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Industry 5.0 Meets Fintech Towards A Human-Centric Digital Economy: Implications For Accounting Systems And Reporting Frameworks

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Abstract
Industry 4.0 has revolutionized financial services through digital finance but remains limited in addressing sustainability, resilience, and human-centric concerns. This study explores how Industry 5.0 principles can bridge these gaps by fostering adaptive, inclusive, and sustainable digital financial systems. Using a conceptual approach, it synthesizes literature on Industry 5.0 and digital finance, integrating technologies like Edge AI, Generative AI, and Mixed Reality with human-centered values such as collaboration, personalization, and equity. The proposed framework includes stages of vision alignment, technology adoption, workforce enablement, and governance. Findings indicate that Industry 5.0 can enhance decision-making, improve transparency, and support AI-enabled reporting and accountability within financial system. However, challenges such as cybersecurity risks, ethical AI issues, and skill shortages remain. The study emphasizes that human–machine collaboration can overcome Industry 4.0's limitations while advancing transparency, empathy, and sustainability. By promoting equitable access, efficient resource use, and user-centric AI solutions, the research contributes to the emerging discourse on Industry 5.0 in digital finance, offering a roadmap for achieving efficiency, equity, and long-term financial resilience. This study contributes to accounting theory by proposing a conceptual framework for next-generation accounting systems integrating Industry 5.0 principles. It advances theoretical understanding of real-time accounting, AI-driven reporting, and socio-technical accounting systems. Implications for financial reporting, auditing, and sustainability accounting are discussed.

Keywords – Industry 5.0, Digital finance transformation, Conceptual framework, Strategic Implementation, Challenges, Opportunities

1. Introduction

The recent technological change in the financial service sector resulted in drastic changes (Mavlutova et al., 2020). This accelerated rise of financial services sector is based on past development stages, including the emergence of electronic trading systems and web-based banking (Machkour and Abriane, 2020). All these changes are deeply entrenched in Industry4.0 an age of automation, centralization, and hyper-efficiency. In line with Industry4.0, a paradigm of Digital Finance4.0 reflects the coming together of financial services and the following advanced information technologies that allows innovative products and platforms, as well as business models (Mpofu, 2024). Regardless of the massive scale and volume of transactions, the various forms of Digital Finance4.0 have been executed in a systematic way of missing structural inequalities, human-centred values, and environmental sustainability. This is explained by the fact that the Industry4.0 technology is planned and implemented to achieve maximum efficiency, scaling, and cost reduction but not equity, contextual fluidity, and human and ecological well-being longevity (Khan et al., 2025). This yields a basic paradox, namely systems which do well in optimal functioning within a closed technical context are likely to do with a context of human society, which is messy, contextual and ethical. Digital finance4.0 systems are, in many cases, replicative and tend to enhance, socio-economic inequalities by exclusion of digital finance first, and mostly, of vulnerable members of the society (Chen et al., 2024; Li et al., 2022). The users of these technologies are often content with them being black boxes of digital finance systems in which they are uninformed or unconcerned with all aspects of it, including terms in which they are entitled to receive products. This loss of trust brings out the second important tension which is algorithmic vs. human transparency. Industry4.0 technologies have focused on operational performance instead of human-centeredness, sustainability, real-time

responsiveness, and interpretability of the economic ecosystem (Kopeinig et al., 2024. A growing complexity of financial systems highlights the importance of continued innovation to ensure digital finance is resilient, inclusive, and sustainable for future generations.

Industry5.0 emerges as a sequential evolution and a necessary conceptual corrective. Hence, Industry5.0 can provide a substantial opportunity to reconstruct digital finance into "Digital Finance5.0" by incorporating human cognitive ability into machine-critical systems with the expectation that human-machine combinations will have improved outcomes (Pizoń & Gola, 2023). Crucially, it provides a framework to resolve the core tensions of Industry4.0 model by advocating for a socio-technical synthesis where technology serves human and planetary goals.

Although research studies have explored Industry4.0 technologies in digital finance (Chang et al., 2023; Bisht eta al., 2022), focusing on blockchain (Mhlanga, 2023), Fintech (Trotta et al., 2024), AI (Al-Baity, 2023), Big Data (Soldatos & Kyriazis, 2022), they lack a systemic integration of human values, ethical responsiveness, and socio-environmental resilience. The literature is still compartmentalized, which focuses on technologies individually instead of discussing the paradigm under which they cannot have a beneficial influence. Very little research has found and proven Industry5.0 technologies into digital finance application (Rawat et al., 2023; Nanda et al., 2025) to attain sustainability. Yet, the theory and practical application of the interconnecting nature of Industry5.0 and digital finance do not well comprehend the broader picture. Particularly, there is the lack of critical work that would establish Industry5.0 as a solution to the conceptual contradictions of Industry4.0, which provided a new logic of digital finance.

Thus, the work is a valuable addition to the current knowledge that provides critical synthesis and a new theoretical framework. It will answer the following research questions: How can the concepts and technologies of Industry5.0 be used in order to overcome the underlying tension of Digital Finance4.0 and, therefore, create human-centricity, resilience, and sustainability in digital finance systems? This guides a paradigm shift in critical rethinking of digital finance by Industry5.0. It adds a conceptual frame that brings technological development and innovation to the socio-environmental aspects. It is based on the Socio-Technical Systems theory (STS). Nonetheless, little focus has been placed on the role these changes play on accounting system, measurement systems and reporting structures. Old-fashioned accounting models are becoming unsuitable to represent real-time, AI-driven, and stakeholder-centric financial realities, which heavily rely on periodic and historical models of accounting. This paper fills this gap by expanding the Industry 5.0 discussion into accounting theory, as the definition of accounting as a socio-technical system that combines Ljudgment and intelligent technologies.

2. Literature Review

2.1. Industry5.0: Concept and Evolution

Industry 5.0 is built on the foundation of Industry4.0, which started in 2011 with a cooperative initiative of the German government and Acatech (Ellahi et al., 2019). Industry4.0 represented a disruption to production whereby technologies were merged physically and digitally to enhance decision-making and improve operations (Ghobakhloo et al., 2021). However, a critical analysis reveals that Industry4.0's disruption was predominantly techno-economic, prioritizing operational efficiency, automation, and data-driven optimization as shown in Table A (in annexure). While industry4.0 created data-enhanced automated systems, Industry5.0 presents an opportunity to rethink this techno-centric trajectory across all industries. A particular focus is on use of human-centric and sustainable technology platforms such as collaborative robot systems, edge AI, mixed reality, and generative AI (Pizoń & Gola, 2023). The core innovation of Industry5.0 is not a new technology, but a new objective; to achieve a synergistic partnership between human intelligence and machine efficiency, placing societal well-being and environmental sustainability at the center of technological progress. In terms of accounting, Industry 5.0 is also an indication of the shift in accounting systems of the past, which were based on tradition and compliance to adaptive, real-time, and stakeholder-friendly reporting systems. This change requires the reconsideration of accounting as interactive socio-technical system as opposed to its traditional roles as a record-keeping.

