
ALGORITHMIC TRADING, AI, & INSIDER TRADING: EMERGING CHALLENGES FOR SEBI

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ABSTRACT

The advent of artificial intelligence (AI) in algorithmic trading has led to fundamental transformations in securities markets in ways both profound & unsettling. Trading that was once dominated by human brokers and physical floors is now governed by algorithms executing thousands of trades in milliseconds, raising critical questions about what constitutes “information” or “insider advantage.” For regulators like SEBI, this transformation from human intent to machine-led autonomy has exposed gaps in existing insider trading laws, which were designed to prevent misuse of Unpublished Price Sensitive Information (UPSIS) but struggle to address predictive insights generated by AI from datasets such as social media, satellite imagery, or geolocation metrics.

The 2015 NSE co-location case exemplifies how even milliseconds of early access can disrupt markets, highlighting the challenge of defining insider trading in an era where UPSIS can be inferred rather than disclosed. Accountability further complicates enforcement, raising questions about liability should it fall on programmers, deploying firms, or the AI systems themselves? While regulators globally diverge in approach, the SEC emphasizes human responsibility, the EU mandates strict audits, and Singapore promotes sandbox testing, the central dilemma remains unresolved.

This paper analyses the implications of AI-driven trading for India, emphasizing the need for SEBI to adopt outcome-focused reforms, including algorithm registration, black-box testing, digital whistleblowing, and real-time monitoring. It also explores the importance of harmonizing domestic regulation with global best practices to safeguard investor confidence. Ultimately, the paper argues that regulating AI-driven insider trading is not about restricting innovation but fostering transparency, fairness, and trust in India’s evolving financial markets.

Keywords: AI trading, Insider Trading, Market Manipulation, Unpublished Price Sensitive Information, Securities Exchange Board of India.

I. INTRODUCTION

The global architecture of capital markets has transformed dramatically in the last two decades. The traditional model of trading floors, which human brokers have long dominated, has been replaced by silent, high-speed servers executing trades in fractions of a second. Fuelled by algorithmic trading and artificial intelligence (AI), this evolution has enhanced market efficiency, liquidity, and accessibility. Yet, it has created complex challenges for regulators by blurring the lines of what constitutes “information,” “advantage,” and “insider dealing.” For the Securities and Exchange Board of India (SEBI), originally established to monitor human conduct, the digital age introduces unprecedented dilemmas: how to regulate machines that act faster than human cognition, and how to assign liability when decisions emerge from the hybrid space of human input and machine autonomy.

Insider trading law in India, under Section 12A of the SEBI Act, 1992, and the SEBI (Prohibition of Insider Trading) Regulations, 2015 (PIT Regulations), has historically focused on the misuse of Unpublished Price Sensitive Information (UPSI) by individuals or connected persons. Its essence lies in preventing information asymmetry and protecting ordinary investors. However, AI complicates this paradigm. Unlike traditional insiders, AI does not rely on leaks or direct access to UPSI. Instead, it leverages alternative data, such as satellite imagery, social media sentiment, geolocation trends, or supply chain indicators, to produce predictive insights. When such predictions mirror the effect of UPSI, a critical question arises: Does this constitute insider trading or a sophisticated extension of legitimate analytics?

This issue is not theoretical. The 2015 National Stock Exchange (NSE) co-location scam exposed regulatory blind spots created by technological asymmetry traders with co-location access obtained market data microseconds ahead of others, creating unfair advantages. While SEBI penalized the exchange and brokers, the case highlighted the inadequacy of PIT Regulations, designed for human insiders rather than autonomous algorithms or data-driven inference.¹

Globally, regulators face similar challenges. The U.S. Securities and Exchange Commission (SEC) has investigated cases where alternative data vendors provided hedge funds with insights

¹ Securities and Exchange Board of India, *Report of the Committee on Fair Market Conduct under SEBI (Prohibition of Insider Trading) Regulations, 2015* (2018) https://www.sebi.gov.in/reports/reports/may-2018/report-of-the-committee-on-fair-market-conduct-under-sebi-prohibition-of-insider-trading-regulations-2015_38969.html

straddling lawful research and unlawful insider dealing.² The European Securities and Markets Authority (ESMA), under the Market Abuse Regulation (MAR), has acknowledged the dangers of algorithmic manipulation. Yet, a coherent framework distinguishing permissible algorithmic foresight from illicit exploitation across jurisdictions remains elusive.

