ICEMIT
BLACE
The Second International Scientific Conference on Economics, Management and Information Technologies – ICEMIT 2025
CONFERENCE PROCEEDINGS

”Beyond the Hype”: retrace (in better and worse) a 35-years odyssey of organizational change in microfinance from ledgers to algorithms

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Article info

Review paper

DOI:
https://doi.org/10.71159/icemit2520F

Abstract

This thematic review synthesises the technological evolution within Microfinance Institutions (MFIs) from 1990 to early 2025. It traces the journey from pre-digital manual systems through core banking computerisation, the mobile revolution and into the current frontier era of AI and blockchain. The analysis reveals that digital technologies have profoundly transformed MFIs's operations, driving significant gains in efficiency and financial inclusion by enabling new, digital-first models. However, this progress is tempered by persistent and emerging challenges. Critical gaps such as the digital divide, regulatory fragmentation, sustainability pressures, and ethical dilemmas concerning data privacy and algorithmic bias continue to threaten equitable outcomes. Literature review has made it possible to codify the evolutionary steps that have occurred. From this starting point, it has been possible to conceive, for better or for worse, the distinctive features of each era, concluding that for the realization of the technology's full potential necessitates a future focus on inclusive infrastructure, robust ethical governance and adaptive regulatory frameworks to ensure financial inclusion truly serves the most vulnerable populations.

Keywords: *microfinance institutions, digital transformation, financial inclusion, artificial intelligence, algorithmic bias*

1. Introduction

Microfinance Institutions (MFIs) have long stood as a critical mechanism for global development, providing monetary amenities such as loans, savings accounts and insurance to groups that are usually not permitted to use official banks (Morduch, 2000). By targeting the economically marginalised, MFIs aim to alleviate poverty and empower communities through financial inclusion. However, the sector's ability to deliver on this mission at scale has historically been constrained by significant operational inefficiencies, high transaction costs and geographical limitations inherent in manual, paper-based systems (Berger & Humphrey, 1994; Otero, 1999; Yaron, 1994). The advent of digital technology has introduced a powerful disruptive force, challenged these traditional, labour-intensive paradigms and fundamentally reshaped the possibilities of financial inclusion (Johnson, 2008; Otero, 1999; Nanda & Yunus, 2024). This digital transformation is not merely an operational upgrade, but a socio-technical phenomenon with profound implications for achieving equitable economic development, making it a subject of critical academic and practical importance.

This study offers a structured, historical synthesis of the digital transformation within MFIs between 1990 and the beginning of 2025. It is directed by two primary research inquiries: i) How, over the past several decades, have digital technology revolutionised the key functions of MFIs? ii) In spite of these technological advancements, what gaps and challenges remain?

While the existing literature largely documents the adoption of specific technologies—from core banking systems to mobile money at discrete points in time—a significant gap remains. There is a lack of a comprehensive, critical synthesis that maps the entire technological evolution of MFIs over a prolonged period, critically examining the interplay between technological phases and their dual impact on efficiency and inclusion. Much of the scholarship focuses on the promises of technology, often overlooking the persistent challenges and unintended consequences that threaten to undermine its benefits. Specifically, the literature is fragmented in addressing the central paradox of the current frontier era: how

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technologies such as AI and blockchain offer immense potential for upliftment while simultaneously introducing significant ethical risks and threatening to exacerbate existing inequities. This review directly addresses this gap by interrogating the nuanced and often contradictory trajectory of technological adoption in microfinance.

The review is positioned within scholarly debates on financial innovation and inclusion (Nanda & Yunus, 2024). It builds upon foundational work by theorists such as (Morduch, 2000), who challenged the industry's "win-win" narrative and highlighted the inherent tension between sustainability and outreach. It extends this critique into the digital age, examining how technology can both bridge and widen this gap. The analysis is framed by the conceptual understanding of technology not as a neutral tool but as a strategically embedded force that reshapes institutional priorities and client relationships, a perspective echoed in the works of (Otero, 1999) and later scholars like (Berg et al., 2020) and (Omokhoa et al., 2024).

Overall, the study is bounded by a thematic review of literature published between 1990 and early 2025. Its scope is limited to the transformation of MFI operations, excluding a broader analysis of macroeconomic impacts or client-level welfare effects. It omits wider economic factors to maintain a clear and focused examination of organisational-level changes, rather than effects across the broader economy. This was methodologically provided to avoid making this paper rather than an impact assessment paper, a reconstruction of evolutionary analysis up to fintech applied to MFIs. Geographically, it synthesises global evidence but acknowledges that technological adoption varies significantly by region. A primary methodological limitation is its reliance on secondary literature; while this allows for a comprehensive synthesis, it does not involve primary data collection. The timeframe of early 2025 is based on the most recent available literature at the time of writing.

