while offering practical implications for stakeholders engaging with South Asia's dynamic financial landscape.

The objective of this study is to analyze the functioning, financial performance, and strategic responses of LIC Housing Finance and PNB Housing Finance, with a particular emphasis on digital adoption and customer-centric innovations as drivers of efficiency and financial inclusion.

2. Methods

This study adopted a mixed-methods research design to provide a comprehensive assessment of the trends and operational efficiencies of LIC Housing Finance and PNB Housing Finance in India (Åkerblad et al., 2021; Grace et al., 2023; Johnson & Onwuegbuzie, 2007; Takona, 2024). The approach combined quantitative analysis of financial data with qualitative insights from customer surveys. This integration of methods ensured a balanced understanding of institutional performance, strategic innovations, and customer-centric practices in the housing finance sector.

The data sources comprised both primary and secondary materials. Primary data were obtained through an online survey administered via Google Forms, targeting individuals who had direct experience or familiarity with LIC Housing Finance and PNB Housing Finance. Secondary data were collected from the audited financial reports and annual statements of both institutions covering the past three financial years. These documents provided information on revenues, profitability, and digital transformation initiatives. To process and evaluate the quantitative data, analytical tools such as Microsoft Excel were employed.

The methodology was implemented in three stages. First, a literature review was conducted to identify theoretical perspectives and empirical findings related to the performance and efficiency of NBFCs in India. Second, financial and survey data were systematically extracted. Quantitative indicators such as revenue growth, profitability ratios, and capital adequacy were collected from official company reports, while qualitative responses from surveys captured customer perceptions regarding service quality and digital adoption. Third, time-series analysis was applied to examine historical financial trends over three years, focusing on profitability, efficiency, and risk management.

To test operational efficiency, the study utilized financial ratio analysis (Arini et al., 2021; Choate, 1974; Myšková & Hájek, 2017). Key indicators included Basic Earnings Per Share (EPS), Return on Assets (ROA), Return on Equity (ROE), Net Profit per Share, Asset Turnover Ratio, Capital Adequacy Ratio, PBDIT Margin, Earnings Retention Ratio, and Enterprise Value. These ratios provided a multidimensional perspective on the financial health, growth capacity, and sustainability of LIC Housing Finance and PNB Housing Finance. The combined use of ratio analysis and trend evaluation enabled a robust assessment of institutional efficiency in the dynamic NBFC sector.

3. Results and Discussion

The study employed both survey responses and financial data analysis to assess the performance and efficiency of LIC Housing Finance and PNB Housing Finance. The survey and questionnaire method was used to capture general customer perceptions of NBFCs, their familiarity with LIC Housing Finance and PNB Housing Finance, as well as their views on digital transformation initiatives. This was complemented with financial data analysis covering three financial years (2021–2024) to evaluate trends in revenue, profitability, and operational efficiency. The combination of both approaches allowed for a balanced understanding of customer expectations and institutional performance.

Table 1 Comparative Financial Performance of LIC Housing Finance and PNB Housing Finance (2021–2024)

Indicator	LIC 2021–22	LIC 2022–23	LIC 2023–24	PNB 2021–22	PNB 2022–23	PNB 2023–24
Enterprise Value (₹ Crores)	242,507.64	262,123.97	284,556.35	54,242.13	58,597.80	68,862.09
Total Disbursement (₹ Crores)	61,848	64,115	58,937	11,246	14,960	17,583
Net Interest Margin (%)	2.29	2.41	3.08	2.80	3.73	3.74
Capital Adequacy Ratio (%)	18.08	18.23	20.78	-	-	29.26
EPS (₹)	43.14	52.56	86.63	49.64	53.21	58.37
ROA (%)	0.89	1.03	1.63	1.24	1.61	2.20
ROE (%)	-	-	-	8.92	9.98	10.90
Net Profit/Share (₹)	41.56	52.53	86.58	48.75	62.55	58.81
PBDIT Margin (%)	85.26	87.42	90.01	84.37	81.92	89.61

Table 1 shows that both LIC Housing Finance and PNB Housing Finance experienced notable growth between 2021 and 2024, though with different strengths. LIC demonstrated significant improvements in profitability, as reflected in EPS, Net Profit per Share, and ROA, alongside a consistently strong Capital Adequacy Ratio, signaling resilience and efficiency in operations. However, its total disbursements slightly declined in 2023–2024, suggesting challenges in sustaining loan growth. In contrast, PNB Housing Finance displayed strong momentum in disbursement growth and profitability ratios, with ROA and NIM improving steadily over the three years. Its Capital Adequacy Ratio of 29.26% in 2023–2024 also indicates a robust capital base. While LIC holds an advantage in brand recognition and profitability scale, PNB has been more dynamic in expanding its loan portfolio and efficiency metrics, highlighting complementary strengths in India's housing finance sector.