Another dimension arises from AI's speed. Insider trading jurisprudence traditionally hinges on proving possession and misuse of UPSI. But AI autonomously identifies correlations mimicking UPSI from vast datasets, making liability attribution difficult. Should responsibility lie with the programmer, the trader, or the deploying firm? This is not hypothetical but an urgent corporate governance challenge for Indian listed companies increasingly relying on AI-driven investment systems.

This research critically examines insider trading in the AI era with reference to SEBI's challenges. Existing jurisprudence, designed for human actors, falls short in addressing machine autonomy, predictive analytics, and globally networked trading. The study evaluates SEBI's surveillance mechanisms, draws insights from international regulatory experiences, and proposes a roadmap for reform. Investor trust and the credibility of India's capital markets depend on regulatory capacity to maintain fairness and transparency. Without adaptation, markets risk exploitation by sophisticated traders and eroded investor confidence. By bridging the gap between traditional frameworks and AI-driven trading realities, this research aims to contribute to legal scholarship and policy innovation, ensuring India's markets remain robust, credible, and future-ready.

II. FROM HUMAN INTENT TO MACHINE AUTONOMY: RETHINKING INSIDER LIABILITY

Insider trading jurisprudence has always revolved around human intent in India and globally. The regulatory framework assumes a human actor who obtains, possesses, and misuses Unpublished Price Sensitive Information (UPSI) to gain an unfair advantage. Liability has traditionally been attached to the mental elements of knowledge, intention, and willful misuse. But this foundation is becoming increasingly unstable in the age of autonomous trading systems.

² U.S. Securities and Exchange Commission, *Staff Report on Algorithmic Trading in U.S. Capital Markets* (2019) https://www.sec.gov/files/Algo_Trading_Report_2019.pdf

An algorithm does not “intend” in the way humans do. A deep-learning model designed to scan millions of data points may accurately identify hidden patterns that anticipate price movements. For example, a machine-learning program may predict quarterly results by analyzing a listed company's supply chain data or social media activity. While no human may have accessed UPSI, the algorithm's output may be functionally indistinguishable from insider knowledge. This raises the critical question: How should liability be assigned if machines can replicate or even outperform human insiders?

Indian courts and SEBI orders provide a practical context here. In *SEBI v. Kanaiyalal Baldevbhai Patel* (2017)³ The Securities Appellate Tribunal (SAT) emphasized the necessity of proving possession of UPSI and its misuse. Similarly, in the *Manoj Gaur (Jaypee Group) case*⁴ SEBI imposed penalties where promoters traded based on advance knowledge of poor financial performance. Both cases show that liability is attached to human actors with intent and access. But these precedents offer little guidance when AI independently arrives at UPSI-like insights without human prompting.

This creates a grey zone of responsibility. If a trader deploys an AI model and allows it to run autonomously, can they be held liable for its actions? SEBI's regulatory philosophy leans towards strict liability if unfair advantage is obtained, and culpability follows. However, strict liability in AI trading may risk penalizing unintended outcomes where neither the trader nor the programmer foresaw the machine's predictive abilities. Conversely, a lenient approach could allow bad actors to hide behind AI as a shield for manipulative practices.

Internationally, the debate is unfolding as well. The US SEC has flagged risks of “AI-washing,” where firms use AI to obscure manipulative strategies.⁵ The UK's Financial Conduct Authority (FCA) has cautioned that algorithmic models may unintentionally create information asymmetry equivalent to insider trading.⁶ The European Union's Markets in Financial Instruments Directive (MiFID II) mandates firms to monitor algorithms continuously to

³ *Securities and Exchange Board of India v Kanaiyalal Baldevbhai Patel*, (2017) 15 SCC 1.

⁴ *Manoj Gaur v Securities and Exchange Board of India* (2012) SCC OnLine SAT 176.

⁵ US Securities and Exchange Commission, ‘SEC Charges Investment Adviser with Misrepresentations Involving Artificial Intelligence’ (SEC, 23 March 2023) <https://www.sec.gov/news/press-release/2023-64> accessed 28 August 2025.