This paradigmatic shift from Industry4.0 to Industry5.0 introduces a series of conceptual tensions, particularly acute in digital finance, as summarized in Table 1.

Table 1. Conceptual Tensions: Industry4.0 vs. Industry5.0 Paradigms in Digital Finance

Core Principle	Industry4.0 Paradigm (The Status Quo)	Industry5.0 Paradigm (The Proposed Correction)	Core Conceptual Tension	Supporting studies
Primary Goal	Maximize efficiency, automation, and shareholder value.	Optimize human well-being, societal resilience, and sustainable value.	Efficiency vs. Well-being	(Schwab, 2017) vs. (Nahavandi, 2019; Rada, 2018)

Role of Humans	Humans are a risk factor and an operational cost to be minimized (e.g., replaced by chatbots).	Humans are a source of creativity, empathy, and ethical judgment to be augmented.	Automation vs. Collaboration	(Soldatos & Kyriazis, 2022; Mhlanga, 2023) vs. (Pizoń & Gola, 2023; Khosravy et al., 2024)
System Design	Centralized, opaque "black box" systems for control and scale.	Decentralized, explainable, and transparent systems for agency and trust.	Opacity vs. Transparency	Implicit in I4.0 design vs. (Longo et al., 2020; Alves et al., 2023)
Approach to Data	Data is a proprietary asset for predictive analytics and profit maximization.	Data is a shared resource for collaborative intelligence and personalized empowerment.	Extraction vs. Empowerment	(Kopeinig et al., 2024) vs. (Ivanov, 2023)
Sustainability	An externality or a compliance cost (e.g., ESG reporting).	A foundational design principle integrated into core operations and products.	Externalities vs. Integration	(Li et al., 2022) on algorithmic bias vs. (Rawat et al., 2023) on inclusive systems

Industry5.0 has six key domains: human-machine collaboration, bio-inspired approaches, digital twins, big data analytics, energy efficiency, and renewable energy integration. These domains have received some form of research attention, with different perspectives being offered, illuminating its focus on human learning, collaborative intelligence, and socially responsible innovation. Key definitions of Industry5.0 have been synthesized and collated in Table B (in annexure).
Nonetheless, the existing literature tends to articulate each of these concepts in isolation, usually in the context of manufacturing. The original contribution of this paper is synthesizing these principles critically and explicitly demonstrating their applicability to address the identified tensions in the digital finance ecosystem, thus moving from description to a prescriptive framework.

2.2. Digital Finance Transformation

Digital finance utilizes improved technology to improve access to financial services, increase efficiencies, and drive innovation. Digital finance products (mobile banking applications and digital wallets) can empower previously unbanked individuals to transact or access credit via smartphone (Agarwal & Ann, 2024). However, "Digital Finance4.0" model is limited to the existing Industry4.0 paradigm. Its significant contributions to scale and efficiency have simultaneously underscored three pressing tensions: (1) a persistent access gap that means access is not equal to equitable or empowering service; (2) a trust deficit stemming from lack of transparent algorithmic decision-making ("black boxes"); and (3) a resilience shortfall due to centralized systems that treat the system as a single point of failure. Industry5.0 extends beyond just incremental improvements; it also introduces a paradigm shift that ensures human-centricity, resilience, and sustainability within financial systems, leading to transformative change.

Blockchain redefines centralized trust by providing a transparent, immutable, decentralized system. Generative AI can be used as an Explainability Engine, which explains why certain decisions were made in a certain way (e.g. why a loan was denied, why stock advice was given) and restores trust. Mixed Reality assists in eliminating the empathy divide in financial planning, and literacy becomes more accessible. But there are still obstacles: privacy of data, regulatory issues, cybercrime, and deficiency in skills. A human-centered design incorporates privacy and security (e.g., on-edge AI processing of data) and uses compliance as a source of trust. Although digital finance makes the system more efficient, the effects on accounting systems are underresearched. Conventional accounting systems lack the ability to record the flowing of data, artificial intelligence based appraisals, and decentralized financial operations. This leads to a demand in the new theoretical framework of accounting that includes the real-time processing of data, the use of algorithms in decision-making, and increased transparency.

2.3. Research Gap

The present research draws on the increasing literature about Industry4.0 technologies in digital finance. Still, it focuses on how Industry5.0 might solve emerging complexities like sustainability and human-centricity. Many studies about technologies such as artificial intelligence (AI), blockchain, and big data have emerged from a technocentric perspective instead of acknowledging the broader financial ecosystem in which these technologies operate. Research focusing on new advanced Industry5.0 tools is equally limited, especially in enhancing further transparency, inclusivity, and resilience in digital finance. This study would address the aforesaid gaps by developing a conceptual framework that usefully integrates Industry5.0 concepts into digital finance systems to establish novelty and sustainability. Also, the literature

does not present a theoretical framework to describe how Industry 5.0 principles transform the accounting measurement, reporting and assurance systems. Very little is known about accounting as a socio-technical system under digitally transformed conditions, and therefore a significant gap is necessary in this study.

2.4 Accounting Systems in Digital Transformation

The accounting systems are important to reflect, process, and communicate the financial information in the organizations. But the conventional accounting paradigms are highly premised on periodic reporting, measurement of historical cost and standardized disclosures.

Within the framework of Industry 5.0, these methods are restricted because the process of financial transactions is becoming more complex, faster, and decentralized. New technologies, including AI, blockchain, and digital twins, threaten the traditional parameters of accounting, providing the possibility to capture data in real time, value predictively and report automatically.

It is thus the case that there is an increasing tendency to conceptualize accounting systems as dynamic, socio-technical systems that comprise human judgment, algorithmic intelligence and stakeholder-based reporting goals.