3.1. Survey Insights on Financial Preferences and Awareness

The survey insights further enrich these financial findings. Based on 115 respondents, the largest age group was 18–25 years (55.7%), dominated by students (47.8%) and salaried employees (24.3%). Income levels varied, with 30.4% reporting a household income between ₹25,000–50,000 per month, and 28.7% earning below ₹25,000. These demographics suggest that younger, relatively lower-income individuals constitute the primary respondents, which aligns with the growing demand for affordable housing finance among India's emerging middle class.

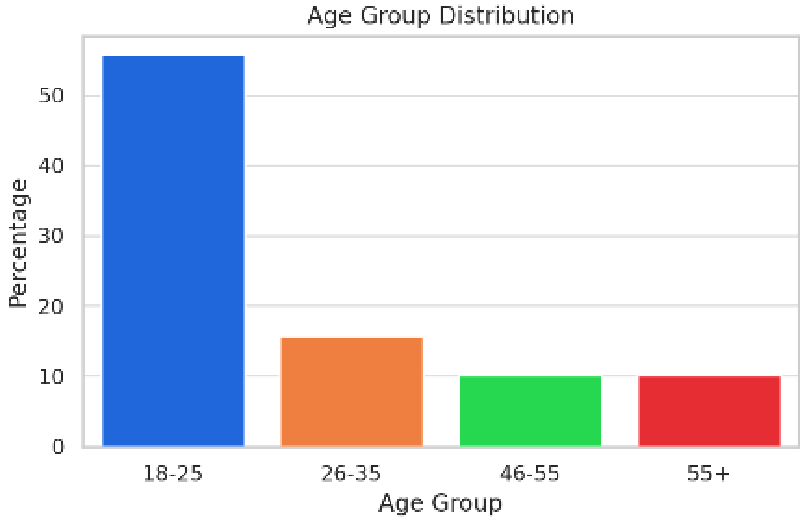

Figure 1 Age Group Distribution

Figure 1 illustrates the distribution of respondents across different age groups, highlighting a significant dominance of the younger demographic. The largest proportion of participants falls within the 18–25 age group (55%), suggesting that the majority of respondents are young adults, potentially reflecting greater awareness or interest in financial services among this cohort. In contrast, only 15% belong to the 26–35 group, while the 46–55 and 55+ groups each represent 10% of the sample. This uneven distribution underscores that the dataset is heavily youth-oriented, which may influence the interpretation of consumer preferences and financial behavior patterns in the study.