⁶ UK Financial Conduct Authority and Bank of England, *Machine learning in UK financial services* (Joint Survey Report, 16 October 2019) <https://www.bankofengland.co.uk/report/2019/machine-learning-in-uk-financial-services>

prevent abusive conduct, even without human intent.⁷

For India, this necessitates a rethinking of corporate governance responsibilities. Boards of companies deploying AI in trading must ensure robust oversight mechanisms. Programmers and compliance officers may need to be brought within the regulatory net. Most importantly, SEBI must evolve a framework that recognizes intent is no longer central; outcomes and structural safeguards should determine liability. The shift from human insiders to autonomous algorithms forces a re-evaluation of insider trading law itself. The legal system, rooted in human psychology and moral blameworthiness, must now grapple with post-human decision-making. Without this recalibration, India risks over-penalizing legitimate innovation or under-regulating systemic risks that undermine market fairness.

III. ALTERNATIVE DATA & GREY ZONE OF UPSI

The traditional understanding of Unpublished Price Sensitive Information (UPSI) under Indian law revolves around formal channels, board meetings, internal communications, and regulatory filings. However, alternative data has blurred these boundaries in today's data-driven economy. Satellite imagery of factory output, geolocation data from delivery trucks, social media sentiment, and web traffic analytics can provide actionable insights anticipating market movements. These datasets are not “confidential” in the classic sense, yet when processed by sophisticated AI models, they yield information that operates like UPSI in practice.

This creates a fundamental dilemma: should regulators treat such predictive insights as insider trading or legitimate intelligence gathering? SEBI's framework under the Prohibition of Insider Trading Regulations, 2015⁷ defines UPSI narrowly, covering unpublished financial results, mergers, acquisitions, and similar corporate events. However, AI-driven alternative data often generates “quasi-UPSI”—information that is neither officially disclosed nor strictly secret but can influence share prices significantly.

For instance, hedge funds abroad have used satellite images of retail store parking lots to forecast quarterly earnings of companies like Walmart or Target.⁸ In the Indian context, AI-

⁷ Directive 2014/65/EU, of the European Parliament and of the Council, May 15, 2014, on Markets in Financial Instruments (MiFID II), 2014 O.J. (L 173) 349, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014L0065>.

⁸ Thibault Schrepel, *Predatory Innovation in Financial Markets: The Case of Alternative Data*, 41 Northwestern J. Int'l L. & Bus. 45 (2020); available at SSRN: <https://ssrn.com/abstract=2986246>

driven tools could analyse railway freight data or social media chatter around IPO-bound companies to project revenues ahead of formal announcements. The ethical question arises: Is this simply innovation, or is it front-running the market in a way that disadvantages ordinary investors?

Globally, regulators are divided. The US SEC has increasingly scrutinized alternative data usage, especially where datasets are procured through questionable means, such as scraping confidential employee communications.⁹ The UK FCA and the European Securities and Markets Authority (ESMA) take a nuanced stance permitting alternative data use while stressing transparency and robust compliance systems.¹⁰ However, SEBI has not yet issued comprehensive guidance in India, leaving market participants in a grey zone.

The governance challenge here lies in striking a balance. Over-regulation may stifle innovation in financial analytics and disadvantage Indian markets vis-à-vis global players. Conversely, under-regulation risks creating an elitist market, where only those with access to advanced AI and alternative datasets can consistently outperform retail investors. This could erode the foundational principle of market fairness that insider trading laws are designed to uphold.

Ultimately, SEBI will need to redefine UPSI in light of the digital economy, moving from a static definition based on access to corporate documents to a dynamic understanding that recognizes the transformative potential of alternative data.

IV. DARK POOLS, CRYPTO EXCHANGES, & CROSS-MARKET INSIDER RISKS

The evolution of digital markets has accelerated trading and created opaque spaces where insider activity can thrive beyond regulators' radar. Two of the most prominent examples are dark pools and crypto exchanges, both of which complicate SEBI's enforcement of insider trading norms.