3. Conceptual Framework

Industry5.0 embraces a path beyond the automation-driven trajectory established by Industry4.0 innovators. It conceptualizes a fused approach that brings together cutting-edge technology and human making, creating a digital finance ecosystem that is personalized, sustainable, and resilient. This concept of digital finance future forms the basis of a conceptual framework exclusively focused on Industry5.0 technologies, including Edge AI, Mixed Reality (MR), Artificial IoT, Holography, and Generative AI. To anchor the framework in theory, this research uses Socio-Technical Systems (STS) Theory (Appelbaum, 1997), which is tasked with a dynamic view of the "technical subsystem" (technologies, infrastructures, and digital tools) and "social subsystem" (humans, organizations, cultures, and values) (Manny et al., 2022). Historically, STS was developed partly to improve productivity for workers vs. the organizations engaging them and seized on technological innovation, including ways to encourage automation (Pasmore et al., 2018). In recent years, STS has become the lens of choice for analysing complex digital transformations, especially those where collaboration and ethical issues arise among individual humans and machine systems (Govers and van Amelsvoort, 2023). In this context, where contemporary finance is faced with growing stakeholder and regulatory demands to blend innovation (AI, MR, CPS) with human-centred goals (equity, personalized, empathic), STS formulates a holistic proposition for examining how co-design and co-evolution of innovation and human-centric goals. It can advocate for systemic digital finance transformations, not only for their resilience but also for inclusion. This outline of the potential Industry5.0 integration into digital finance is established and inferred from an accumulated theoretical and empirical research body. The technological enablers stem from the work of Gill et al. (2025), Singh & Gill (2023), Sehgal et al. (2025), Chen and Laio (2021), Falola et al. (2024), Oyewole et al. (2024), Moh (2018), Rawat et al. (2024) and Lou et al. (2025). These works deal with the technical subsystem of the STS model and depict how new technologies influence performance at the operational level. The sociocentric ideas, such as collaborative intelligence, empathy, and equity, correspond to the social subsystem of the STS theory. Extant Literature supports an underlying attraction toward a socio-technical equilibrium and empowerment on a humanistic level (Khosravy et al., 2024; Sheth et al., 2024). Moreover, the framework puts into consideration an accounting perspective through a redefinition of core accounting functions, which are, measurement, recognition, reporting, and assurance, in Industry 5.0 settings. The conceptualization of accounting is on a real-time, AI-assisted, and stakeholder-centric system as integrated in the socio-technical interactions.

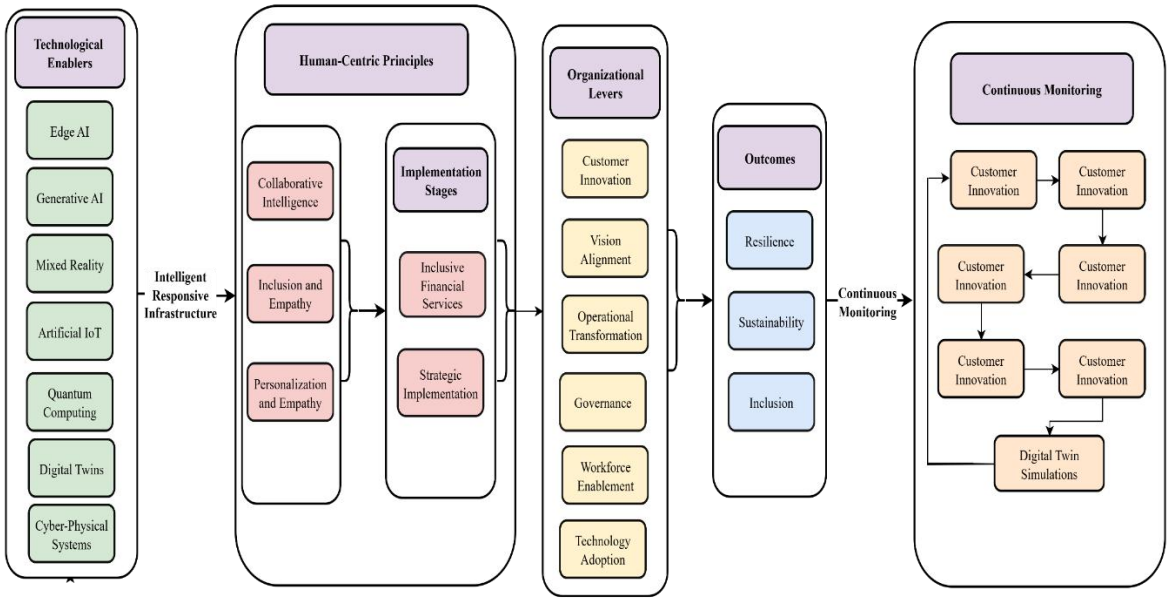
What is interesting about this line of thought is the endorsement of adhering to ethical, relational, and psychological issues required to be incorporated within the design and deployment of new technology. Additionally, the framework's strategic implementation phases—vision alignment, technology adoption, workforce enablement, and governance—are based on organization and transformation literature, such as Bellantuono et al., (2021); Santoso & Surya, (2024); Ajayi & Udeh, (2024); and Chawla & Mehra, (2023); the stages establish a socio-technical integration process as a fundamental principle of STS theory. This ensures that the technological and the human systems are developed in common alignment, rather than with fundamental differences. Finally, the framework combines interdisciplinary literature on sustainability, resilience, and human-AI collaboration with the European Commission's Industry 5.0 methodology, as introduced by Rada (2018) and Nahavandi (2019), belonging to the category of the stages involving competency, change, and challenges.

3.1. Key dimensions of the framework

The proposed conceptual model presents cause-and-effect relationships between critical elements of Industry5.0 in digital finance transformation. Advanced technological enablers (Edge AI, Generative AI, Mixed Reality (MR), and Artificial IoT) are at the base of the model, enhancing human capabilities such as collaboration, empathy, and personalization. The human-oriented capabilities fuel strategic implementation approaches with operational delivery outcomes, aligned vision, empowered workforce, transformed operations, and governance. With a continuous feedback loop through digital twins and performance analytics, behavioral practices of users and metrics of the financial system inform the iterative

change and evolving nature of design, strategy, and use of technologies.

Figure 1. Conceptual framework



Source: Developed by the authors with the assistance of eraser.io through prompt engineering, based on concepts and linkages identified from extant literature.
Note: The outputs generated by eraser.io were thoroughly reviewed, verified, and refined multiple times by the authors. The authors take full responsibility for the accuracy, interpretation, and final form of the conceptual framework presented in this study.

3.1.1. Technological Enablers: Exclusive Industry5.0 Technologies

The technologies facilitating Industry5.0 are not enhanced versions of Industry4.0 technologies, but an overhaul of the structure of digital finance. Their merit goes beyond technical improvements but rather they are able to respond to the acute tensions that exist in the mode of production today (efficiency vs. equity; opacity vs trust; centralization vs. resilience).