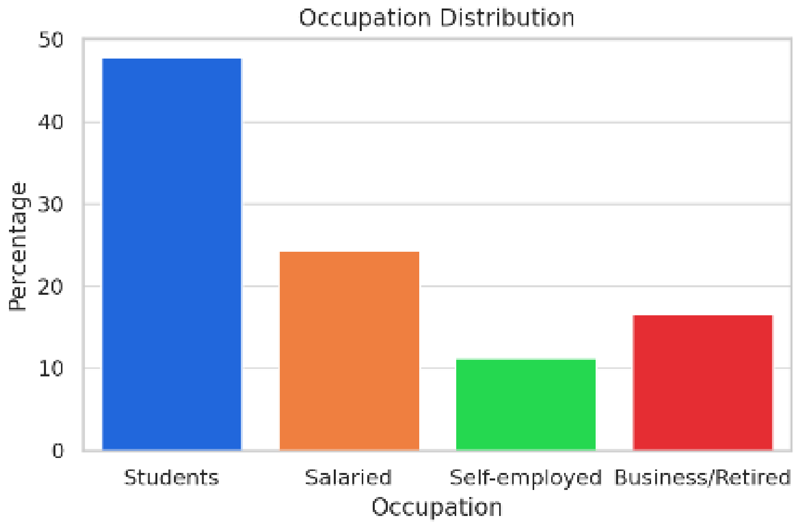

Figure 2 Occupation Distribution

Figure 2 shows the occupational distribution of respondents, indicating that nearly half of them are students (47.8%), making up the largest segment in the survey. This suggests a strong representation of younger individuals who are still in education and may be at the early stage of financial decision-making. The next largest group is salaried employees (24.3%), followed by business owners or retired individuals (16.6%), while self-employed professionals (11.3%) represent the smallest portion. This distribution reflects a diverse sample but with a clear dominance of students, which may shape the results toward perspectives that are more future-oriented rather than based on current financial commitments.

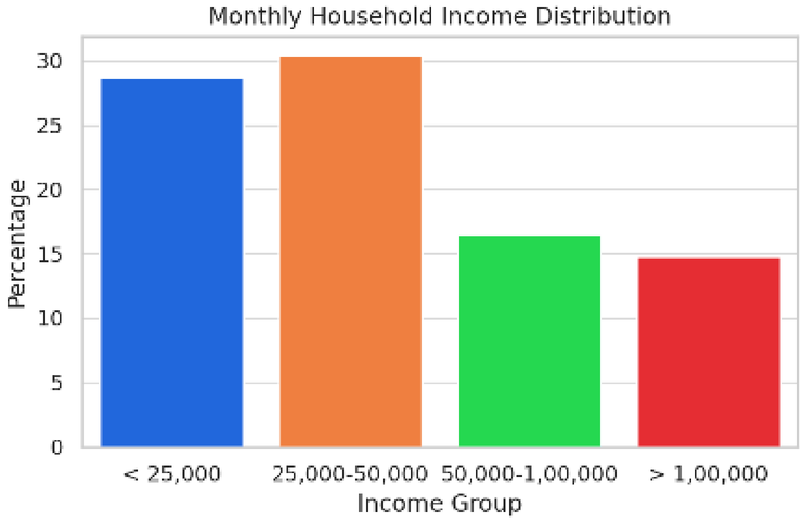

Figure 3 Monthly Household Income Distribution

Figure 3 illustrates the monthly household income distribution of respondents, showing a relatively balanced spread across different income brackets. The largest group, 30.4%, earns between ₹25,000–₹50,000, followed closely by 28.7% who earn less than ₹25,000. A smaller but still notable portion, 16.5%, falls within the ₹50,000–₹1,00,000 range, while 14.8% report earning more than ₹1,00,000 per month. This distribution suggests that most respondents belong to lower- and middle-income households, which may influence their borrowing behavior and preferences for affordable loan options. At the same time, the presence of higher-income respondents highlights a degree of financial diversity within the sample.

Regarding financial behavior, 16.7% of respondents relied on life insurance for savings, while 15.8% preferred fixed deposits. A majority (66.1%) had not applied for a home loan in the past five years, while 33.9% had. Interest rates emerged as the most important factor in choosing a loan provider (23.5%), followed by processing time, customer service, and brand trust (19.1%). Awareness of LIC was exceptionally high at 97.4%, whereas PNB Housing Finance was recognized by only 54.8% of respondents, suggesting that brand visibility remains a challenge for PNB compared to LIC.

Customer experiences with digital services also revealed important trends. About 71.3% of respondents were aware of online applications and EMI calculators offered by LIC and PNB Housing Finance, with 69.9% reporting usage of these services. Among users, 37.1% rated the services as very convenient, while 25.8% were neutral and 23.7% somewhat satisfied. Preferred modes of interaction varied, with 46.1% favoring in-person interactions, 14.8% relying on agents, and a smaller group using phone support or hybrid channels. Respondents' suggestions emphasized faster processing times and the introduction of new schemes, though many expressed general satisfaction with current services.

Together, these results highlight that LIC Housing Finance has demonstrated stronger brand recognition and profitability improvements, while PNB Housing Finance has shown rapid growth in disbursements and efficiency ratios. The survey indicates that customers increasingly value digital services, but also continue to prioritize human interaction in financial transactions. Both institutions face the challenge of enhancing customer engagement, strengthening digital adoption, and maintaining sustainable profitability in a competitive housing finance market.

