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Reimagine CapTech and the future of capital markets

The dawn of a new era

June 2025

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Foreword by KPMG in India

Imagine a world where every decision in capital markets is powered by groundbreaking technology and data intelligence, a world where innovation and reliability seamlessly blend to drive sustainable economic progress. As innovative technology developments continue to drive transformative changes rapidly, it is essential to address the inherent risks of such transformation seamlessly. Robust self-governance, proactive risk management and technological advancements can be leveraged to turn risks into opportunities.

This report dares to explore that world, charting the bold evolution of CapTech and inviting readers to join a transformative journey. It begins by tracing the dynamic evolution of market structures, from the gradual adoption of early technological innovations to today's radical breakthroughs. By examining global trends and modern regulatory guidelines, the report reveals how integrating diverse stakeholders into a unified ecosystem is not just beneficial but essential for sustainable growth and inclusivity.

The analysis delves deep into the transformative power of technology and data. As the backbone of this revolution, information technology redefines market infrastructure, while an explosion of data fuels the rise of AI-powered intelligence. The report highlights that artificial intelligence, especially generative AI, serves as the key catalyst reshaping every aspect of market operations. It showcases how these tools drive unparalleled efficiencies across the value chain and empower the '*Aatmanirbhar*' investor by providing easy access to trusted and personalised insights that enable informed decision-making.

Turning to the Indian capital markets, the report offers an insightful exploration of digital transformation. It presents practical examples illustrating how emerging technologies enable market participants to innovate, manage risk, and build resilience. These stories offer practical insights into carving out new avenues for value creation in an increasingly complex landscape, where technology is not just an enabler but a critical investment towards market leadership.

Finally, this report provides strategic recommendations for various stakeholders, from regulators and government bodies to market infrastructure institutions, intermediaries and self-reliant investors. The recommendations aim to foster operational excellence, bolster security, and create an environment in which technological innovation can flourish without compromising market integrity.

This report is a call to action in an era marked by rapid digital transformation. It invites readers to immerse themselves in its insights and discover strategies that enable to navigate and shape the future of capital markets with confidence and foresight. Whether one is a policymaker, industry professional, or investor, the perspectives and recommendations within these pages are intended to equip readers with the tools needed to thrive in this brave new world.

Akhilesh Tuteja
Global Cyber Security Leader
KPMG

Foreword by CDSL

Last year, CDSL completed 25 years of its service to the Indian capital markets. As we reflect on these 25 years of growth, we are inspired to look ahead and envision our future as we transition from #SilverToCentury. Our journey towards sustainable growth is guided by the rich history and timeless teachings of our holy scriptures and epics, such as the Ramayana, Mahabharata, Quran, Bhagavad Gita, Guru Granth Sahib, the Bible, and other revered books. These texts and stories emphasise the values of trust and integrity, which are fundamental to our mission.

Drawing inspiration from the Ramayana, the story of Lord Hanuman offers a compelling metaphor for emerging technologies like AI and quantum computing — combining immense power with wisdom and restraint. Just as Lord Hanuman used his strength in service of a greater cause, our technological advances must be guided by **ethics, integrity, and humility**, all in pursuit of the public good.

Therefore, as market enablers, it becomes our fiduciary duty to foster these values of trust, transparency, and integrity within the capital markets ecosystem. Last year, our inaugural CDSL Annual Symposium focused on safeguarding digital trust. This year, we aimed to sustain and deepen that trust with the theme '**Reimagine CapTech & the Future of Capital Markets**'.

The capital markets have evolved significantly with advancements like paperless trading, automatic settlements, and the rise of demat accounts. While the market evolves further, building and sustaining investor trust is paramount as we plan a future that champions *Aatmanirbharta* (self-reliance) while safeguarding users from potential risks.

While AI stands for Artificial Intelligence in our tech-driven world, the acronym can be tailored to outline the principles of the CapTech ecosystem as well. The principles of **Automate, Augment, and Accelerate (3As)** alongside **Intent, Integrity, and Innovation (3Is)** form the foundational pillars of CapTech.

CapTech must leverage emerging tech to automate seamless integration of data & streamline processes, reduce manual intervention, and enhance efficiency; building on services like the eDIS, Margin Pledge & Repledge, T+0 settlements, and more. The Indian capital markets have yet to reach their full potential, with significant scope for increased investor participation, currently reflected in over 190 million demat accounts and counting. To realise this vision, the use of advanced tools and technologies should be augmented to strengthen capabilities, expand market reach, and improve service delivery. Furthermore, the industry must prioritise accelerating operational efficiencies and minimising pitfalls within the capital markets.

These 3As are complemented by the 3Is: Intent, which emphasises a clear and purposeful direction towards public good; Integrity, which underscores the importance of ethical conduct and transparency; and Innovation, which drives continuous improvement and adaptation to emerging trends and will ultimately revolutionise the CapTech ecosystem. Together, the 3As and 3Is create a robust framework for fostering sustainable growth, trust, and excellence within the capital markets ecosystem.

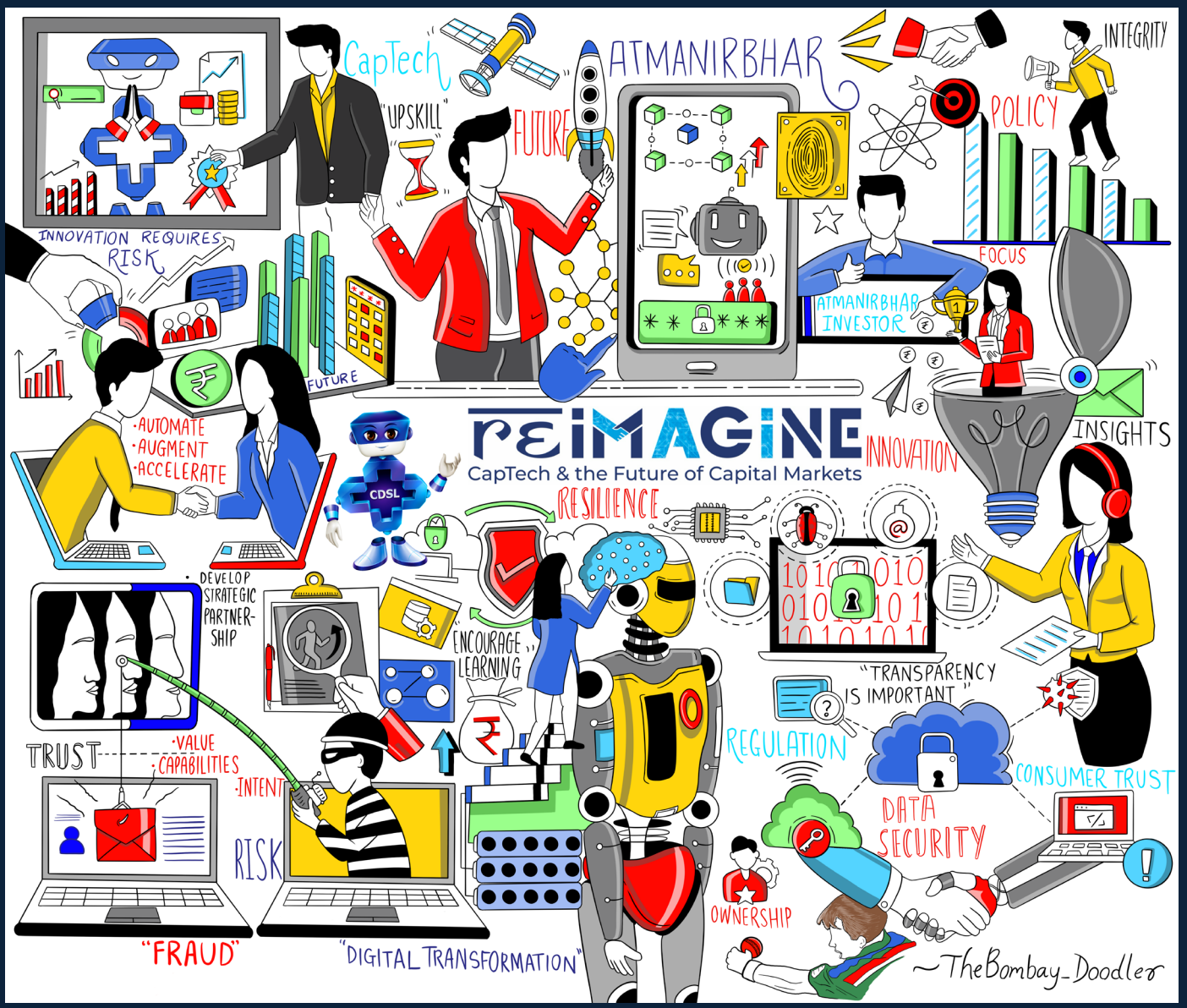
Our financial ecosystem, **attuning to its new identity as CapTech**, aims to empower the ultimate AI—the ***Aatmanirbhar* Investor**. This report explores key enablers of the vision, providing actionable recommendations for institutions, governments, and investors to initiate a meaningful discourse in the industry. It aims to addresses potential risks and strategies to reimagine those risks as opportunities.

As scientist and the former President of India, Dr. A.P.J. Abdul Kalam once said, "Building capacity dissolves differences. It irons out inequalities." Let this day be a reminder of the exciting possibilities that lie ahead. Together, we can democratise the capital markets and ensure that our tricolour continues to fly high.

Let's boldly reimagine the CapTech ecosystem together.

Jai Hind!