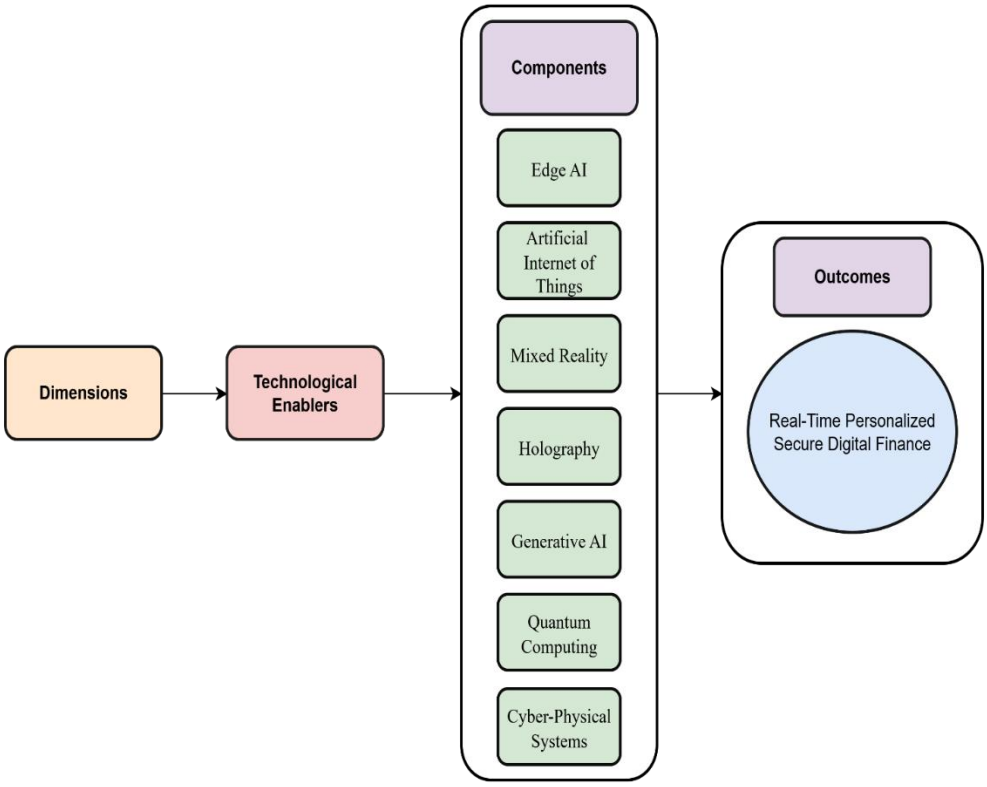
The edge AI introduces the artificial intelligence features to the edge of the network, which allows performing real-time analytics and decision-making in finance without needing a central data center. It helps detect fraud more quickly and carry out transactions quicker, as well as operate finances more adaptively by minimizing latency (Patil, 2024). It also ensures privacy, reduces the cost of operation, increases efficiency in digital finance ecosystems. Importantly, Edge AI can overcome the conflict of real-time processing and data sovereignty by taking sensitive financial data off the cloud servers. As a case in point, credit scoring or fraud detection can be done locally on amersch and farmer device using some contextual information (such as harvest) or market price. It enhances the financial inclusion of isolated areas, reduces privacy concerns with the centralized approach and helps in making finance more fair.

The concept of artificial IoT (AIoT) will revolutionize the financial assets management because it will allow real-time monitoring, optimization, and decision-making during the creation and transfer of assets (Mishra and Sant, 2021). Financial operations IoT devices powered by AI have the ability to monitor performance, take automatic actions, and allocate funds. An example of this is through sensors on a funded solar farm that can judge energy production, oftentimes in anticipation of maintenance and can automatically implement smart contracts or insurance claim. Mixed Reality (MR) helps to improve financial planning and interactions with customers by using immersive virtual spaces (Egieya et al., 2023). Companies can model portfolios in three-dimensional rooms, closing empathy and literacy gaps and reconciling the complexity algorithms and human cognition conflicts. Likewise, holography offers visual representation of the complex financial models in three-dimension (Begum et al., 2022), taking the interaction out of the screen where the face-to-face virtual communication can be performed with the advisor and help build trust and transparency.

Generative AI is based on complex algorithms to perform complex financial calculations (Rane, 2023). Generative AI is capable of processing large amounts of data to discover hidden factors, predict the future market, and provide investment recommendations that are specific to a situation. The greatest invention of Generative AI is an Explainability Engine. Being an Engraving Engine, Generative AI solves the black box issue of financial AI, and trust. Quantum computing offers a new level of computational capabilities to the digital finance industry to solve complex financial solutions at unparalleled speeds (Atadoga et al., 2024). The quantum computing is particularly effective at risk modeling and risk analysis, risk portfolio selection, high-frequency trading.

Digital twins generate virtual financial systems, which allow predictive analytics, real-time monitoring, and scenario testing (Yaqoob et al., 2020). In digital finance, they will have the ability to test the investment strategies, address vulnerabilities, and aid the resilient system design. With digital twins, the context of risk management will change to resilience engineering by simulating market conditions or regulatory modifications, filling the gap between the wisdom of the past and future-proofing. As an example, instead of trying out a new policy or macroeconomic shock, a central bank could model millions of possible scenarios and trace how it would cause cascading failures and unintended consequences. This turns regulators into active planners of financial stability as opposed to being reactive watchdogs. These technologies have the potential to make a major change in terms of accounting. Edge AI enables real-time transactions to be recorded, digital twins to predict valuation and estimate accounting scenarios (and) generative AI to enable automatic financial reporting and disclosures. Blockchain also increases accounting reliability since the records become immutable and auditable.

Figure 2. Technological enablers



Source: Developed by the authors with the assistance of eraser.io through prompt engineering, based on concepts and linkages identified from extant literature.
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Cyber-physical systems (CPS) integrate physical and digital systems, allowing for a natural interaction between tangible financial assets and their digital counterparts (Javaid et al., 2023). The system capabilities allow a settlement control model. CPS technologies offer various advanced methods of real-time asset management, and advanced security protocols. They eliminate the mechanical and reconciliation problems that impede finance's physical and digital worlds. Thus, a new and seamless trusted flow of value and goods has been created. Roles in digital finance transformation are summarised in Table 2.