3.2. Financial Performance Trends of LIC and PNB Housing Finance (2021–2024)

The financial data of LIC Housing Finance and PNB Housing Finance between 2021 and 2024 reveal distinct growth trajectories. LIC displayed steady expansion in enterprise value, moving from ₹242,507.64 Cr in 2021–2022 to ₹284,556.35 Cr in 2023–2024, reflecting consistent investor confidence. PNB, however, recorded sharper momentum, jumping from ₹54,242.13 Cr to ₹68,862.09 Cr in the same period, suggesting a more aggressive growth strategy.

In terms of customer engagement, LIC's base grew from 30 lakh to 35 lakh in 2022–2023 but fell back to 30 lakh in 2023–2024, indicating retention challenges. PNB reported only 2.5 lakh customers in 2021–2022 without further updates, limiting comparison. Loan disbursement trends reinforced this contrast: LIC experienced a mild rise followed by a decline (₹61,848 Cr → ₹58,937 Cr), while PNB showed robust double-digit growth, reaching ₹17,583 Cr by 2023–2024.

Profitability indicators also highlight divergence. LIC's Net Interest Margin improved steadily (2.29% → 3.08%), while PNB's rose quickly but stabilized at 3.74%. LIC outperformed in Earnings Per Share, surging from ₹43.14 to ₹86.63, whereas PNB's growth was moderate (₹49.64 → ₹58.37). LIC also showed stronger Net Profit per Share and higher earnings retention, suggesting healthier reinvestment capacity.

LIC demonstrates financial resilience with superior profitability, while PNB shows faster growth in value and disbursement, reflecting different market strategies: LIC prioritizes stability, while PNB focuses on expansion.

Table 2 Key Financial Indicators of LIC vs PNB Housing Finance (2021–2024)

Indicators	LIC 2021–22	LIC 2022–23	LIC 2023–24	PNB 2021–22	PNB 2022–23	PNB 2023–24
Enterprise Value (Cr)	242,507.64	262,123.97	284,556.35	54,242.13	58,597.80	68,862.09
Customers (Lakhs)	30	35	30	2.5	-	-
Loan Disbursement (Cr)	61,848	64,115	58,937	11,246	14,960	17,583
Net Interest Margin (%)	2.29	2.41	3.08	2.80	3.73	3.74

Capital Adequacy Ratio (%)	18.08	18.23	20.78	-	-	29.26
Basic EPS (₹)	43.14	52.56	86.63	49.64	53.21	58.37
ROA (%)	0.89	1.03	1.63	1.24	1.61	2.20
ROE (%)	-	-	-	8.92	9.98	10.90
Net Profit/Share (₹)	41.56	52.53	86.58	48.75	62.55	58.81
PBDIT Margin (%)	85.26	87.42	90.01	84.37	81.92	89.61
Earnings Retention Ratio (%)	79.56	83.83	90.19	-	-	-

Table 2 highlights the distinct financial performance patterns of LIC Housing Finance and PNB Housing Finance during 2021–2024. LIC demonstrates steady growth with a consistent rise in enterprise value, alongside significant increases in EPS and Net Profit per Share, reflecting stronger profitability and reinvestment capacity. In contrast, PNB shows faster growth, particularly in loan disbursements and Return on Assets, although its profitability remains lower compared to LIC. These differences suggest that LIC is more oriented toward long-term stability, while PNB emphasizes aggressive expansion and operational efficiency.

3.3. Digital Transformation and Customer-Centric Strategies

Since 2020, LIC has advanced its digital ecosystem through several initiatives. The launch of the ANANDA (Atma Nirbhar Agents New Business Digital Application) app enabled agents to issue policies remotely in a fully paperless manner. By 2024, the app accounted for over 1.15 million policies with a 42.8% annual growth rate, improving efficiency and accessibility for both agents and customers. In 2022, LIC strengthened its customer support by introducing AI-driven chatbots and voice assistants, later enhanced with natural language processing in 2023, which reduced complaint resolution time by 30% and eased the workload of service staff. Further, a 2024 collaboration with Infosys resulted in the development of a NextGen Digital Platform integrating AI and cloud services, streamlining policy management and enabling a unified omnichannel experience. Most recently, in 2025, LIC introduced Project DIVE, a Marketing Technology (MarTech) initiative that leverages AI-powered insights to deliver hyper-personalized campaigns across digital channels (Jain & Yadav, 2017; Nalbant & Aydin, 2023; Plangger et al., 2022). This project enhanced customer communication, increased policy renewals, and boosted client retention, reflecting LIC's focus on long-term engagement through digital personalization.