Nehal Vora
Managing Director & Chief Executive Officer, CDSL



An artist's interpretation of CDSL's annual symposium on "Reimagine CapTech & the Future of Capital Markets" held on 8 February 2025, in Mumbai, India

Executive Summary

Artificial intelligence and quantum computing, among other emerging technologies, have already begun transforming various sectors, and capital markets have been the vanguard of this change in India. These technologies are being utilised to reinforce digital trust, for risk analysis, faster settlements, streamlined IPO processing, algorithmic trading, personalised financial advice, improving decision marking, and transforming the business models of the industry, among other product and operational efficiencies.

State of the Indian capital markets

Indian capital market saw the highest ever market cap in September 2024[1], making it the fourth largest market globally. This growth is evident through the volumes and value of trades executed seamlessly. **In January 2025, both the primary depositories settled equity volumes of 38.98 billion and values worth INR9.94 trillion[2]**. The shift from T+2 to T+1 settlements, and successful beta implementation of the T+0 settlements for select securities, ahead of some of the largest economies, showcases India's agility and commitment to innovation and cutting-edge upgrades. Electronic Know Your Customer service (eKYC) and electronic account opening (eAccount opening) became game changers that fast-tracked opening of demat accounts during COVID-19. The scale of these transactions, therefore, demonstrates the significant disruption and successful adoption of these advancements.

The dividend for these forward choices has begun encashing results, with an inflection point around the pandemic when markets and the number of demat accounts both soared to new highs. The number of demat accounts stood at around 18.7 million in 2010, rising to 49.8 million in 2020[3]. As of March 2025, the same number stood at **192.4 million[4]**.

Identity and vision of CapTech: AI for AI

To sustain the growth witnessed during the early years of dematerialisation, and to uphold the ethos set forth by our country's leaders and regulators; the depositories and other MIIs must build on top of these substantial market reforms. **CapTech, defined as the tech-enabled and tech-powered capital markets**, will now have to prepare for the next phase of evolution and growth. Market players are poised to reimagine two pivotal dimensions of the future: How to **harness CapTech to empower the investors**, and how to **deepen market potential** by collaborating with and enabling market participants to drive innovation and sustainable growth.

For either of these, it is crucial to ensure skillful adoption of the fundamental models of these emerging technologies into meaningful real-world applications. This report delves into the identity of CapTech, opportunities for the Indian capital market, and the challenges hindering the adoption of these technologies.It encapsulates recommendations and collaborative opportunities for the four most important stakeholders of the CapTech markets – regulators, MIIs, intermediaries, and the ultimate benefactor, the investor.

As depicted above, the CapTech ecosystem must **Automate, Augment, and Accelerate** with the right **Intent and Integrity to Innovate** for the capital markets. The intersection of the 3As and the 3Is inspire and represent the most important A.I. – the rise of the ***Aatmanirbhar* (self-reliant) Investor**. The two biggest enablers for realising this vision are the right talent (niche and upskilled) and the market's agile mindset to adopt at lightning speeds.

Seizing opportunities and reimagining challenges

India has increased its focus on developing its own AI labs, foundational models, and quantum computing resources. However, the industry and the academia need to collaborate to increase our foothold in research and development of these emerging technologies.

1 Comeback trail: India retraces path to $5 trillion market capitalisation, Business Standard, April 2025, accessed April 2025
2 Internal CDSL data
3 Demat tally surges to 185 million in 2024 with 46 million new additions, Business Standard, January 2025, accessed April 2025
4 Highest-ever 192.4 mn demat accounts opened in FY25, brokerages add 41.1 mn, Business Standard, April 2025, accessed April 2025

According to a UN report[5] from July 2024, India filed for 1,350 patents in the field of Gen AI from 2014 to 2023, compared to 38,210 patents filed by the lead nation (~3 per cent). The report recommends a higher focus on research and development along with real-time tech applications for the capital market.

India's securities regulator, the Securities and Exchange Board of India (SEBI), has been at the forefront of innovating and implementing new technologies for a more seamless and secure capital market. One of SEBI's latest wins include protecting the investors from 70,000 fraud investment handles and deceptive posts within six months since October 2024 through the use of technology[6].

The report highlights some of the most successful market experiments, including the convergence of **AI with the regulator's vision to simplify IPO processing, the rise of Supervisory and Regulatory Technology (SupTech and RegTech), and increased operational efficiency experiments**. Some key examples are detailed in the report.

Emerging Tech for democratisation of the capital markets

While there are barriers to overcome and risks to avoid, the effort is worth it because the benefits are real – and because the benefits will accelerate over the coming years. As CapTech evolves and democratises markets for all, it will transform the industry and foster an equitable growth by welcoming new market participants such as fintech startups, tech providers, and retail investors, also enhancing collaboration amongst institutions. This integration symbolises a core shift powered by the democratisation of financial tools, improved information access, and the rise of collaborative ecosystems.

By fostering innovation, enhancing transparency, and promoting financial assimilation, the advancements in India's capital markets are shaping a future that is more dynamic, resilient, and inclusive, setting an example for the world. The recommendations in this report aim to empower all stakeholders, including regulators, MIIs, intermediaries, and investors, to harness these advancements and pave the way for a robust financial ecosystem aligned to the vision of 'Viksit Bharat @2047', ultimately giving way to a truly ***Aatmanirbhar*** **Investor** in India.

5 China-based inventors lead on global GenAI patents: UN report, United Nations, July 2024, accessed April 2025
6 SEBI Removed 70,000 Fraud Investment Handles and Deceptive Posts since October: Ananth Narayan, MoneyLife, March 2025, accessed April 2025

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Chapter 1:

Introduction and overview of CapTech

The world of capital markets is undergoing an unprecedented transformation, driven by the rapid adoption of emerging technologies that are fundamentally redefining how the capital markets i.e. regulators, MIIs, intermediaries and investors operate and interact. **This fusion of technology and capital markets referred to in this document as CapTech** (Capital Market Technology), encompasses the application of advanced tools like artificial intelligence (AI), quantum computing, blockchain, cloud computing, high-speed network, and edge computing to enhance decision-making, improve efficiency, and create new opportunities for innovation. These technologies, whether deployed independently or in combination, open the doors to groundbreaking business innovations, such as personalised investment strategies, autonomous trading, and quantum-secure financial transactions. However, they also introduce significant risks, including cybersecurity threats, systemic vulnerabilities, and ethical concerns.

These risks have prompted regulators and policymakers worldwide to step in, establishing guardrails for responsible use of these technologies while safeguarding market stability. At the same time, the evolving landscape has created fertile ground for new players, from technology firms to decentralised platforms, to capitalise on these advancements. By seizing these opportunities, these stakeholders are reshaping the competitive dynamics of capital markets, making them more inclusive, innovative, and resilient. This interplay between innovation, risk management, and the integration of new market participants forms the foundation of CapTech's transformative journey, setting the stage for the profound shifts explored in this chapter.

1.1 Progressive chronicles: Evolution of CapTech in India

The journey of CapTech in India is one of continuous improvements, marked by key technological milestones that have reshaped the financial ecosystem. From early digitisation efforts to today's cutting-edge innovations like Gen AI enabled products and state-of-the-art Digital Public Infrastructure (DPI), India's CapTech evolution reflects a broader trend of convergence between technology and financial services.

1990 - 2000 Early stages: Digitisation and automation

In the 1990s and early 2000s, the first wave of CapTech innovation focused on digitisation and process automation. The shift from physical trading floors to digital systems such as electronic trading platforms, and centralised clearing systems streamlined traditional market operations. These platforms significantly improved efficiency, reduced transaction costs, and increased accessibility for investors by allowing depository participants and brokers from remote locations to participate, thereby laying the foundation for modern capital markets.

One of the most transformative impacts of this shift was the reduction in settlement time. Previously, trade settlements took several days due to manual processes and fragmented systems. With the advent of centralised clearing and automated reconciliation, settlement cycles were shortened, reducing counterparty risk and enhancing liquidity.

The introduction of electronic trading, along with the establishment of dematerialised (Demat) accounts by depositories such as CDSL, transformed the traditional markets, making them more affordable and accessible to retail investors. Before this transformation, investors had to contend with physical share certificates, which resulted in high brokerage fees, stamp duties, and manual processing delays. Rapid digitisation efforts, combined with the early adoption of automated regulatory processes, ensured better governance and transparency across market activities, ultimately leading to an explosion of retail participation.

2000-2010

The rise of data-driven decision making

The 2000s marked a turning point with the proliferation of data and analytics. Financial institutions began to harness data for real-time decision-making, risk management, and predictive analytics. Platforms that combined data with intelligent automation, enabled institutions to offer tailored solutions to clients, optimise portfolios, and detect market anomalies. This was also the era of algorithmic trading and robo-advisors, which laid the foundation for democratisa.tion of investment opportunities for retail investors while improving operational efficiency.

Regulatory bodies, such as SEBI, played a key role by leveraging data analytics to enhance market surveillance and detect irregular trading patterns. Technology enabled supervisory capabilities were integrated into the system to monitor capital markets. These developments set the stage for the rise of intelligent tools that drive real-time oversight and decision-making in financial markets.

18.7 million demat accounts by the end of 2010*

2010-2020

The era of advanced automation and artificial intelligence

49.8 million demat accounts by the end of 2020*

The 2010s to early 2020s ushered in a wave of disruptive technologies that redefined the CapTech landscape. During this period, CapTech in India witnessed a unique blend of innovation, regulatory foresight, and technological adoption. Initiatives like Digital India in 2015, accelerated the integration of advanced technologies into financial markets, ensuring that even underserved regions benefit from cutting-edge solutions. AI-powered tools began to revolutionise processes across the financial ecosystem, from fraud detection and compliance monitoring to personalised client experiences. Novel innovations now enabled automated reporting, anomaly detection, and market predictions, significantly improving operational agility and decision-making accuracy.