Table 2. Role in digital finance transformation

Technology	Primary Function in Digital Finance	Key Benefit	Addressing I4.0 Tension	Supporting studies
Edge AI	Real-time, localized analytics & decision-making (fraud detection, credit scoring)	Data sovereignty, low latency, inclusion for low-connectivity areas	Centralization vs. Resilience	(Singh & Gill, 2023; Kamruzzaman et al., 2022)

Artificial IoT	Real-time monitoring & management of physical assets linked to finance	Transparency, new asset-backed products, proactive management	Disconnect between physical & financial worlds	(Mishra & Sant, 2021; Srinadi et al., 2023; Chen & Liao, 2021)
Mixed Reality	Immersive financial planning & customer engagement	Empathy, improved financial literacy, and collaborative decision-making	Automation vs. Collaboration	(Egieya et al., 2023; Moh, 2018; Oyewole et al., 2024)
Generative AI	Complex modeling, personalized advice, "Explainability Engine"	Transparency, trust, and personalization at scale	Opacity vs. Transparency	(Rane, 2023; Rane et al., 2024; Ferraro et al., 2024)
Quantum Computing	Ultra-fast processing of complex financial algorithms	Advanced risk modeling, portfolio optimization, and cryptographic security	Computational limitations for complex problems	Atadoga et al., 2024; Saxena et al., 2023; Rawat et al., 2024)
Digital Twins	Virtual replicas for predictive modeling & scenario testing	Resilience engineering, proactive policy testing, system strengthening	Historical Analysis vs. Future-Proofing	(Yaqoob et al., 2020; Javaid et al., 2023; Gejo-García et al., 2022)

3.1.2. Human-centric principles

Industry5.0 places humans at the center of technological advancement, ensuring that digital finance systems empower, rather than replace, human expertise (Leng et al., 2023). These are key social-technical complementary institutional structures that address the fundamental tensions of opacity, exclusion, and rigidity in the current digital finance system. Table 3 explains implementation challenges with socio-technical principles. These principles are used in accounting contexts, where they focus on the interpretability, ethical reporting and disclosures related to the stakeholders. By making accounting human-oriented, one ensures that financial data is easy to comprehensible and transparent as well as oriented to the greater societal and environmental goals.

Collaborative Intelligence

Collaborative intelligence combines human creativity with machine intelligence to enhance innovative financial decision-making (Khosravy et al., 2024). It uses machine-based analytical intelligence with financial time-series data and traditional ratio assessments, identifying patterns and predicting customer behavior using logic or risk models. This paradigm shift considers time-series and operational exposures to financial risk. While institutions may deploy AI-only systems, these lack human engagement for collaborative intelligence. This principle resolves the Industry4.0 dilemma of Automation vs. Judgment. It implies shifting resources to develop "AI-savvy relationship managers" or "quantitative strategists" who can critically engage with AI insights. For risk assessment, models become adaptive and supervised by human intelligence, rather than static and algorithmic.

Personalization and Empathy

Personalization and empathy are integral to developing customer-centric financial solutions (Sheth et al., 2024). Generative AI and Mixed Reality will position financial institutions to change how they understand and engage with their customers (Rane, 2023). Using technological advancements, financial institutions can gather insights about how their customers behave and their preferences around finance. Generative AI can analyze large data sets and make proper predictions based on financial data for a customer. Generative AI can proactively engage customers by suggesting the type of investments, loans, or savings options based on their goals. Mixed Reality (MR) allows customers to visualize complex financial concepts. These technologies help generate empathy, a natural human behavior, as financial institutions can begin anticipating their customers' touch points (Sheth et al., 2024).

Table 3: Implementation Challenges & Socio-Technical Principles

Human-centric principles	Key Concepts	Associated Challenges	Supporting Literature	STS Subsystem

Collaborative Intelligence	Human-AI partnership, leveraging intuition & machine speed	Skills gap, organizational resistance to new workflows	(Khosravy et al., 2024; Bajaj et al., 2023)	Social & Technical
Inclusion & Equity	Access for underserved communities, alternative data for credit	Algorithmic bias, digital divide, and infrastructure costs	(Ebirim & Odonkor, 2024; Verma & Kumar, 2024; Li et al., 2022)	Social
Governance & Ethics	Explainable AI (XAI), algorithmic fairness, and regulatory compliance	"Black box" problem, evolving regulations, ethical audits	(Abrahams et al., 2024; Chawla & Mehra, 2023; Javaid et al., 2022)	Social & Technical
Workforce Enablement	Upskilling, hybrid teams, new roles (e.g., AI-Human Interaction Designer)	Cost of training, continuous learning culture, and defining new roles	(Ajayi & Udeh, 2024; Krimpmann, 2015)	Social
Cybersecurity & Resilience	Quantum-resistant crypto, real-time threat detection, and Digital Twins for testing	Rising cybercrime costs, quantum vulnerability, and the complexity of systems	(Chawla & Mehra, 2023; Kamruzzaman et al., 2022; Gejo-García et al., 2022)	Technical

For example, Generative AI can replicate situations and generate empathetic responses in customer conversations (Ferraro et al., 2024). This principle challenges the Industry4.0 flawed practice of pseudo-personalization based on segmentation. There is a need for shifting from selling a product to collectively realizing financial well-being. For regulators, this will raise different questions related to data ethics.

Inclusion and Equity

Underserved and rural communities, especially those historically excluded from financial systems, can achieve inclusion and equity through access to financial services (Ebirim & Odonkor, 2024). Financial institutions can drive economic empowerment, reduce inequality, and foster sustainable development. AIoT and Edge AI can bridge gaps for financial institutions. AIoT enables real-time data actions even in areas with limited infrastructure (Verma & Kumar, 2024). Edge AI minimises the use of consistent internet connectivity to remote systems (Singh and Gill, 2023). With the help of alternative data such as mobile usage habits and social media, AI models can determine creditworthiness of individuals with no credit history. The mobile platforms that AI and IoT facilitate allow transactions, savings, and payments, which is the Industry4.0 problem of Efficiency vs. Equity. Financial regulators must begin to focus on not just the accessibility, but instead rewarding inclusive systems, such as by through regulatory sandboxes of alternative data algorithm, or capital relief of banks that serve marginalized markets.

3.1.3. Strategic Implementation Stages

Vision and Alignment

The first step in the foundation of any digital transformation is to align the organization's digital finance objectives with the principles of Industry5.0 as defined by resilience, sustainability, and inclusion. A shared vision allows collaboration and ensures all stakeholders work towards the same objectives. Activities conducted at this stage include strategic visioning workshops and goal definition (Bellantuono et al., 2021). These workshops promote collaboration among leadership, technology, and financial management. Examining how Industry5.0 technologies will stimulate long-term value generation and organizational development is paramount during these sessions. The key novelty here is the definition of "value". In an Industry4.0 model, there is a vision based on ROI, or cost savings and efficiency. In this Industry5.0 framework, there is an explicit redefinition of value as multi-dimensional capital: financial, human, social, and natural. These phases also indicate the revolution of the accounting practice. The accounting systems are changing the fixed reporting systems into dynamic, connected systems that help make real-time decisions, increase internal controls, and automate the auditing process with the help of AI.

Technology Adoption

The second stage centers on utilizing the modern technologies encapsulating Industry5.0 for the digital finance sphere. Adopting advanced, emerging tools, like Edge AI, Mixed Reality (MR), and other technologies, to develop digital finance platforms will enhance and optimize systems and the capabilities of its users, while ensuring that the technologies align with the goals of desire and are opened up to the measurement of benefits.