Employing a meticulous thematic analysis in accordance with the framework of Braun and Clarke (2006), this review identifies four distinct evolutionary phases. The findings reveal a trajectory of remarkable progress from manual systems to AI-driven operations, yet they consistently highlight that each phase introduces new possibilities with tensions. The conclusion underscores that realizing technology's equitable potential requires proactively mitigating risks of exclusion, a challenge that defines the sector's future trajectory.

3. Methodological techniques

A qualitative research design, specifically a systematic thematic review, offers here a critical synthesis of technological evolution within MFIs. This design is selected for its capacity to facilitate the systematic identification, analysis and interpretation of patterns (themes) across a diverse body of qualitative literature (Braun & Clarke, 2006). Given the objective of mapping a complex historical trajectory and interpreting nuanced developments and challenges, a qualitative thematic approach is deemed most appropriate, as it enables in-depth engagement with conceptual and contextual subtleties that quantitative methods may overlook.

Data are gathered through a comprehensive search of peer-reviewed, open-access academic literature. Primary sources include articles retrieved from major databases such as Scopus and Web of Science, Braun and Clarke's (2006) "six-phase framework" for thematic analysis ensures methodological rigor.

4. Expected results

Thematic analysis of the literature is expected to reveal a clear, four-phase evolutionary trajectory in the technological adoption of MFIs, each phase building upon the last while introducing new complexities.

The initial phase is anticipated to be characterized by pre-digital manual systems (1990s–early 2000s), establishing a baseline of operational challenges—data fragmentation, high transaction costs and severe geographical constraints—that subsequent technologies would aim to resolve. The subsequent wave of core banking computerization (mid-2000s–2010) is expected to be identified as a foundational period, delivering crucial operational standardization and efficiency gains. However, the analysis will likely demonstrate that these benefits were unevenly distributed, inadvertently exacerbating the digital divide and favoring urban over rural outreach due to high costs and infrastructural barriers (Kumar et al., 2010).

The review is projected to highlight the mobile and digital revolution (2010–2020) as a definitive paradigm shift. The synthesis will likely show that this era successfully fused efficiency with inclusion, leveraging mobile money and cloud computing to facilitate the emergence of digital-first MFIs and extend services to previously excluded populations (Omwansa, 2014). Crucially, the analysis is expected to confirm that technology evolved from a support tool into a core strategic asset driving institutional mission.

For the current frontier era (2020–2025), the review is poised to uncover a landscape of immense potential tempered by significant risk. The findings will likely indicate that technologies such as "Machine Learning" and "Artificial Intelligence" hold the capacity to revolutionize risk assessment using alternative data, enabling hyper-efficient operations and fairer access to credit for the most vulnerable (Omokhoa et al., 2024). Similarly, blockchain is anticipated to offer a transformative potential for ensuring transparency, lowering fraud and automating contracts via smart contracts (Kumarathunga et al., 2022).

However, a critical finding is expected to be the identification of a central paradox: these same technologies introduce profound new challenges. While successful cases like Bancamía (Colombia), Amret (Cambodia), Microfund for Women (Jordan), BBVA Microfinance Foundation (Latin America), Banco Guayaquil (Ecuador), M-Pesa (Kenya), Lendwithcare (LWC), Aye Finance (India), TiendaPago (Peru), KopoKopo (Kenya) and Konfio (Mexico) have been developed, the analysis reveals and likely concludes that without proactive mitigation, algorithmic bias in AI models could perpetuate discrimination, while infrastructure gaps and high costs threaten to create a two-tier system, leaving smaller, rural MFIs further behind (Khan et al., 2025). Furthermore, regulatory fragmentation around data privacy and cryptocurrency is anticipated to be a significant hurdle to scalable and ethical innovation (Dezem et al., 2024).

Ultimately, the synthesis is expected to posit that the future trajectory of microfinance is not predetermined by technology alone. The expected results will underscore that realizing the full positive potential of this evolution is contingent upon conscious, strategic choices, prioritizing inclusive infrastructure, enforcing rigorous ethical governance and developing adaptive regulatory frameworks, to ensure that the digital frontier empowers rather than excludes.