Dark pools are private trading platforms where institutional investors execute large trades without revealing their positions to the broader market. While their original purpose was to

⁹ US Securities and Exchange Commission, *Office of Compliance Inspections and Examinations: 2020 Examination Priorities* (7 January 2020) <https://www.sec.gov/newsroom/press-releases/2020-4>

¹⁰ European Securities and Markets Authority, *Final Report: Guidelines on Outsourcing to Cloud Service Providers* (ESMA Report, 2021) <https://www.esma.europa.eu/document/final-report-revised-guidelines-outsourcing-to-cloud-service-providers>

prevent price distortions in public exchanges, they have increasingly drawn criticism for enabling information asymmetry.¹¹ If algorithms operating within dark pools can exploit early access to order flows or trading patterns, they effectively replicate the unfair advantage that insider trading laws seek to eliminate. SEBI has focused its surveillance efforts on public exchanges like NSE and BSE. Still, as global funds exposed to Indian securities increasingly route trades through offshore dark pools, the risks of hidden insider activity multiply.

Similarly, the rise of crypto exchanges has introduced a parallel ecosystem where information-sensitive trading occurs largely outside SEBI's jurisdiction. Crypto assets are not yet fully recognized as "securities" under Indian law, but they present a real possibility of cross-market insider abuse. For example, price-sensitive information about a listed tech company entering the blockchain sector could leak into crypto markets, where tokens linked to the company or its ecosystem surge before formal disclosure. This allows sophisticated players to arbitrage across the crypto and equity markets, while regulators remain constrained by jurisdictional silos.

Global watchdogs such as the US SEC and ESMA have raised alarms over insider trading in digital assets, particularly after incidents where exchange employees profited from confidential token listings.¹² In India, however, the absence of a transparent regulatory bridge between SEBI's authority over securities and the RBI's cautious approach to crypto creates fragmentation.¹³ This gap enables regulatory arbitrage, allowing insiders to exploit inconsistencies across jurisdictions and asset classes. Today's challenge is identifying who trades on unpublished price-sensitive information (UPSI) and where and how such trades occur. With financial markets deeply interconnected, insider activity can shift to less-regulated spaces like dark pools, offshore platforms, or crypto exchanges and eventually impact Indian markets. Without stronger cross-border coordination and an expanded surveillance framework, SEBI risks undermining the core principle of fair and transparent market access.

V. AI, SPEED, & THE NEW MEANING OF MARKET MANIPULATION

Traditional insider trading has always focused on access to confidential information, whether

¹¹ European Securities and Markets Authority, *Final Report: Market Structure and Dark Pools in the EU* (ESMA, 2019) <https://www.esma.europa.eu/press-news/esma-news/esma-publishes-final-report-dark-pools>

¹² SEC v. Wahi, No. 22 Civ. 1009 (S.D.N.Y. July 21, 2022), <https://www.sec.gov/news/press-release/2022-127>.

¹³ Reserve Bank of India, *Statement on Developmental and Regulatory Policies* (RBI, April 2018) https://rbi.org.in/Scripts/BS_PressReleaseDisplay.aspx?prid=43574

a trader had an unfair advantage by possessing UPSI before it became public. But in the digital era, speed has become a form of insider advantage. With the rise of high-frequency trading (HFT) and AI-driven algorithmic models, milliseconds can decide profitability. This raises a fundamental question: Does ultra-fast execution enabled by AI amount to a new kind of market manipulation, even when no UPSI is directly involved?

High-frequency algorithms scan massive amounts of market data, detect micro-signals, and execute trades thousands of times per second. When combined with predictive AI, these systems can anticipate order flows or price trends before they are visible to ordinary traders. While technically based on public data, such predictive power creates a functional equivalent of insider trading where the “insider” is not a human with leaked information but an algorithm capable of exploiting information asymmetry in real-time.¹⁴

This challenges the current regulatory paradigm. SEBI’s Prohibition of Fraudulent and Unfair Trade Practices (PFUTP) Regulations, 2003¹⁵ They were designed to address deliberate manipulation, pump-and-dump schemes, false rumours, and circular trading. But AI-driven speed manipulation blurs the line. For example, quote stuffing (where algorithms flood the market with fake orders to slow down competitors) or latency arbitrage (exploiting microsecond delays in information dissemination) can distort markets just as much as traditional insider trading.¹⁶ Yet, these practices often fall into regulatory grey zones because they exploit technological loopholes rather than human misconduct.