For example, Edge AI enables financial institutions to perform advanced data processing much closer to the source of data, and therefore sees less latency and better ongoing real-time decision making (Santoso & Surya, 2024). When applied in digital finance, Edge AI can improve numerous processes, from monitoring

transactions to improving financial forecasting. Managers must consider how this technology increases human agency (for instance, does Edge AI increase local branches' capacity or surveillance?). This contrasts the question from "What can this technology do?" to "What should this technology do for our stakeholders?" For policymakers, regulatory sandboxes should allow for expedited approvals for technologies that score well on these assessments.

Workforce Enablement

Upskilling employees is fundamental to enabling and preparing them to work collaboratively with augmented technologies and systems (Krimpmann, 2015). Digital finance requires technical and analytical minds that can drive creative solutions. Utilizing mixed-reality-based training simulations allows financial institutions to embed various scenarios for multiple employees to see and understand how new technologies can shape and become integrated into workflows. Continuous learning programs must be established to contribute to an upskilling strategy that ensures employees can keep up with digital technologies (Okuku, 2024). Constant learning programs must integrate formal training with a workplace culture that embraces employee experimentation and innovation. The Industry5.0 reframing transitions workforce enablement from a cost center to building Collaborative Intelligence. There is a need for new roles, like "AI-Human Interaction Designer" or "Ethical AI Auditor". Managers should be radically increasing their investment in workforce enablement, focused on innovation metrics rather than compliance with learning.

Operational transformation

The operational transformation stage aims to reconfigure financial activities (Woerner et al., 2022) to fully exploit the Industry5.0 technologies. This typically occurs within a financial institution through automated manual tasks, improved data analytics capacity based on accurate data, and streamlining the process associated with new workflows to operate efficiently while lowering costs. Using RPA (Robotic Process Automation) and/or Generative AI can lead to less human involvement in the repetitiveness of a process. In contrast, human creativity can be redirected into the neocortex, where the collective intelligence can be leveraged to encompass a larger view (Lo et al., 2024). Operational transformation is purposely redesigned to coordinate, and not remove, human-machine collaboration. The KPI changes from "headcount reduced" to "value of human redeployment." For example, the value created when employees are freed up from data-entry tasks by RPA is reassigned to design customer onboarding experiences using Generative AI.

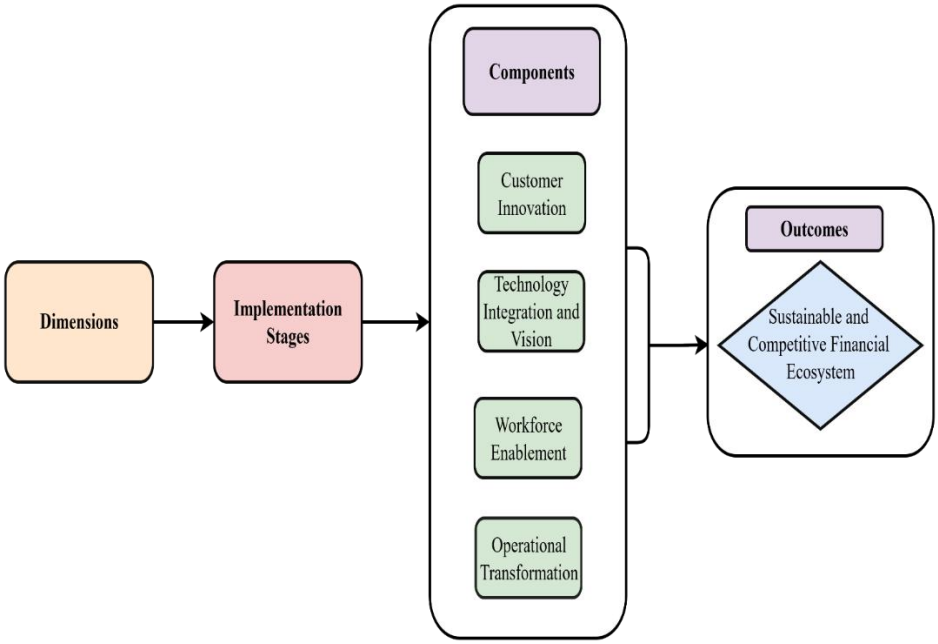
Customer-Centric Innovation

At this point, the emphasis has turned to creating more effective and inclusive solutions that improve customer experience (Ejjami & Rahim, 2024). Institutions can improve inclusivity and engagement by leveraging immersive technologies such as holography and generative AI. For example, Holographic technology can offer clients the opportunity for virtual consultations, which can be more interactive and engaging for discussing strategic financial planning, investments, and risk management. The hybrid consultation can address the challenge of accessibility and better engage customers who cannot attend a physical branch, like clients who can participate in person (Murinde et al., 2022). Generative AI will assist in market insights and the clients' unique preferences to identify personalized investment strategies based on their risk tolerance. This stage is now defined as Co-Creation and Financial Well-being. Generative AI does not simply provide a fixed plan but it interacts with the customer to model scenarios and co-create a plan. The implication is to develop new approaches to measure "co-creation value" and "improvement in financial health." Managers can foster product development cycles to integrate customer collaboration with Industry5.0.

Governance and Cybersecurity

As financial institutions use increasingly sophisticated technologies, implementing sound governance and cybersecurity processes is essential to ensure transparency, security, and regulatory compliance (Abrahams et al., 2024). Sound systems must be developed to ensure sufficient protection for the institution and provide trust for customers and regulators. Decentralized finance (DeFi) platforms continue to use blockchain technologies to offer secure peer-to-peer financial services without traditional banking infrastructure. However, quantum computing poses a potential shift in vulnerability for traditional encryption. Its computational power may render standard protocols obsolete. Financial institutions should approach implementing quantum-resilient cryptography to avoid potential loss of protection for financial data (Chawla & Mehra, 2023). Real-time detection and response can be used to improve cybersecurity with the help of AI. The AI-powered systems can scan data sets to point out otherwise unusual behavior, including unauthorized access or fraud transactions, so the institutions can swiftly counteract them (Kamruzzaman et al., 2022). Accompanied by blockchain, organisations will be able to develop security measures that build more sophisticated features.

Figure 3. Implementation Stages



Source: Developed by the authors with the assistance of eraser.io through prompt engineering, based on concepts and linkages identified from extant literature.
Note: The outputs generated by eraser.io were thoroughly reviewed, verified, and refined multiple times by the authors. The authors take full responsibility for the accuracy, interpretation, and final form of the conceptual framework presented in this study.

Even though these technologies offer important developments on high level of security, financial sector governance will be affected by ethical and compliance problems. Algorithms can be audited and carefully tested to be fair, explainable, empathetic, and not merely product-wise correct, thus, the policymakers can regard it as a regulatory process of Ethical Audits. To establish trust, investing in explainable AI (XAI) and open data practices can be a competitive edge to the managers.