Policy-driven reductions in Securities Transaction Tax (STT) through the 2013 Union Budget, along with the phased intraday margin reforms starting in 2020, significantly lowered transaction costs in Indian capital markets. The introduction of the Segregated Nominee Account (SNA) structure within the IFSC at GIFT City in 2018, enabled foreign investors to route orders through registered intermediaries with client-level compliance thereby improving market access under a robust regulatory framework. This further strengthened India's position as an attractive investment destination.

Regulators also started adopting advanced AI to enhance surveillance and fraud detection systems. For instance, SEBI's data lake project promoted the use of AI and machine learning (ML) to analyse market patterns, detect irregularities, and improve oversight[7].

2020 and beyond

The new frontier of revolutionary CapTech innovations

From 2020 onward, the CapTech market is being reshaped by innovations such as generative AI, edge computing and quantum computing. These breakthroughs are fundamentally altering market operations, enabling institutions, intermediaries, and investors to make more dynamic and informed decisions.

SEBI is also taking a proactive stance to ensure that Indian markets are well-positioned to embrace these transformative changes by implementing forward-looking measures to enhance market integrity while mitigating associated security risks.

185.3 million demat accounts by the end of 2024, a rise of 46 million new accounts since 2023*

*Reference 3 on page 5

7 Sebi invites bids to create 'data lake' with analytical capabilities, The Indian EXPRESS, June 2020, accessed April 2025

Its initiatives focus on improving infrastructure efficiency, monitoring systemic risks, and adopting quantum-resistant systems. A notable development is the introduction of an optional T+0 settlement cycle, which enables faster access to funds and lower margin.

Additionally, regulatory efforts have spurred the emergence of discount brokerage firms with minimal fees, further accelerating retail participation. The regulator's advanced capabilities to track FinFluencers and detect potential insider trading through AI-driven surveillance are protecting investor interests and maintaining market trust.

Looking ahead, the future of CapTech is set to be defined by technologies such as blockchain-powered institutional decentralised finance (DeFi), and quantum-secure encryption.

The rise of AI-driven trading, real-time settlements, and blockchain-based clearing mechanisms, coupled with faster, low-latency networks, will likely drive transaction costs toward near-zero levels, thereby unlocking even greater retail participation.

Globally, financial institutions are exploring these innovations to create more efficient, transparent, and inclusive systems. In India, the focus remains on expanding access to advanced financial tools to investors from even semi-urban and rural areas, by leveraging DPI and strengthening regulatory frameworks for safer adoption. These developments not only align with the broader vision of 'Viksit Bharat @2047', aiming for a developed, innovative nation, but also empower the *Aatmanirbhar* investor by creating a self-reliant, technologically advanced capital market ecosystem.

1.2 The changing landscape: Global trends and modern guidelines in capital markets

CapTech propels the evolution of capital markets by integrating advanced technologies that reimagine the financial landscape and transcend traditional market principles. This shift marks a move from modest enhancements to transformative innovation, opening new pathways for market operations and stakeholder engagement.

Historically, financial markets relied on manual trading, centralised decision-making, and siloed operations. Today, CapTech dismantles these legacies by enabling faster, smarter, and interconnected systems. Technologies such as generative AI, agentic AI, and edge computing are already addressing inefficiencies, optimising resource allocation, and facilitating personalised services at an unprecedented scale, while emerging quantum computing solutions promise to harness unparalleled computation power.

Collaboration with global players is now a key driver in this transformation. By aligning with international standards and leveraging cross-border innovations, Indian capital markets are not only integrating best practices but are also inspiring new business models that evolve into broad market themes.

These collaborative efforts are accelerating innovation, sparking novel market strategies, and creating a dynamic environment where technology-enabled solutions redefine industry norms.

> Trust, not money, is the true currency of the capital markets.
>
> **Mr. Nehal Vora**
> Managing Director & Chief Executive Officer, CDSL

Sowing the seeds of novel business innovations

Each CapTech advancement acts as a seed for transformative business innovation, such as:

Generative AI

introduces automation in financial reporting, investment research, and fraud detection. By generating synthetic data, it supports robust financial modeling while protecting data privacy. These capabilities empower firms to enhance decision-making and deliver tailored insights to clients.

Agentic AI

enables autonomous systems like smart advisors and self-adjusting portfolios that adapt to real-time market changes. These innovations provide personalised financial strategies and democratise access to sophisticated investment tools.

Edge computing

for AI enhances real-time market analytics and trading capabilities through localised data processing. Its low-latency networks ensure instant decision-making and empower underserved regions and individual investors with broader access to financial tools.

Quantum computing

facilitates advanced portfolio optimisation, market simulations, and quantum-secure encryption, ensuring not only enhanced financial performance but also fortified security frameworks for sensitive data.

These developments are not isolated, they influence one another, fostering interconnected systems that create efficiencies across the value chain. The convergence of complementary technologies generates exponential value, amplifying their individual capabilities.

For example, quantum computing's optimisation capabilities complement generative AI's ability to analyse vast datasets, together improving the precision of investment strategies.

As we reimagine CapTech and the future of capital markets, the foundation of innovation must be built on robust security. With AI-driven advancements in intrusion detection and cybersecurity, we can ensure that the next generation of capital markets remains resilient, trustworthy, and secure in the face of evolving threats.

Mr. Shravan B.K.
Chief Information Security Officer,
Zerodha

Blossoming into overarching market themes

Over time, these technological seeds give rise to broader market themes that are shaping the future of capital markets. Key themes include:

Personalised finance

AI-driven insights enable tailored investment strategies that cater to individual investor profiles, enhancing customer engagement and satisfaction.

Operational efficiency

Technologies like edge computing enhance process efficiency with minimal human oversight, thereby reducing operational costs and errors.

Resilient systems

Quantum computing and AI bolster market infrastructure, creating more secure and adaptive financial systems that can withstand disruptions.

Democratised finance

The accessibility of advanced financial tools levels the playing field for retail investors and expands market participation across underserved regions.

Evolving regulatory and statutory guardrails

While CapTech innovations are driving unprecedented opportunities, they are also reshaping the nature of risk and reward. Autonomous systems powered by AI reduce human error, but they also introduce algorithmic risks and ethical concerns. Similarly, while quantum cryptography shows the potential to secure financial data against cyber threats, it raises the stakes for cybersecurity as new vulnerabilities emerge. These dualities underline the need for businesses to not only embrace innovation but also develop robust frameworks to manage associated risks that challenge the stability and security of capital markets.

As a result, regulatory bodies and governments across the globe are stepping in to establish robust frameworks and guardrails to ensure the responsible adoption of these technologies. These are critical in balancing the promise of innovation with the need for accountability, fairness, and resilience within the financial ecosystem.

Regulating AI and automation: Artificial intelligence, particularly generative and agentic AI, ushers immense potential in automating processes and personalising financial services. However, these technologies also pose challenges, such as algorithmic bias, lack of transparency, and ethical concerns. Governments and regulators are responding with policies like the **EU's AI Act,** which focuses on ensuring that high-risk AI applications are explainable, fair, and secure. Similarly, in India, **SEBI has introduced regulations for algorithmic trading, requiring brokers to get exchange approval for each algorithm, implement unique identifiers for audit trails, and ensure proper risk controls**[8]. These measures aim to prevent market manipulation, enhance transparency, and protect retail investors from the unintended consequences of AI-driven trading strategies.

Preparing for quantum computing risks: Quantum computing promises advanced portfolio optimisation and quantum-secure encryption, but it also poses existential threats to traditional cryptographic systems. To address this, organisations like the National Institute of Standards and Technology (NIST) are spearheading the development of quantum-resistant cryptographic standards. Likewise, **SEBI's Cyber Security and Cyber Resilience Framework (CSCRF) emphasises the need for market participants to prepare for post-quantum security threats.** SEBI has urged financial institutions to assess their cryptographic resilience and transition toward quantum-safe encryption to safeguard sensitive financial data against future cyber risks. These efforts aim to protect critical financial infrastructure, ensure data confidentiality, and maintain market integrity as quantum computing becomes more mainstream.

Guardrails for edge computing and decentralised systems: The rise of edge computing introduces new security and privacy challenges due to the distributed nature of data processing. As cyber threats evolve, concerns such as OTP theft and credential-based attacks highlight the need for stronger authentication mechanisms. Regulators are advocating for standards that not only secure edge devices but also promote passwordless authentication solutions, such as biometrics and cryptographic keys, to mitigate risks and enhance compliance with data protection laws.

On the other hand, innovations leveraging decentralised systems/platforms like Web3, tokenisation and more particularly crypto are under scrutiny from bodies like the Financial Stability Board (FSB) to establish clear operational guidelines that protect consumers while fostering innovation[9]. SEBI has also cautioned investors against engaging with unauthorised electronic platforms that facilitate trading in unlisted securities of public companies. Such platforms often operate without proper authorisation, posing significant risks to investors. **SEBI emphasises that only recognised stock exchanges are authorised to provide platforms for fundraising and trading in securities**[10].

Global collaboration for uniform standards: Recognising the global nature of CapTech innovations, international collaboration is gaining traction. **Organisations such as the World Economic Forum (WEF) and the Financial Action Task Force (FATF) are advocating for harmonised regulations to ensure a level playing field and mitigate systemic risks.** For instance, the FATF's guidance on cryptocurrency and virtual assets aims to prevent money laundering and illicit activities without stifling technological advancements.

Fostering innovation through compliance: Interestingly, **regulatory frameworks can be perceived as restrictive constraints, but in reality, they are enabling.** By defining clear standards and expectations, they create a fertile market for technology providers to design solutions that help businesses meet and even exceed compliance requirements. Regulatory requirements have spurred demand for AI explainability platforms delivering transparent, auditable decision making and for post quantum cryptographic solutions designed to withstand quantum supremacy. In this way, modern regulations serve both as guardrails and as catalysts driving responsible innovation and sustainable growth across capital markets.