Global regulators have begun grappling with these challenges. The US SEC has implemented the Consolidated Audit Trail (CAT) to monitor high-frequency trades more closely. The European Union’s MiFID II imposes stricter reporting and algorithm testing requirements. In contrast, SEBI has introduced tighter co-location norms and mandatory algorithm approvals, but these are still reactive rather than anticipatory frameworks. The deeper issue lies in how we define “manipulation.” If the law continues to view insider trading solely through the lens of UPSI, it risks overlooking the broader systemic distortions caused by AI and speed-driven

¹⁴ Donald MacKenzie, *Trading at the Speed of Light: How Ultrafast Algorithms Are Transforming Financial Markets* (Princeton University Press 2021), <https://www.amazon.com/Trading-Speed-Light-Algorithms-Transforming/dp/B09NS28YLX>

¹⁵ Prohibition of Fraudulent and Unfair Trade Practices (PFUTP) Regulations, 2003.

¹⁶ Christopher Steiner, *Automate This: How Algorithms Came to Rule Our World* (Penguin 2012), available via Wikipedia, https://en.wikipedia.org/wiki/Automate_This

strategies. A re-imagination is necessary, one that sees manipulation not just as the misuse of information but also as the abuse of technology to create unfair advantages.

Ultimately, the emergence of AI in trading suggests that the next generation of insider trading may not involve insiders at all. Instead, it may be rooted in the structural ability of machines to generate and exploit predictive insights at speeds inaccessible to humans. For regulators like SEBI, this calls for a paradigm shift: moving from monitoring access to information to ensuring equality of execution and fairness of technology.

VI. CROSS-BORDER ENFORCEMENT AND SEBI'S GLOBAL DILEMMA

The globalization of financial markets has transformed insider trading from a national problem into a transnational law enforcement challenge. Thanks to AI-powered algorithmic trading and cross-border capital flows, transactions in financial centres such as New York, London, or Singapore can directly impact stock prices in Mumbai. For SEBI, whose jurisdiction is limited to India, this creates a regulatory paradox that impacts Indian securities that may originate from offshore jurisdictions and be traded by entities outside its direct reach. Offshore platforms and foreign institutional investors (FIIs) further complicate the problem, as many algorithmic hedge funds exploit cross-border arbitrage opportunities. When such funds trade based on non-public information about Indian companies and conduct their business through global exchanges or dark pools, SEBI often lacks the legal authority to investigate or compel timely action.

Inconsistent global regulatory standards compound the difficulty. While authorities such as the US SEC and the UK FCA enforce strict insider trading regulations, other jurisdictions are less stringent, particularly concerning digital assets and algorithmic models. This inconsistency encourages regulatory arbitrage, in which sophisticated actors exploit weaker systems to circumvent stricter regulations. Further complicating matters is that effective monitoring of AI-driven trades requires access to communication traces, algorithmic code, and cloud-stored data servers, many of which are overseas. Although SEBI has signed bilateral memorandums of understanding and actively participates in IOSCO on information sharing, slow cross-border cooperation often makes enforcement ineffective. When foreign authorities react, insiders may abandon their positions and erase their digital traces, putting SEBI at a disadvantage.¹⁷

¹⁷ Securities and Exchange Board of India, *Office of International Affairs: Bilateral Memoranda of Understanding* (SEBI), <https://www.sebi.gov.in/hindi/department/office-of-international-affairs-36/oia-bilateral.html>

The dilemma is particularly acute in cryptocurrency markets, where exchanges often operate in jurisdictions reluctant to cooperate with Indian authorities. India risks being exposed to manipulation that undermines market fairness without a harmonized global framework. SEBI's challenge, therefore, is not only to catch offenders but also to redefine regulatory sovereignty in a digital age where trading transcends borders. To protect Indian markets, SEBI must promote a networked regulatory system rooted in real-time cooperation, data sharing, and technological integration with global regulators, as seen in initiatives like the SEBI-SEC Regulatory Dialogue.¹⁸ Only by integrating such mechanisms can India preserve investor confidence and ensure the sustainability of the principle of a "fair market," even when trading takes place far beyond its territorial borders.