Continuous Monitoring

The final stage is related to the analysis of the performance of the system and how the system may be adjusted. Edge-AI and Digital twins can be utilized by financial institutions to streamline operations, anticipate difficulties, and be responsive in a rapidly evolving digital environment. Predictive analytics helps identify performance patterns of the financial system and customer behaviors, allowing institutions to tackle potential problems proactively. Digital Twin technology creates a digital version of financial systems so institutions can test various scenarios and attributes of products and services (Gejo-García et al., 2022). Implementing Industry5.0 technologies in digital finance through stages mitigates technological hurdles and ensures holistic transformation involving people, processes, and systems. The last phase is Socio-Technical system learning. Continuous monitoring feedback using Digital Twins and Edge AI reports financial KPIs and models. Digital twins could simulate the commercialization phase for new micro-loan products and capture the impact on a community's economic resilience. Practitioners can accumulate a closed-loop system where institutions learn from and reset policies based on impacts on people and the planet. This implementation framework could be considered a new Theory of Change.

4. Theoretical Implications for Accounting

This research will be of value to accounting theory, as its basic conceptualization will be to transform the accounting system in the new environment of Industry 5.0 settings. The conventional accounting frameworks, based predominantly on the periodic reporting, historical cost, and uniform disclosure, are becoming less and less effective in the complexity, pace and interdependence of contemporary financial ecosystems (Ijiri, 1975). These traditional models have been created to cater to fairly stable and linear economies, yet modern digital environments are marked by flows of data, decentralized transactions and are decided by algorithms.

The paradigm change that Industry 5.0 will bring is an accounting system that is not retrospective and compliance-driven but a real-time, predictive, and stakeholder-oriented system (Vasarhelyi et al., 2015). According to this paradigm, accounting ceases to be a passive process of recording the previous actions, and it becomes the part of organizational intelligence and decision making process. Predictive valuation, simulation of scenarios and continuous tracking of financial and non-financial performance can be performed with the help of advanced technologies that are artificial intelligence, digital twins, and so on (Kokina and Davenport, 2017). At the same time, blockchain technology can strengthen the basic features of accounting information transparency, verifiability, and auditability by providing non-modifiable and

decentralized systems of record keeping (Dai and Vasarhelyi, 2017).

In addition to the technological augmentation, this research contributes to a theoretical change in its ability to redefine accounting as a socio-technical system. In this context, accounting is viewed as a process of interactivity where human judgment, ethical reasoning, as well as contextual understanding are combined with machine intelligence, data analytics, and automated processes. The view transcends the technical or mechanistic views of accounting and appreciates how social and technological factors co-evolve to influence the accounting practices and results. It additionally emphasizes the role of interpretability, trust, and human supervision in accounting based on AI world.

In addition, the framework proposed helps to encourage the shift to multi-capital accounting that extends the scope of the conventional financial reporting by bringing in the aspects of social, environmental, as well as human capital (Gray, 2010). This brings accounting to the wider scope of sustainability and stakeholder-focused goals, and it means the rise of the need of integrative reporting, value-generating efforts beyond financial measures.

In general, these changes expand and deepen the current theory of accounting with its demands of flexibility, immediate responsiveness, transparency, and anthropocentrism. They dispute the supremacy of strictly historical and rule-based accounting paradigms and forward-thinking, interdisciplinary, and dynamic theoretical base of financial reporting and assurance in the world of Industry 5.0.

4.1 Challenges and Opportunities in Implementation

Transforming digital finance—including payments, lending, cryptocurrencies, blockchain, FinTech, InsurTech, WealthTech, and RegTech—towards Industry5.0 offers both opportunities and challenges. Implementation of Edge AI, MR, Generative AI, AIoT, Quantum Computing, and CPS needs not only high-level technical capability, but also planning. When applied to payments and lending, the Edge AI reinforces real-time decision-making and fraud detection, but finding qualified talent, model building, and utilizing resource limits provide obstacles (Kamruzzaman et al., 2022). The hardware and software requirements of integrating MR into InsurTech and WealthTech are extensive, which can cause resource diversion of core operations. The IoRT brings even more complexity, and the volume of data, the needs of infrastructure, and privacy risks make it a highly important investment in management systems and cybersecurity (Kabir et al., 2024). Generative AI can be efficient in terms of customer engagement and content generation, whereas it creates significant ethical and legal risks, including biased results (Okonji et al., 2024). Quantum computing improves the scalability and cryptographic security of blockchain but is costly and time consuming to implement. Nevertheless, Industry5.0 offers unmatched opportunities of customized, anthropocentric customer experience. It will require the combination of technological skills and strategic human resource management to overcome difficulties. Regarding accounting, these issues are the need to make AI-powered systems auditable, dealing with bias in financial reporting by algorithms, and updating regulatory frameworks to comply with real-time and automated accounting methods.

5. Conclusion

The future of Industry4.0 to Industry5.0 is more than a simple technological evolution, it is a change of direction in terms of strategy and concept of how the future of digital finance is created. The techno-centric focus of Industry4.0 generated the contradictions of financial marginalization, invisibility, vulnerability, and poor socio-environmental fit, whereas Industry4.0 had focused on efficiency, automation, and scale. This review has presented a new paradigm of how Industry5.0, using its human-centricity, resilience, and sustainability concepts, can manage these tensions (Xu and Cho, 2025).

The research redefined digital finance as a socio-technical process that is operated by multi-capital goals and presented it using new KPIs of financial, human, and environmental outcomes. It changes the discourse of access to empowerment and shows avenues to inclusive-by-design products, which use decentralised technologies and alternative data to direct the underserved as the viable markets and not as charitable appendages. The structure restates the concept of risk as a socially constructed forward-thinking and introduces cooperative-intelligence as a framework that is combining the classifications of human judgment and AI-based analytics, and invests in Digital Twins to test the resiliency of the system against systemic shocks.

Regulatory implications and managerial implications are also discussed. Controllers also need to shift compliance-based regulations towards outcome-based regulation such as innovation sandboxes and ethical impact assessments to achieve fairness and stability. These principles are to be enshrined by the financial institutions in order to generate trust and relevancy in the long term. To academics and professionals, the study represents a catapult into new research on the topic of socio-technical synergies and their consequences on stability and inequality. The impact of the research on the accounting theory is suggested transition to the real-time transparent and human-centered accounting systems. It suggests the need to introduce new frameworks that will include AI, sustainability, and socio-technical interactions in the accounting practice. The digital finance can become an enabler of inclusive and sustainable societies by taking an Industry5.0 prism.