8 Safer participation of retail investors in Algorithmic trading, Securities and Exchange Board of India (SEBI), February 2025, accessed March 2025

9 High-level Recommendations for the Regulation, Supervision and Oversight of Global Stablecoin Arrangements: Final report, Financial Stability Board, July 2023, accessed March 2025

10 India's market regulator warns against trading in unlisted securities via unauthorised platforms, Reuters, December 2024, accessed March 2025

Regulators and Fintech players are leveraging these advancements in CapTech to build modern SupTech (Supervisory Technology) and RegTech (Regulatory Technology) tools empowering regulators as well as market participants to effectively monitor compliance, enhance risk management, and ensure adherence to evolving policies. These technologies are enabling real-time oversight, automated reporting, and streamlined regulatory processes, fostering a more agile and accountable financial system.

> The recent strides in frontier technologies – including in AI, Quantum computing, robotics and energy – could be the harbinger of a new paradigm in the global economy. The nature and character of capital markets will not remain immune to these deep changes. Our capital markets ecosystem has the opportunity to shape and create the future and show the way to the world, and our MIIs have a key role to play in this journey.
>
> **Mr. Ananth Narayan**
> Whole Time Member, SEBI

1.3 Integrating new stakeholders in the persistent base

The evolution of CapTech has redefined financial markets by expanding the range of participants. Today, the ecosystem includes agile fintech startups, innovative technology providers, empowered retail investors, and strategic institutional partners, all working together to reshape market dynamics. This shift is a deliberate move toward democratising finance, as easier access to advanced financial tools, real-time data, and collaborative platforms allows new stakeholders to actively influence capital markets and drive a more inclusive financial landscape.

The democratisation of finance

CapTech innovations such as generative AI, robo-advisors, and AI-driven portfolio management, have dramatically lowered entry barriers for retail investors. Personalised investment strategies, real-time financial guidance, and automated portfolio adjustments empower individuals to participate actively in markets. **For instance, several online trading platforms now enable individuals to invest and manage portfolios directly, eliminating the need for traditional intermediaries.** This trend reflects technology's role in bridging expertise and accessibility gaps.

Fintech startups and evolving business models

The rise of fintech startups and technology providers has been instrumental in reshaping the financial ecosystem. By leveraging AI, edge computing, and related technologies, these startups are introducing disruptive business models that improve operational efficiency and broaden inclusivity. **Some startups are pioneering digital payment solutions that simplify transactions, while others are offering innovative credit products for retail and SME segments, including microcredit facilities.** Additionally, lending platforms now use machine learning models to analyse nontraditional data like transaction patterns, utility payments, and social media signals to provide more nuanced credit assessments. This collaboration between fintech firms and established financial players is creating a dynamic ecosystem where innovation drives new market themes and business strategies.

Increased institutional participation and collaboration

Advancements in AI, and edge computing have also encouraged greater institutional participation. Real-world use cases include **major banks using AI-powered risk assessment tools to monitor portfolio exposures in real time, while insurance companies deploy edge computing for rapid claims processing and fraud detection. Additionally, leading asset management firms have integrated AI-driven analytics into their trading strategies to optimise asset allocation and improve performance during volatile market conditions.** These developments illustrate how traditional institutions are evolving and collaborating with new market entrants to enhance operational efficiency and client service.

Building a unique CapTech landscape for India

India's financial markets reflect a distinctive blend of technological innovation, regulatory foresight, and a focus on inclusivity. Regulatory frameworks have created an environment where fintech startups and new market participants thrive while ensuring market integrity and stability. **Initiatives such as Aadhaar, UPI, the Account Aggregator framework etc. have played a crucial role in improving data accessibility and enabling financial inclusion**. These innovations empower individuals and businesses with personalised financial solutions while enhancing overall market transparency.

Regulatory bodies in India, particularly SEBI, have taken proactive steps to integrate new stakeholders while maintaining market stability.

The regulator has introduced a regulatory sandbox framework that enables fintech startups to test innovative solutions in a controlled environment, while also issuing comprehensive guidelines for algorithmic trading and robo-advisory services. Their approach ensures that the inclusion of new participants, including fintech startups and technology providers, operates within a robust framework that promotes transparency, accountability, and security.

Opportunities and challenges of stakeholder integration

The inclusion of new stakeholders presents both opportunities and challenges for CapTech. On one hand, it fosters innovation, broadens access, and enhances market efficiency. On the other hand, it introduces complexities such as heightened cybersecurity risks, regulatory compliance requirements, and the need for robust privacy measures.

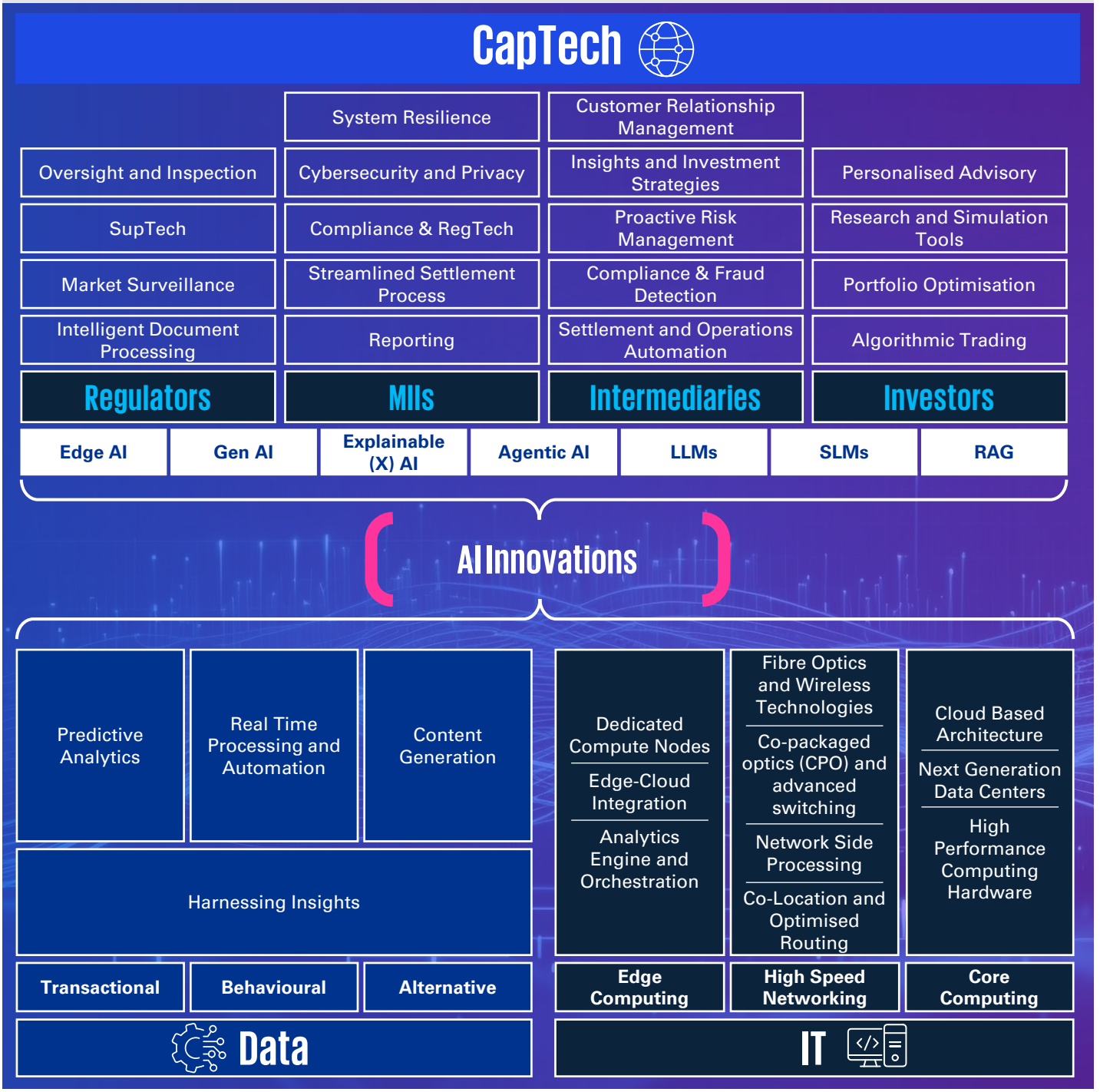
As CapTech evolves, the interplay between innovative technologies, robust regulations, and diverse market participants will define the future of financial markets. By embracing this dynamic environment, CapTech is paving the way for a financial system that is not only more accessible and transparent but also future-ready and resilient.

> We stand on the brink of a transformative era in capital markets, driven by the innovative force of CapTech. As we reimagine the future, the integration of Artificial Intelligence is pivotal—AI enhances decision-making while democratising access to financial insights, fostering a more inclusive and resilient market ecosystem. We must harness these technologies to build a future where every investor is equipped to thrive in an ever-evolving financial landscape.
>
> **Mr. Dhiraj Relli**
> Managing Director & Chief Executive Officer, HDFC Securities

Chapter 2:

Technology and data: Building blocks for AI innovation

The evolution of capital markets is fundamentally driven by technology and data, which serve as the foundational elements powering AI innovation. Technology provides the necessary infrastructure for scalability, speed, and connectivity, while data, in its diverse and voluminous forms, fuels intelligent decision-making. Leveraging these building blocks, artificial intelligence (AI) acts as a catalyst to revolutionise capital markets, and together, these forces are redefining financial ecosystems, democratising access, and driving efficiency. However, the rapid pace of change also introduces risks that, when managed effectively, can further strengthen market resilience.