Table 1. Key components from the studies

		Operational perspectives	
		Impact	**Driver**
PHASE CODED NAME	**Pre-digital manual systems (1990s – early 2000s)** Paper ledgers & files Basic spreadsheets	High error rates, operational bottlenecks, inability to aggregate data in real-time and severe geographical limitations	Basic record-keeping and administrative support
Main characters	Fragmented Management Information Systems (MIS) (Baydas et al., 1997; Gonzalez, 2007; Morduch, 2000; Otero, 1999; Yaron, 1994)		
PHASE CODED NAME	**Core banking computerization (Mid-2000s – 2010)** Centralized Core Banking Systems (CBS)	Reduced paperwork and administrative errors, improved portfolio management and quantifiable cost reductions (up to 25%)	The pursuit of internal operational efficiency and standardization
Main characters	On-premise software & servers Early SaaS models (Akanji, 2001; Frederick, 2009; Kapoor et al., 2007; Kumar et al., 2010; Sergio & Danel, 2006)		
PHASE CODED NAME	**Mobile & digital revolution (2010 – 2020)** Mobile money (e.g., M-Pesa) Cloud computing (SaaS) Digital credit scoring	Dramatically faster and cheaper operations (e.g., 24-hour loan disbursement), process automation and data-driven decision-making	Dual purposes of high-tech efficiency and massive financial Integration
Main characters	Agent banking networks (Berg et al., 2020; A. Khan & Shireen, 2020; Munya, 2017; Ombutora, 2013; Pytkowska & Korynski, 2017; Servin et al., 2012; Srinivas & Mahal, 2017)		
PHASE CODED NAME	**Frontier technologies & AI integration (2020 – 2025)** Artificial Intelligence (AI) & Machine Learning Advanced Cloud Platforms (e.g., Mambu) Blockchain & Smart Contracts	Alternative data credit scoring for the "invisible," automated customer service (chatbots), enhanced fraud detection and seamless FinTech partnerships	The pursuit of hyper-efficiency, predictive analytics and deeper, more ethical inclusion.
Main characters	Open Banking APIs (Dezem et al., 2024; Y. Khan et al., 2025; Kisoso, 2023; Kumarathunga et al., 2022; Omowole et al., 2024; Zotorvie et al., 2024)		

Source: Author’s analysis based on collected studies

5. Discussion & conclusion

This review unequivocally demonstrates that the technological evolution of MFIs is a tale of profound transformation fraught with a critical paradox. While the journey from paper-ledger inefficiency to AI-driven analytics has unlocked unprecedented gains in operational efficiency and client outreach, it has simultaneously introduced and amplified formidable risks that threaten the sector’s foundational mission of equitable financial inclusion. The core tension is no longer merely between efficiency and outreach, as posited by Morduch (2000), but has evolved into a more complex conflict between algorithmic efficiency and ethical equity, between digital potential and digital exclusion.

The frontier technologies of AI, blockchain and advanced cloud platforms offer a future of hyper-efficiency and deeper inclusion, but are intrinsically linked to significant perils. The potential for algorithmic bias threatens to automate and perpetuate historical discrimination (Omokhoa et al., 2024), while infrastructural inequity and the high cost of adoption risk cementing a two-tier system that leaves smaller, rural MFIs and their clients further behind (Khan et al., 2025). Furthermore, regulatory fragmentation creates a precarious environment that stifles responsible innovation and fails to protect vulnerable populations from data exploitation and financial harm (Dezem et al., 2024).

Therefore, realizing the emancipatory potential of technology is not an inevitable outcome; it is a conscious choice that demands immediate and concerted action. This review serves as an urgent call to action for scholars, practitioners and policymakers. A call for urgence is strongly due by the research community to pivot towards addressing critical, empirically grounded questions. Sicuramente aprire le porte ad ampie fette di popolazione, anche nelle più remote aree geografiche richiede investimenti infrastrutturali. But the scalability of technology could enable cheaper access, like smartphones, to almost every corner of the globe. Political will and ethical responsibility will have to guide policymakers and MFIs toward sustainable goals and humanize the economy.

The four phases highlighted demonstrate the significant advances made through technology in the sector. At the same time, however, new paradigms and challenges are posed to humanity as it integrates fintech into MFIs so that they can continue to fulfill their original purpose. Ethical challenges on the razor's edge of a double-edged sword are the main future prospects that humanity and technology will have to face in this field.

There is a pressing need for robust, longitudinal studies to move beyond conceptual frameworks and pilot projects. Research must quantify the real-world impact of forensic auditing (Zotorvie et al., 2024), blockchain applications (Kumarathunga et al., 2022) and AI-driven models (Ting et al., 2025) on long-term financial integrity, client over-indebtedness and social performance.

Future research must priorities developing scalable, affordable and context-specific technological solutions for smaller and rural MFIs operating under severe resource constraints (Omowole et al., 2024). This includes designing low-literacy interfaces and off-line functionality to bridge the digital divide.

Interdisciplinary research is paramount to develop transparent, explainable AI (XAI) frameworks and robust ethical guidelines that can be practically implemented to mitigate bias and ensure accountability (Omokhoa et al., 2024).

The intrinsic limits of this research are represented by the very nature of the periodization work, which takes into account the main events and breaking points, but which are nevertheless in a certain sense the fruit of the researcher's sensitivity.

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