6. Research Propositions and Future Research Agenda

P1: Edge AI and Risk Detection

Application of Edge AI in digital lending will significantly decrease the level of fraud and decrease

the decision latency when compared to centralized AI systems.
Reason behind this idea: STS theory states that decentralized systems are more adaptive to local situations when based on real-time human governance. Edge AI will enable end-user processing to enable faster fraud detection and act on it with less reliance on the centralized systems. We could conduct comparative trials across a centralized and edge-lending platform in a fraud-prone market to validate this assertion.

P2: Generative AI and Personalization
Generative AI-based personalization for finance will result in better customer satisfaction and trust building among underserved demographic segments than rule-based recommendation engines.
Rationale: STS emphasizes that technology has to respect the values of humans and the social diversity of people. While generative AI creates contextualized content (e.g., financial plans or loan explanations in local vernacular) and promotes inclusivity, these themes cross-reference. We can test this theory with user experience (UX) studies measuring satisfaction and trust among demographic segments.

P3: Human-Centered Design and Market Engagement
Financial institutions implementing human-centered principles (for example, empathy, inclusiveness) will have greater engagement and retention in rural markets than a bank that only thinks about automation.

Rationale: STS- socio-contextual alignment defines technology adoption. Banks that include empathy (for example, culturally relevant interfaces in the technology or human support layers) are likelier to have enduring relations with clients with limited trust or access to technology. In pilot projects, retention metrics, repeat impressions, activity, and Net Promoter Scores could support these measurable outcomes.

P4: Mixed Reality and Financial Literacy
Mixed reality-based financial planning tools will have greater success in improving financial literacy and client engagement than traditional 2D interfaces.

Rationale: STS theory emphasizes active user engagement, positioning individuals as agents within the system. MR design supports experiential learning, particularly benefiting those with limited financial education. Researchers can assess learning retention, decision quality, and confidence compared to traditional interfaces. Future studies may test these ideas through experimental pilots or institutional case studies. Empirical validation of socio-technical linkages can refine and strengthen the conceptual framework, advancing a more inclusive and human-centered digital finance ecosystem.

P5: AI-driven Accounting Systems
AI-enabled accounting systems will improve the accuracy, timeliness, and transparency of financial reporting compared to traditional accounting methods.
Rationale: Within a socio-technical framework, AI can enhance accounting processes by reducing manual errors, enabling continuous data processing, and improving the reliability of financial information. This proposition can be tested through comparative studies of AI-enabled and traditional accounting systems.

P6: Real-time Reporting and Decision-Making
Real-time accounting systems will enhance managerial and stakeholder decision-making by providing continuous, up-to-date financial information.
Rationale: Industry 5.0 emphasizes real-time data integration and human-centric decision-making. Real-time accounting systems enable timely insights, improve transparency, and support proactive financial management. Empirical validation may involve analyzing decision outcomes under periodic versus real-time reporting environments.

Table 4. Proposition Core Relationship Methodology Outcome Metrics

Proposition	Core Relationship	Methodology	Outcome Metrics
P1: Edge AI & Risk	Edge AI → ↓ fraud & latency	A/B testing (centralized vs edge systems)	Fraud rate, decision time
P2: Gen AI & Personalization	Gen AI → ↑ satisfaction & trust	UX studies (controlled groups)	CSAT, trust scores
P3: Human-Centered Design	Empathy/inclusion → ↑ retention	Longitudinal pilot (control vs treatment)	Retention rate, NPS
P4: MR & Literacy	MR tools → ↑ literacy & engagement	Controlled trials (MR vs 2D)	Knowledge retention, confidence
P5: AI Accounting Systems	AI accounting → ↑ accuracy & transparency	Comparative study (AI vs traditional)	Error rate, timeliness, transparency
P6: Real-time Reporting	Real-time accounting → ↑ decision quality	Experimental/field study	Decision speed, accuracy, satisfaction

Future researchers could also develop comprehensive frameworks combining Industry5.0 technologies, such as Generative AI, Edge AI, and digital twins, with human-centric and sustainable practices. Focus should be on adaptable blueprints for financial ecosystems. Longitudinal research on the impact of Industry5.0 on digital finance, particularly in underserved and rural areas, is required. Research must identify techniques for ensuring safe and ethical governance of data privacy. Research should also investigate frameworks for balancing a regulatory environment while innovating and ways to implement transparency and accountability in AI-powered financial services. However, research should study challenges of Industry5.0 principles globally, and generating international collaboration. In conclusion, research is required on how Industry5.0 can help support financial institutions through global crises, including economic recessions, pandemics, or geopolitical instability.

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Annexure

Table A. Industrial revolution

Industry Era	Core Innovations	Characteristcis	Digital Finance implications
Industry1.0(late 18th century) (landes, 1969)	Mechanization through steam power and water	Machines in agriculture and manufacturing have replaced manual labor.	Emergence of formal banking to fund industrial capital; early stock markets
Industry2.0(late 19th century) (Chandler, 1990)	Mass production, assembly lines, and electricity	Expansion of consumer goods and mass labor	Rise of institutional banking, central banks, and early financial instruments
Industry3.0(late 20th century) (Brynjolfsson & McAfee 2014)	Automation, electronics, IT, and the early internet	Digitization of services, global trade expansion	Emergence of online banking, ATMs, SWIFT, and early e-commerce platforms
Industry4.0(early 21st century) (Schwab, 2017)	Cyber-physical systems, IoT, Big Data, AI	Real-time processing, automation, predictive analytics	Rise of digital finance: mobile payments, blockchain, digital lending, FinTech
Industry5.0 (emerging – 2020s) (Adedoyin & Dogan, 2025)	Human-AI collaboration, Edge AI, Mixed Reality, Quantum Computing, sustainability	Emphasis on ethics, resilience, personalization, and sustainability; shift from efficiency to empathy	Inclusive, adaptive finance; personalized services; AI-human synergy; real-time risk mitigation; ESG-aligned financial models

Table B. Key definitions

Authors	Key definitions
(Rada, 2018)	I5.0 is a human-driven revolution focused on upcycling waste through the 6R principles. This improves living standards, innovation, and high-quality products.

(Nahavandi, 2019)	The concept of I5.0 involves pairing human workers with factory machines to enhance process efficiency. This is achieved by integrating workflows with intelligent systems, allowing human creativity and brainpower utilization.
(Longo et al., 2020)	I5.0 is emerging, combining Cyber-Physical Production Systems (CPPS) and human intelligence for more efficient factories. Policymakers seek human-centered designs to address workforce shortages caused by I4.0.
(Chew & Ling, 2021)	I5.0 advances I4.0 by focusing on symmetrical innovation and global governance. It separates highly connected automation systems to create safe exits, improving safety and efficiency in manufacturing and production.
(Alves et al., 2023).	I5.0, where humans and cobots work together to create autonomous manufacturing through enterprise social networks. Cobots handle repetitive tasks, while humans focus on critical thinking and creativity.