2.1 Information technology: The foundation of market transformation

Capital markets today operate in an environment where every millisecond counts, and the ability to process, analyse, and act on data in real time is essential. Modern IT infrastructure is not just a support system, it is the critical enabler that allows AI to function at an unprecedented scale. State-of-the-art data centers, advanced networking technologies, and agile cloud-based architectures provide the core computational power, ultra-low latency, and seamless connectivity required for real-time analytics, risk management, compliance, and beyond. This robust IT backbone empowers AI systems to analyse vast streams of market data almost instantaneously, uncover valuable insights, and drive decisions that enhance operational efficiency and competitive advantage.

The subsequent sections explore how IT empowers AI in capital markets from three distinct perspectives: core computational power, high-speed networking, and advanced edge computing, and illustrate how these layers work together to create a unified, resilient foundation.

> Technology has always changed lives, and AI is no exception. Its true value lies in how responsibly and effectively we harness it.
>
> **Prof. Varsha Apte**
> Public Interest Director, CDSL

Core computational power: Scalability through cloud and data center modernisation

Modern capital markets require infrastructure that can dynamically scale to meet increasing data volumes and computational demands. Key elements of this infrastructure include:

- **Cloud-based architectures with virtualisation and orchestration:** Leveraging both public and private cloud platforms enables dynamic allocation of computing resources. Virtualisation abstracts the underlying hardware to create flexible, scalable virtual machines, while orchestration tools automate the provisioning and management of these resources. This combination supports large-scale AI model training and real-time inference, integrating diverse market data streams to produce deeper, actionable insights.
- **Next-generation data centers:** Modern data centers are engineered with high-density, energy-efficient servers, robust cooling systems, and optimised layouts to handle continuous, high-performance AI workloads. These facilities use dynamic infrastructure management to rapidly scale processing power, ensuring consistent performance during peak market activity and supporting critical applications.
- **Specialised high-performance computing hardware:** Dedicated accelerators, such as GPUs, FPGAs, and custom ASICs, play a vital role in reducing processing times for complex AI algorithms. These specialised components, integrated within both cloud environments and on-premises systems, enable the rapid execution of computations necessary for real-time analytics, and automated decision-making.

High-speed networking: Ultra-low latency and robust connectivity

Speed is critical in capital markets, where even microsecond delays can result in significant financial losses. Advances in networking technology ensure that critical data is transmitted with minimal latency:

- **High-speed fiber optics and wireless technologies:** Cutting-edge fiber optic networks, combined with emerging wireless transmission technologies, provide the ultra-low latency necessary for high-frequency trading. These networks are optimised to minimise signal delay, ensuring that market data is transmitted and processed almost instantaneously.
- **Co-packaged optics (CPO) and advanced switching:** CPO integrates optical components directly with processing units, lowering latency and also reducing energy consumption. Additionally, high-performance switches and routing protocols enhance data flow among trading systems, ensuring that decision-making processes occur at near-light speeds.
- **Network-side processing and hardware acceleration:** By moving decision-making closer to the network interface, often using FPGA-based appliances or custom-designed network interface cards, AI systems can process data with minimal overhead. This hardware acceleration is crucial for executing arbitrage strategies where opportunities exist for only a few microseconds.
- **Co-location and optimised routing:** Placing trading systems in the same data centers or nearby facilities as exchanges minimises physical distance, reducing transmission delays. Advanced routing protocols and real-time network management ensure data follows the shortest path, while intelligent load balancing maintains robust connectivity under high network loads.

Edge computing infrastructure: Bringing analytics closer to the source

Edge computing complements core computational power and high-speed networking by bringing processing capabilities closer to the end user and data source. This is particularly important as market data and AI workloads become more intensive:

- **Dedicated edge compute nodes:** Edge compute nodes are specialised, self-contained mini data centers deployed at the network's periphery. These nodes incorporate processing units, storage, and localised networking components designed for real-time data processing. Their architecture is optimised for low latency and high availability, ensuring that critical market data is handled immediately and reliably, even in adverse network conditions.
- **Edge-cloud integration:** Integrating edge clouds extends the capabilities of central data centers to the network's edge. This approach enables dynamic, on-demand resource allocation where AI workloads and analytics are processed closer to the source of market data. The edge cloud framework alleviates congestion in central infrastructures and supports real-time decision-making by providing scalable compute resources that can be rapidly provisioned based on current market demands.
- **Edge analytics engines and orchestration platforms:** Edge nodes leverage containerised AI inference engines, microservices architectures, and specialised hardware accelerators (such as edge TPUs) to perform complex computations locally. By handling pre-processing, data aggregation, and on-device model updating in real time, edge infrastructure minimises bandwidth usage and ensures that only distilled, high-value insights are transmitted to central systems, optimising overall performance and operational efficiency.

The true power of modern IT infrastructure lies in the seamless interplay between core computational power, high-speed networking, and edge computing. These layers converge into an integrated ecosystem that empowers AI to transform capital markets across multiple dimensions, enabling institutions to process data rapidly, execute decisions with unparalleled precision, and secure a competitive edge in every facet of the market.

Opportunities and risks in IT evolution

Opportunities

- Lower transaction costs and increased market liquidity
- Enhanced price discovery through algorithmic trading and HFT
- Reduced inefficiencies via automation and digital platforms.

Risks and mitigation strategies

- Cybersecurity threats and system outages can disrupt market operations. Advanced governance frameworks, fail-safe mechanisms and AI enabled audits ensure resilience
- Data breaches pose risks to financial integrity, but innovations in encryption and access controls help mitigate these exposures.
- Negative market events and fraud risks are on the rise; however, AI systems enable deeper analysis of data at very high speeds, enabling faster identification and containment of impact due to these threats.

> AI has the power to transform retail investing from intuition-driven to intelligence- driven. Responsible use of AI can ensure that everyone, irrespective of experience, has access to synthesised and relevant information and insights.
>
> **Mr. Satyadarshi Behera**
> Head of Data Science, CRED

2.2 Data explosion: The fuel for AI-powered market intelligence

Data is arguably the most critical asset in today's information-driven era. Any industry that incorporates technology into its operations must consistently gather, clean, analyse, and interpret data to stay competitive. Data forms the foundational pillar of modern innovation, underpinning nearly every technological advancement. This reliance is particularly pronounced in fields like artificial intelligence (AI) and machine learning (ML), which are essentially advanced extensions of data analytics.

> AI and Gen AI is empowering investors by driving ease of use, availability of insights and automation. For example, AI-driven sentiment analysis can help traders gauge market sentiment in real time, leading to more informed investment decisions. As AI becomes more mainstream, it is crucial to build robust capabilities for governance, data, talent and technology.
>
> **Mr. Kunal Pande**
> Partner KPMG, India

The expanding role of data in capital markets

The type of data used in AI systems is determined by the specific problem being addressed. In the realm of capital markets, each market participant faces unique challenges, leading to a broad and varied spectrum of data requirements for effective AI integration.

For instance, investors may seek AI-driven solutions to generate investment suggestions, forecast potential gains and losses, and analyse individual portfolio performance. Beyond personal investments, they might require insights into broader market trends, the performance of specific companies or sectors, and the strategies underpinning successful enterprises.

At a larger scale, market participants often focus on understanding macroeconomic indicators such as national economic performance, employment rates, geopolitical dynamics, and public sentiment. These factors help shape decisions and strategies across the industry. On the other hand, regulators prioritise data related to fraudulent activities, anomalies in financial operations, and potential risks to market integrity. This enables them to uphold transparency, ensure compliance, and protect investors.

The rapid expansion of diverse data types, including transactional, alternative, and behavioral data, is redefining the way insights are generated in capital markets.

Diverse data streams

- **Transactional data:** This includes traditional datasets such as trade execution details, historical price movements, and corporate filings. These data points form the backbone of technical and fundamental analysis.
- **Alternative data:** Aggregated credit card transactions for consumer spending trends, maritime AIS tracking to monitor trade flows, and web-scraped job postings to gauge labour-market shifts offer non-traditional insights to hedge funds and institutional investors.
- **Behavioural data:** Sentiment analysis using data from social media platforms, interactions on mobile apps or web portals etc. have become crucial for understanding retail investor behavior. Behavioural data helps gauge investor psychology, sentiment shifts, and emerging trends.

However, to harness the full potential of diverse data and empower AI systems to deliver actionable intelligence that enhances decision-making and transforms operations, market players must implement robust data governance practices. This means establishing comprehensive checks and controls across the entire data lifecycle, from collection and storage to processing and dissemination, to ensure data quality, security, and compliance. Rigorous data validation protocols, strict access controls and regular audits are crucial for maintaining the integrity of the data used by AI systems, thereby enabling market players to achieve consistent performance, foster trust, and secure a competitive edge.

Harnessing insights

- **Real-time processing:** Platforms powered by AI and big data analytics can process millions of data points per second, delivering actionable insights to traders and investors.
- **Content generation:** AI-driven natural-language generation systems create customised reports and documents by combining structured data with unstructured sources, enabling faster, and highly personalised content delivery.
- **Predictive analytics:** Machine learning models predict market trends and risks, optimising trading strategies and portfolio allocations.

Opportunities and risks in AI-powered data utilisation

Opportunities

- Enhanced risk management and improved decision-making.
- Competitive advantages through advanced market predictions and tailored insights.

Risks and mitigation strategies

- Data fragmentation and regulatory restrictions can limit AI's effectiveness; innovations in data harmonisation and privacy-preserving technologies are addressing these challenges.
- Ethical concerns regarding data privacy necessitate adoption of robust responsible AI governance frameworks across data lifecycle.