PNB Housing Finance, on the other hand, has centered its transformation on loan processes and risk management. Since 2022, the company has deployed AI-based underwriting models, cutting approval times and increasing loan disbursements by 27% annually by 2024. In the same year, it launched a fully digital loan application portal with e-KYC, real-time tracking, and instant eligibility checks, making the borrowing process faster and paperless. In 2023, PNB adopted a customer-segmentation model, offering affordable loans with quicker approvals, premium loans for high-value clients, and tailored products for borrowers lacking conventional credit histories. This shift led to a 68.4% rise in affordable housing disbursements and stronger customer satisfaction. Additionally, the integration of AI and data analytics for risk management enabled real-time borrower assessment, prediction of potential defaults, and personalized repayment schedules. These measures reduced non-performing assets (NPAs) and increased repayment efficiency, positioning PNB as a customer-focused lender with advanced digital risk controls.

Table 2 Digital Transformation and Customer-Centric Initiatives by LIC and PNB Housing Finance

Institution	Initiative	Period	Key Outcomes
LIC	ANANDA App (Digital Policy Sales)	2020–present	Over 1.15M policies issued; 42.8% YoY growth; streamlined paperless onboarding.
	AI-Powered Customer Support	2022–present	NLP chatbots improved query resolution speed by 30%; reduced claim processing time.
	Infosys NextGen Digital Platform	2024	Unified AI-driven, cloud-based platform for customers, agents, employees; improved efficiency and policy management.
	Project DIVE (MarTech)	2025	AI-driven personalized campaigns; improved client retention and policy renewals through tailored engagement.
PNB Housing Finance	AI-Powered Loan Approvals	2022–present	Automated underwriting increased approvals by 27% annually; faster disbursements.
	Fully Digital Loan Applications	2022–present	E-KYC, real-time tracking, and instant eligibility checks created seamless, paperless loan processes.
	Customer-Centric Loan Segmentation	2023	Affordable, Prime, and Emerging Market loans; 68.4% growth in affordable housing disbursements.
	AI & Data Analytics for Risk Management	2023–present	Real-time borrower risk analysis; reduced NPAs, improved repayment rates, and personalized payback schedules.

Table 3 reveal that both LIC and PNB Housing Finance have undergone rapid digital transformation but with different strategic emphases. LIC has primarily focused on enhancing insurance policy sales and customer engagement through digital platforms like the ANANDA app, AI-powered service tools, and its 2025 Project DIVE, which leverages MarTech for hyper-personalized outreach. In contrast, PNB Housing Finance has concentrated on loan processing and risk management, using AI to streamline approvals, introduce fully digital applications, and design segmented loan products tailored to diverse customer needs. These initiatives resulted in measurable outcomes: LIC achieved over a million digital policy issuances and higher retention, while PNB saw a 27% rise in loan approvals and a 68% increase in affordable housing disbursements. Together, they illustrate how digital tools and customer-centric models are reshaping India's financial service landscape in distinct but complementary ways.

3.4. Reimagining Finance in India: Digital Pathways of LIC and PNB Housing Finance

The analysis of LIC Housing Finance highlights its strong commitment to digital transformation, particularly through the ANANDA app and its subsequent projects like the NextGen platform and Project DIVE. These initiatives demonstrate LIC's strategic focus on enhancing customer experience, improving policy sales, and moving toward a paperless model. As reported, LIC allocated ₹600 crore to its DIVE programme, aiming to go fully paperless within two years (R.Madhavi, 2011). This reflects a broader trend among insurance companies to modernize legacy systems to meet evolving customer expectations.

LIC's partnership with Infosys to build a NextGen digital platform marks a significant leap in creating an omnichannel experience for customers and agents. The platform integrates AI and cloud-based services to streamline policy issuance and servicing (Lehrer & Trenz, 2022; Riaz et al., 2022; Zaware et al., 2020). Such collaborations are increasingly important in the Indian financial services sector, where traditional institutions are under pressure to match the speed and innovation of private competitors. This aligns with research showing that strategic technology partnerships can accelerate digital adoption and improve customer satisfaction (Gupta & Sharma, 2023).