> The future of AI is not just about who has the most resources, but about who can harness the collective power of innovation. Open-source models like Llama are leveling the playing field, making cutting-edge technology accessible to anyone, anywhere. By democratising access to AI, we're not only accelerating innovation and driving economic growth, but also creating a more inclusive and competitive ecosystem where startups, small businesses, and individuals can thrive.
>
> **Mr. Manohar Hotchandani**
> Director of Business Development, AI, Payments & Reality Labs (India), Meta

2.3 AI and generative AI: The catalysts for innovation

KPMG conducted a recent survey involving executives and board members from 1800 companies in six industries and ten countries with varying revenue sizes:*

100% of surveyed companies said their boards have taken strategic action regarding AI.

Nearly 72% of companies are either testing or using AI for financial reporting, projected to rise to 99% in three years.

64% of companies foresee auditors reviewing their AI use in financial reporting and endorsing their AI controls.

10% of the IT budget is now allocated to AI and is set to rise significantly in the next year.

* AI in financial reporting and audit: Navigating the new era, KPMG International, 2024, accessed March 2025.

Leveraging technology and data, AI and generative AI are renovating the operations of capital markets. It not only facilitates automation but also enhances convenience and produces valuable insights. This significant shift towards AI highlights a new era in the finance sector, underpinned by intelligent algorithms and data-driven decision-making processes.

Some of the leading contributions of AI in market evolution are:

Convenience through personalisation

- **Robo-advisors**: AI-powered advisory platforms provide hyper-personalised investment recommendations based on real-time data and individual risk profiles, democratising wealth management.
- **Customer engagement**: Virtual assistants and AI chatbots enhance client experience by offering 24/7 support, streamlining onboarding, and simplifying complex financial concepts.
- **Predictive planning**: AI tools forecast cash flows, dividends, and market risks, helping individual and institutional investors plan for the future conveniently.

Automation across processes

- **Compliance and fraud detection**: AI automates compliance checks and identifies fraud patterns, ensuring regulatory adherence and reducing operational risks.
- **Trading strategies**: Algorithmic trading powered by machine learning optimises execution, minimises costs, and identifies arbitrage opportunities.
- **Back-office optimisation**: Routine tasks like reconciliation, reporting, and auditing are automated, reducing costs and increasing efficiency.

Data modeling and insights

- **Synthetic data creation**: Generative AI creates synthetic datasets for back testing trading strategies and assessing risk in scenarios where real-world data is scarce.
- **Content generation**: Tools like ChatGPT draft market reports, earnings summaries, and research briefs, saving analysts time and effort.
- **Scenario simulation**: Generative AI enables dynamic scenario modeling, allowing firms to stress-test portfolios against various economic conditions.

Opportunities and risks of AI

Opportunities

- Significant efficiency gains and cost reductions across financial operations.
- Data-driven decision-making that improves market outcomes and fosters innovation.

Risks and mitigation strategies

- Algorithmic bias and ethical concerns call for transparent AI governance.
- Over-reliance on AI systems requires human oversight and adaptive regulatory frameworks to mitigate potential risks.

> The true potential of AI in capital markets lies in its responsible adoption. As trust and cybersecurity evolve from regulatory mandates to strategic advantages, organisations must strike a balance—leveraging AI's power while prioritising resilience, trust, and security. The future will be shaped by those who innovate boldly while safeguarding wisely.

Mr. Akhilesh Tuteja
Global Cyber Security Leader, KPMG

As per a KPMG survey, key steps market leading companies are taking now to overcome barriers to AI adoption are:*

70% are ensuring technology leadership is involved in discussions.

69% are developing principles on how their organisation will utilise AI.

51% are incorporating the impact of AI into training programs.

42% are considering new data mining mechanisms for AI-related data.

42% are piloting AI initiatives to validate ROI.

41% are increasing investment in AI adoption.

40% are formulating communication programs to keep up with regulations.

Most effective business practices in ensuring ethical use of Gen AI*

- Regular audits
- Ethical frameworks
- Education & training
- Human oversight
- Third-party review
- Collaboration & regulation
- Privacy measures
- Disclosure

* AI in financial reporting and audit: Navigating the new era, KPMG International, 2024, accessed March 2025.

Chapter 3:

Reimagining the Indian capital markets: Innovation and adaptation through real world use cases

Positioned at the intersection of innovation and growth, the Indian capital markets are fueled by technological advancement, regulatory evolution, and changing investor preferences. As the complexities of global markets grow and digital tool adoption accelerates, the key stakeholders, including investors, institutions, and regulators, in the Indian capital markets are actively adopting innovative practices to maintain competitiveness and resilience. This chapter explores the evolution of Indian capital markets, underscored by pertinent use cases and emphasises the role of digital transformation, emerging technologies, risk management, and sustainable finance proliferation.

> The Indian Capital Market has always been at the forefront of technology adoption. In the current landscape as well, the industry is geared up to adopt emerging technologies to make markets more reliable, protect investor interests, and create better value for all participants.
>
> **Mr. Amit Mahajan**
> Chief Technology Officer, CDSL

3.1 Digital transformation and automation: Carving value in modern markets

The digital transformation of Indian capital markets is characterised by faster, more transparent, and efficient operations, as technology and automation redefine traditional mechanisms. Supported by artificial intelligence (AI), machine learning (ML), and regulatory technologies (RegTech), these automated processes are streamlining operations, reducing errors, and enhancing decision-making capabilities of various organisations. Concurrently, supervisory technologies (SupTech) are bolstering regulators to ramp up market oversight and compliance.

Within the Indian markets, RegTech solutions like automated compliance management and fraud detection systems are altering the interaction dynamics between financial institutions and regulators. Indian startups are at the forefront of innovation, offering automated tools for data aggregation, KYC, risk assessment, compliance reporting, etc. Meanwhile, SEBI has incorporated various SupTech solutions for real-time market activity monitoring, enabling super fast identification of anomalies, such as insider trading or suspicious trading volumes.

One prime example of this digital revolution is the introduction of an AI-powered algorithmic trading platform by a leading brokerage firm in India. This platform allows traders to create, back-test, and implement trading strategies without the need for coding expertise. Such innovations have democratised algorithmic trading, expanding the opportunities for retail investors and increasing their participation in the market.

Addressing this growing interest among retail investors, SEBI has proposed a framework to facilitate their involvement in algorithmic trading[11]. The proposed measures include stock exchanges seeking approval for every algorithm intended for retail use and tagging orders with unique identifiers, thereby ensuring enhanced transparency and a greater scope for auditability.

11 Safer participation of retail investors in Algorithmic trading, Securities and Exchange Board of India (SEBI), February 2025, accessed March 2025

3.2 Assimilation of emerging tech

Emerging technologies like AI, blockchain, and quantum computing are shaping the future of capital markets by offering innovative solutions to long-standing challenges. From enhancing liquidity to democratising access to data, Indian startups and institutions are finding practical ways to integrate these technologies into their operations.

Utilising AI and blockchain, an Indian fintech company, has optimised supply chain financing. It capitalises on real-time business data to furnish liquidity to MSMEs, thereby streamlining their capital access. This technological innovation plays a crucial role in mitigating financing discrepancies in underserved sectors, which exemplifies the transformative power of technology in fostering inclusive growth.

Similarly, a known Indian brokerage firm, has designed AI-driven tools that facilitate traders in examining market trends, forecasting stock fluctuations, and making insightful decisions. These tools deploy extensive data sets and sophisticated algorithms to offer users real-time insights, thereby improving the overall trading experience.

Depository participants are also leveraging AI for risk management, customer behaviour analysis, and operational efficiency. From automating reconciliations to predicting transaction anomalies and tailoring services based on user behaviour, DPs are evolving into tech-enabled custodians of market trust, playing a vital role in strengthening transparency and resilience in capital markets.

3.3 Navigating risk, ensuring resilience: The role of AI and tech

The spotlight on risk management has intensified in the Indian capital markets, especially considering market volatility, cyber threats, and emerging economic challenges. AI and technology-backed solutions are providing a potent arsenal to organisations, enabling them to foresee, observe, and mitigate risks more effectively.

The application of AI in fraud detection and risk mitigation has been significant. Financial institutions now utilise AI-powered systems to detect fraudulent activities in real-time. **Large brokerage houses in India, for instance, deploy AI models to scrutinise millions of daily transactions - highlighting anomalies and potential insider trading patterns or price manipulation.** By learning from historical data, these models continuously improve their predictive accuracy and thereby serve as robust tools for risk mitigation.

SEBI, as regulator, has also adopted technology to bolster market resilience and enhance regulatory oversight, playing a monumental role in championing Technology-Driven Resilience. With the integration of the **Integrated Market Surveillance System (IMSS) and the Data Warehousing and Business Intelligence System (DWBIS), SEBI showcases how AI and big data analytics can be used to detect unusual trading patterns, fraud, and systemic risks across different exchanges**[12]. These advanced tools enable proactive interventions, fortifying market stability and promoting investor confidence.

As digitalisation increases, so does the risk of cyberattacks. Indian MIIs and other capital market institutions are investing in robust cybersecurity frameworks, with AI playing a pivotal role in threat detection. Tools powered by machine learning can better identify and neutralise potential breaches, safeguarding sensitive financial data. For instance, a technology startup specialises in providing cloud-based security solutions tailored for financial markets.

By integrating AI and technology into risk management strategies, Indian capital markets are building a more resilient ecosystem capable of adapting to future challenges.

> India's IT industry built a globally respected ecosystem by fostering deep trust between all stakeholders like competitors, regulators, and technology partners. The same principle holds immense potential for CapTech. If we come together to build a trust-based, collaborative ecosystem, India's capital markets can become more secure, inclusive, and globally competitive. The dream of India as an economic superpower can be co-created indeed!
>
> **Mr. Harish Mehta**
> Founder, Onward Technologies & Co-founder and First Elected Chairman, NASSCOM

12 Implementation of Data Analytics Projects and Building of Data Models at SEBI, Securities and Exchange Board of India (SEBI), June 2021, accessed April 2025

3.4 Beyond sustainability: The rise of impact investing and inclusive finance

Environmental, Social, and Governance (ESG) principles have become a significant focus for organisations, offering them advantages in terms of meeting regulatory requirements and enhancing corporate reputation. ESG-focused companies not only meet necessary criteria established by jurisdictions but also enhance their public image by demonstrating environmental and societal consideration. This focus on ESG has attracted investors, who see the principles as predictors of long-term growth and sustainability.

In India, the trend towards ESG adoption is propelled by the introduction of the Business Responsibility and Sustainability Report (BRSR) by SEBI. Mandatory for the top 1,000 publicly listed companies, this framework demands more transparent ESG reporting, thus assisting investors in making informed decisions.

As the preference for sustainable and socially conscious investments grow, capital markets adapt accordingly. This evolution paves the way for impact and inclusive investing, driving the creation of innovative financial products and services.

One such remarkable initiative is India's Social Stock Exchange (SSE), launched in 2023. This platform permits social enterprises and non-profits to raise funds through zero coupon bonds, thereby attracting investors with a keen interest in impact investments. This move underscores a firm commitment to sustainability and inclusivity within financial markets.

Simultaneously, the introduction of ESG-centric mutual funds by Indian asset management firms further expands this sustainability commitment. These funds invest in enterprises with steadfast ESG practices.

It is important to note that, SEBI's guidelines have been instrumental in augmenting the appeal of such financial products by establishing clear frameworks and stringent disclosure norms. SEBI also plans to broaden sustainable financing to include social and sustainability-linked bonds[13]. This strategy aims to direct investments to endeavors with positive social and environmental effects, embodying an obligation to promote inclusive growth.

Start-up-led ESG innovation has also emerged as a key enabler in this ecosystem. Indian startups are using cutting-edge technologies, including artificial intelligence (AI), to advance ESG goals. From platforms offering AI-powered ESG risk evaluation and scoring tools, to fintech solutions facilitating green energy financing and carbon footprint tracking, these innovations are crucial in addressing a core challenge: **to leverage sustainability data effectively for decision-making, it must be collected, transformed, and reported with greater speed, frequency, and scalability.** AI plays a pivotal role by automating data extraction from unstructured sources, detecting patterns, and generating predictive insights in real time. Achieving this, however, demands not only advanced technological infrastructure but also large-scale business process transformation. Startups are uniquely positioned to meet this need with agile, AI-driven solutions that bridge operational gaps and empower companies to act on ESG insights more efficiently.

At the same time, many of these startups are also driving financial inclusion through digital platforms that democratise access to capital markets, thus creating investment opportunities for underserved sectors. These platforms make investing simpler, reduce entry barriers and offer educative resources, promoting wider involvement in wealth generation.

The evolution of Indian capital markets showcases their agility to innovate while simultaneously tackling the unique challenges of a dynamic and diverse economy. From using RegTech and SupTech, integrating emerging technologies to encouraging ESG-focused investments, the Indian capital markets are mapping out a future defined by resilience, efficacy, and inclusivity. The examples and initiatives discussed underscore the transformative possibility of technology and sustainable finance, laying the groundwork for a robust and fair financial ecosystem in India.

13 SEBI Expands Sustainable Finance Framework With New ESG Debt Instruments, Outlook Business, August 2024, accessed April 2025

Using AI to scale ESG in capital markets

- AI can extract insights from large ESG datasets, improving automation of disclosures and regulatory reporting for listed entities.
- AI can ingest third-party ESG data to build investment-grade, product-level emissions and sustainability profiles.
- AI enables verification of ESG claims across suppliers and portfolios, ensuring consistency across fragmented data sources.
- AI helps ensure cross-border compliance, supporting institutional investors managing multi-market portfolios.

Intelligent ESG can drive real business value in capital markets

- **Accuracy:** Better ESG data quality enhances investment screening and portfolio decarbonisation strategies.
- **Cost:** Automated ESG data processing reduces manual effort, saving compliance and analyst resources.
- **Speed:** Real-time ESG visibility allows investors to act early on risks and opportunities before they impact performance.
- **Insights:** Deeper ESG analytics help link sustainability metrics with alpha generation and long-term financial returns.

Capital market is going through an interesting transformative phase driven by emerging technologies like AI, blockchain and data analytics that redefine efficiency, transparency and accessibility turning every transaction into an opportunity.

Ms. Shubhosree Dasgupta
Chief Data and Analytics Officer,
HSBC India

Chapter 4:

Strategic recommendations for stakeholders

In the rapidly evolving landscape of the Indian capital markets, stakeholders: Market Infrastructure Institutions (MIIs), intermediaries, regulators, and investors, must work in unison to harness the potential of AI. MIIs and intermediaries drive efficiency and customer satisfaction by innovating and transforming their offerings; regulators ensure stability by crafting frameworks that promote collaboration and responsible innovation; and investors inject financial adaptability into the ecosystem, pushing it toward new horizons.

This synergy forms the bedrock of a successful technological transition. To nurture this thriving ecosystem and create an *Aatmanirbhar* (self-reliant) investor base, it is essential to define actionable strategies that empower each stakeholder group.

Below are tailored recommendations for each market stakeholder to make the most of AI-driven transformation.

> By harnessing emerging technologies like AI, we can revolutionise risk management practises from mitigating threats to creating strategic advantages. In addition, enhanced collaboration between regulators, MIIs, and market participants can enable us to set a global benchmark for risk management excellence.
>
> **Mr. Vinay Madan**
> Chief Risk Officer, CDSL

4.1 AI for government bodies and regulators: Crafting a framework for stability and innovation

As custodians of market integrity, regulators and government bodies play a critical role in ensuring stability while fostering innovation. The balance between robust regulation and technological advancement is key to building investor trust and market resilience.

1 Establish robust guidelines for AI systems

Regulators can craft comprehensive frameworks for the ethical and secure use of AI in capital markets by considering the following key aspects:

Risk-based classification
Implement a system that categorises AI applications based on their potential risk to users, with higher-risk systems subjected to more stringent requirements.

Transparency and disclosure
Mandate that users are informed when interacting with AI systems, such as chatbots, to maintain trust and allow for informed decision-making.

Human oversight
Ensure that AI systems, especially those involved in critical decision-making processes, incorporate mechanisms for human oversight to prevent unintended outcomes.

Data quality and governance
Establish standards for data quality to ensure that AI systems operate based on accurate and unbiased information, thereby enhancing their reliability.

Accountability measures
Define clear accountability protocols for AI system providers and users, ensuring that responsibilities are well-outlined in case of malfunctions or ethical breaches.

2 Promote AI education among stakeholders

To ensure the effective adoption of AI, regulators can promote AI education and training for market participants and investors. Programs to educate stakeholders about the capabilities and risks of AI can build a more informed ecosystem. Regular workshops and consultations with market participants could be extended to include specific modules on AI.

3 Encourage collaboration between public and private sectors

Regulators can foster collaboration between fintech startups, financial institutions, and academic institutions to create innovative AI applications. Programs like SEBI's innovation sandbox, provide a controlled environment for testing AI-based solutions without posing systemic risks.

4 Use AI for audits

To maintain stability, regulators can continuously monitor AI systems to identify vulnerabilities and prevent misuse. Supervisory technology (SupTech) tools like AI-based data analytics can enable real-time audits of trading patterns and compliance breaches. For instance, tools that identify manipulative trading behaviors or fraudulent schemes in high-frequency trading can be vital for market integrity. In addition, AI-facilitated automated audits streamline regulatory oversight, reduce manual errors, and enhance overall compliance processes, ensuring a robust framework for market stability.

> Risk Management is about prediction and with AI as a partner, it becomes a powerful way to build investor trust.
>
> **Prof. Umesh Bellur,**
> Public Interest Director, CDSL

4.2 AI for market infrastructure institutions (MIIs): Enhancing efficiency and security

Market Infrastructure Institutions, such as stock exchanges, clearing corporations, and depositories, play a pivotal role in maintaining the integrity and efficiency of capital markets. The integration of AI into their operations can lead to significant advancements in system performance, security, and compliance.

1 Implement AI for surveillance and compliance

MIIs can increase adoption of AI-driven surveillance systems to monitor trading activities in real-time, identifying patterns indicative of market manipulation or insider trading.

2 Enhance risk management

AI can be utilised to assess and predict systemic risks by analysing large datasets, including transaction records and market trends. This proactive approach can enable MIIs to implement preventive measures, thereby safeguarding the financial ecosystem.

3 Optimise clearing and settlement processes

By employing AI algorithms, MIIs can streamline clearing and settlement operations, reducing processing times and minimising errors. This optimisation leads to increased efficiency and reliability in trade executions.

4 Strengthen cybersecurity measures

Incorporating AI into cybersecurity protocols allows MIIs to further strengthen their threat response mechanism. AI systems can identify unusual activities and potential breaches, ensuring the protection of sensitive financial data. Using SupTech helps management continuously monitor and verify the proper execution of cybersecurity controls and protocols, keeping a close check on system health.

5 Facilitate regulatory reporting

AI-powered tools can automate the compilation and submission of regulatory reports, ensuring accuracy and compliance with evolving standards. This automation enhances transparency, comprehensiveness and speed, reduces administrative burden on MIIs, and reduces cost of compliance.

4.3 AI for intermediaries: Driving innovation and customer-centric services

Intermediaries, including depository participants, brokers, asset management companies, and financial advisors, serve as the bridge between investors and markets. Leveraging AI enables these entities to offer personalised services, improve operational efficiency, and enhance client satisfaction.