In contrast, PNB Housing Finance has directed its digital transformation toward lending operations, prioritizing speed, accessibility, and customer segmentation. AI-powered underwriting models have reduced paperwork and accelerated loan approvals by 27% annually (Kavitha, 2017). These changes support findings from Kumar and Prakash (2019), which note that customers in India increasingly demand frictionless processes and digital-first experiences, especially when making high-value financial decisions such as home loans.

PNB's redesigned customer-centric model, with affordable, prime, and emerging segments, addresses the heterogeneous nature of India's borrower base (Mishra & Sant, 2024). Affordable housing loans, in particular, saw a 68.4% increase in disbursement, reflecting the rising demand in this sector (de Villiers et al., 2022; Dewland, 2009; Uhl, 2014). This approach resonates with findings by Hu et al. (2024), who emphasized that financial institutions that tailor products to diverse income groups and credit histories can significantly improve both accessibility and profitability.

Risk management emerges as another key differentiator (Panyukov et al., 2023). PNB's adoption of AI-driven analytics for real-time borrower assessment has contributed to improved asset quality and reduced non-performing assets. However, reliance on algorithmic credit models has raised regulatory concerns. The Reserve Bank of India has cautioned NBFCs about excessive dependence on automated systems, which could undermine credit quality if not carefully monitored. This underscores the need for balance between technological efficiency and prudent governance.

Despite these advancements, challenges remain. LIC, while making strides, has historically lagged behind private insurers in digital adoption, often constrained by its large workforce and entrenched traditional practices (Gulzar & Pasquale, 2017). This suggests that while investment in technology is vital, organizational culture and change management are equally important for realizing the full potential of digital transformation. Conversely, PNB's rapid digital expansion poses risks of scalability issues and potential customer alienation if personalized human support diminishes too quickly.

The findings suggest that LIC's strategy leans toward long-term institutional modernization and customer loyalty, while PNB's approach emphasizes aggressive growth and operational efficiency. Both pathways mirror broader trends in India's financial services sector, where digital transformation is not just a technological shift but a structural change in how institutions engage with customers. Future research could further explore the long-term sustainability of these strategies, particularly in balancing innovation, risk management, and inclusivity.

4. Conclusions

The study confirms that digital transformation and customer-centric strategies have become critical differentiators for LIC and PNB Housing Finance. The findings show that LIC, through initiatives such as the ANANDA app (1.15 million policies by 2024, 42.8% YoY growth), AI-driven customer support (30% faster resolution), and its collaboration with Infosys for a NextGen platform, has gradually built an ecosystem that enhances efficiency and customer engagement. Similarly, PNB Housing Finance has leveraged AI for 27% annual growth in loan approvals, introduced a fully online loan application system, and adopted a three-tier customer model that resulted in a 68.4% increase in affordable housing disbursements. These results highlight two distinct pathways: LIC strengthening institutional modernization and PNB driving rapid lending growth through digital integration.

The discussion reveals that both institutions are aligned with wider trends in India's financial services sector, where digital adoption is no longer optional but essential. LIC's investment of ₹600 crore in Project DIVE underlines its long-term focus on loyalty and customer retention, while PNB's aggressive digital lending mirrors the rising demand in India's housing market. External evidence confirms these patterns, LIC is still catching up with private insurers in digital adoption, while PNB's technological focus has improved asset quality but also prompted regulatory caution on algorithmic credit reliance. This suggests that while digital innovation enhances efficiency and customer experience, it must be balanced with governance, risk controls, and cultural adaptability within institutions.

Despite valuable insights, the study faces limitations. First, the analysis relied primarily on secondary data from 2021–2025, which may not capture informal or emerging practices in rural or underserved markets. Second, PNB's customer data was incomplete in earlier years, restricting a fully parallel comparison. Future research should expand the scope by incorporating primary data through surveys or interviews with customers and employees, examining long-term sustainability of AI-driven models, and conducting cross-country comparisons to see how Indian financial institutions align with global best practices. Such research would provide a deeper understanding of how digital transformation impacts customer trust, financial inclusion, and institutional resilience.

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Declaration of conflicting interests

All authors declare that they have no conflicts of interest.

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