1 Adopt AI for customer relationship management

AI-driven customer relationship management (CRM) systems can analyse client behaviour and preferences, enabling intermediaries to offer tailored investment advice and product recommendations. This personalisation fosters stronger client relationships and loyalty, especially within India's diverse investor base. **Notably, retail investors from tier-2 and tier-3 cities, who make up the majority of new demat account holders and often seek financial literacy in regional languages, can benefit significantly from such targeted services like CDSL's electronic Consolidated Account Statements (eCAS), available in 23 regional languages.**

2 Integrate AI in investment strategies

By utilising AI for algorithmic trading and portfolio management, intermediaries can optimise investment strategies, enhance returns, and manage risks more effectively. AI's ability to process vast amounts of data allows for more informed decision-making.

3 Implement AI-powered chatbots for client interaction

AI chatbots can handle routine client inquiries, provide account information, and assist with transactions, offering 24/7 support. This automation enhances customer service, and improves grievance redressal, while allowing human advisors to focus on more complex tasks.

4 Enhance compliance and fraud detection

Intermediaries can integrate AI systems to monitor transactions for suspicious activities, ensuring compliance with regulatory requirements and protecting clients from potential fraud. AI's pattern recognition capabilities are instrumental in identifying anomalies.

5 Streamline administrative processes

AI can automate administrative tasks such as Know Your Customer (KYC) procedures, document verification, and reporting. This automation reduces operational costs and accelerates client onboarding processes.

6 Invest in AI training and development

To fully harness AI's potential, intermediaries can invest in training programs for their staff and collaborate with fintech startups and academic institutions. This investment ensures the development of AI tools that cater to specific market needs and promotes a culture of continuous innovation.

> The future of capital markets lies in leveraging technology to bring best in-class research, simplify consumer experiences, and empower investors at every level. We are redefining CapTech by delivering innovative solutions that democratise access to financial markets, foster transparency, and drive informed decision-making. By integrating advanced research and an intuitive platform experience, we aim to set new benchmarks in how capital markets evolve and operate in an increasingly digital-first world.
>
> **Mr. Ujjwal Jain**
> Chief Executive Officer, Share.Market by PhonePe

4.4 AI for *Aatmanirbhar* Investors (AI for AI): Navigating the future with emerging technologies

Empowering investors with the knowledge and tools to leverage AI will be crucial for creating an *Aatmanirbhar* investor community. In a world increasingly shaped by emerging technologies, investors must adapt and evolve to stay ahead.

1 Embrace technology to stay ahead

Indian investors can leverage AI-powered tools such as robo-advisors, sentiment analysis platforms, and portfolio optimisation applications to make informed investment decisions. Some platforms which use AI for algorithmic trading, empower even non-technical investors to automate and refine their strategies.

2 Stay informed about AI and market trends

Investors are encouraged to remain updated about advancements in AI and their implications for capital markets. Participating in financial literacy programs, attending workshops, and leveraging AI-powered learning tools can help them stay informed. SEBI's investor awareness initiatives could also include modules on AI-driven investing.

3 Validate before you trust

While AI tools hold immense potential, investors should remain cautious and assess the credibility of such solutions. Understanding the algorithms, data sources, and underlying assumptions is crucial, especially when such AI-driven platforms promise 'too good to be true' returns. These claims must be validated through market data and grounded in data-backed research.

As the CapTech ecosystem continues to flourish with expanding opportunities and innovative products, it becomes imperative for every investor to remain well-informed—meticulously evaluating their choices, assessing their risk tolerance, and discerning potential hurdles. By refining their aptitude to gauge product suitability, investors can unlock the immense potential of India's capital markets while embodying the spirit of *Aatmanirbharta*, empowering themselves to make confident, astute decisions.

Mr. Nehal Vora
Managing Director & Chief Executive Officer, CDSL

4 AI as a tool for *Aatmanirbhar* investors

AI can act as a powerful ally for investors by offering insights, predictions, and strategies that were once the exclusive domain of financial experts. Beyond providing real-time market analysis, AI-driven platforms enable investors to enhance their financial literacy and simulation skills. For instance, adaptive self-learning modules can offer personalised educational content, helping investors understand complex market dynamics and develop customised investment strategies. Additionally, AI-based simulation tools allow investors to model various market scenarios in a risk-free environment, thereby refining their decision-making skills and preparing them for market volatility. This dual approach, combining continuous learning with practical simulation, empowers investors to become truly self-reliant, aligning seamlessly with India's vision of financial inclusion and *Aatmanirbharta*.

The strategic recommendations outlined above, aim to empower every stakeholder in the Indian capital market ecosystem. By embracing AI, fostering collaboration, and building robust frameworks, regulators, government bodies, MIIs and intermediaries can create immense value while ensuring stability. At the same time, empowering investors with knowledge and tools to leverage AI will lay the foundation for a resilient and inclusive financial ecosystem, guiding India toward the development of *Aatmanirbhar* investors in an increasingly AI-driven future.

Artificial Intelligence transforms the *Aatmanirbhar* investor into a smarter, self-reliant decision-maker by offering real-time insights, and personalised strategies, paving the way for confident investments and a stronger, self-sufficient Indian economy.

Mr. Rajesh Panwar
Director, Department of Economic Affairs, Ministry of Finance, Government of India

Glossary

Agentic AI	A type of AI designed to operate autonomously in representing or acting on behalf of a user in various tasks or environments
AI	Artificial Intelligence
AIS	Automatic Identification System
Algorithmic Trading	Trading using algorithms that execute high-speed trades automatically based on predetermined criteria
API	Application Programming Interface
ASIC	Application Specific Integrated Chip
BRSR	Business Responsibility and Sustainability Report
CapTech	Capital Market Technology
CDSL	Central Depository Services (India) Limited
CPO	Co-packaged optics
CRM	Customer Relationship Management
DeFi	Decentralised Finance
Demat	Dematerialised
DP	Depository participants
DPI	Digital Public Infrastructure
eCAS	electronic Consolidated Account Statements
ESG	Environmental, Social, and Governance
EU	European Union
FinFluencers	Financial influencers on social media who may affect market trends or investment decisions
Fintech	Financial Technology
FPGA	Field Programmable Gate Array
FSB	Financial Stability Board
Gen AI	Generative AI—a type of AI that can generate text, images, and other content based on the data it has learned from
GIFT City	Gujarat International Finance Tec-City
GPU	Graphics Processing Unit
HFT	High Frequency Trading
IFSC	International Financial Services Centre
IPO	Initial Public Offering
KYC	Know Your Customer
LLM	Large Language Model
MIIs	Market Infrastructure Institutions
ML	Machine Learning
MSMEs	Micro, Small, and Medium Enterprises
NIST	National Institute of Standards and Technology
OTP	One-Time Password
Quantum Computing	A type of computing that uses quantum-mechanical phenomena, such as superposition and entanglement, to perform operations on data
RAG	Retrieval Augmented Generation
RegTech	Regulatory Technology
Retail Investors	Individual non-professional investors who buy and sell securities or funds
SEBI	Securities and Exchange Board of India
Settlement Time	The process by which securities are delivered, typically against payment, to fulfill contractual obligations arising from securities transactions
SLM	Small Language Model
SME	Small and Medium Enterprise
SNA	Segregated Nominee Account Structure
SSE	Social Stock Exchange
STT	Securities Transaction Tax
SupTech	Supervisory Technology
T+0	Same day Trade Settlement
TPU	Tensor Processing Unit
UPI	Unified Payments Interface
Tokenised Assets	Digital representations of a portion of equity, asset, or project, making it easier and more efficient to trade and manage
WEF	World Economic Forum
XAI	Explainable Artificial Intelligence

Thank you for inspiring us

Chief Guest

Dr. K Kasturirangan, Former Chairman - Indian Space Research Organisation (ISRO), Chairman - NEP Committee, Chairman - National Curriculum Framework Committee

Guests of Honour

- **Mr. Ananth Narayan Gopalakrishnan**, Whole Time Member, SEBI
- **Ms. Kaku Nakhate**, President & India Country Executive, Bank of America

Eminent Speakers

- **Mr. Anup Bagchi,** Managing Director & Chief Executive Officer, ICICI Prudential Life Insurance
- **Mr. Harish Mehta**, Founder, Onward Technologies & Co-founder and First Elected Chairman, NASSCOM
- **Mr. Srikanth Velamakanni**, Co-founder, Group Chief Executive and Executive Vice Chairman, Fractal Analytics Limited

Panel Speakers

- **Mr. Amit Mahajan**, Chief Technology Officer, CDSL
- **Mr. Akhilesh Tuteja**, Partner & National Leader, Clients and Markets, KPMG in India
- **Mr. Avneesh Pandey**, Chief General Manager, SEBI
- **Mr. Bhavin Parekh**, Chief Product Operations Officer, Angel One
- **Mr. Dhiraj Relli**, Managing Director & Chief Executive Officer, HDFC Securities
- **Mr. Jonty Rhodes**, Former South African international cricketer
- **Mr. Kunal Pande,** National Co-Head – Digital Risk and Cyber, KPMG in India
- **Mr. Manohar Hotchandani**, Director of Business Development, AI, Payments & Reality Labs (India), Meta
- **Mr. Nehal Vora**, Managing Director & Chief Executive Officer, CDSL
- **Mr. Rajesh Panwar**, Director, Department of Economic Affairs, Ministry of Finance, Government of India
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- **Mr. Siddharth Sureka**, Chief AI Officer, Motilal Oswal Financial Services Limited
- **Mr. Swaminathan Aiyer**, Director - Data & AI - India and South Asia, Microsoft
- **Mr. Ujjwal Jain**, Chief Executive Officer, Share.Market by PhonePe
- **Prof. Umesh Bellur**, Public Interest Director, CDSL
- **Prof. Varsha Apte**, Public Interest Director, CDSL
- **Mr. Vinay Madan,** Chief Risk Officer, CDSL

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