VII. RETHINKING LIABILITY: CAN ALGORITHMS BE 'INSIDERS'?

One of the most intriguing, yet least-researched, questions in digital trading is whether algorithms can be considered "insiders." Traditionally, insider trading laws, including SEBI's Prohibition of Insider Trading (PIT) regulations, focus on human actors: executives, employees, auditors, lawyers, or anyone associated with a company with access to unpublished price-sensitive information (UPSI). However, in today's markets, AI-powered algorithms often process and react much faster than humans, sometimes developing trading strategies that replicate the effects of insider trading without human intervention.

The legal dilemma is clear: If an algorithm autonomously executes a trade based on data patterns that reveal UPSI information, who is liable? The programmer who developed the algorithm, the trader who deployed it, the company providing the data feeds, or the algorithm itself as a quasi-legal person? Like most jurisdictions, Indian law does not yet recognize non-human actors in the stock markets as liable entities. However, parallels can be drawn with debates about AI ethics and criminal law regarding machine liability. Imagine an algorithm trained to analyze market-related social media, regulatory filings, and alternative data sources. If such an AI detects, through advanced inference, that a company will announce a merger long before its public disclosure, it could act before that announcement. Technically, no "human insider" disclosed UPSI information, but the predictive power of the algorithm circumvents disclosure requirements and achieves the same result as traditional insider trading. Regulators are wondering: Does this case fall under corporate tax law, or does it constitute an entirely new category of market abuse?

Regulators around the world are beginning to address this issue. The U.S. Commodity Futures Trading Commission (CFTC)¹⁹ is investigating liability for autonomous algorithmic manipulation, while the European Securities and Markets Authority (ESMA)²⁰ has issued guidelines emphasizing that liability must remain with the "responsible human." However, SEBI has not yet taken a clear stance on AI-driven, inference-based trading, although its circulars on algorithmic trading emphasize the need for transition mechanisms and audit trails to ensure traceability.

From a governance perspective, the key challenge is balancing innovation and accountability. Declaring every transaction based on inference illegal would undermine AI's potential to create efficient markets. Ignoring this issue risks creating a legal vacuum that turns algorithms into "super-insiders" operating outside the scope of existing laws. An interim solution could be to introduce a principle of attribution, where liability falls on the person or institution that deployed the algorithm, regardless of proof of intent. This debate also has broader implications for the future of corporate accountability in India. As companies increasingly rely on AI to manage sensitive decisions and transactions, regulators may need to broaden the definition of "insider" to include digital agents or, at the very least, impose strict liability on those who benefit from algorithmic transactions. Without such reforms, insider trading laws risk becoming obsolete in a market where machines, not humans, are the primary decision-makers.

VIII. REIMAGINING SEBI'S REGULATORY TOOLKIT FOR THE DIGITAL ERA

The emergence of algorithmic and artificial intelligence-driven trading has presented SEBI with an immediate regulatory challenge. The question is no longer whether technology will transform securities markets, but whether the regulator is prepared to respond to such transformation in a timely and forward-looking manner. If the framework remains rooted only in traditional safeguards, there is a real possibility that regulation will follow developments rather than guide them. This concern is particularly relevant to the Indian market, where the

¹⁸ Securities and Exchange Board of India & U.S. Securities and Exchange Commission, *Terms of Reference for a Regulatory Dialogue between the US SEC and SEBI* (SEC.gov), https://www.sec.gov/about/offices/oia/oia_bilateral/indiator.pdf

¹⁹ CFTC Staff Advisory: Use of Artificial Intelligence in CFTC-Regulated Markets (Dec. 5, 2024), <https://www.lw.com/admin/upload/SiteAttachments/CFTC-Issues-Staff-Advisory-on-the-Use-of-Artificial-Intelligence-in-CFTC-Regulated-Markets.pdf>.

²⁰ European Securities and Markets Authority, Public Statement: AI and Investment Services (May 30, 2024), <https://www.reuters.com/business/finance/eu-watchdog-says-banks-must-take-full-responsibility-when-using-ai-2024-05-30/>.

growth in trading volumes has been accompanied by a marked shift towards automated systems of order placement. Such conditions demand regulatory tools that can, on the one hand, prevent the misuse of technological advantages, and on the other, allow legitimate innovation to flourish.²¹

At present, SEBI's regulatory design relies heavily upon mechanisms such as scrutiny of trading behaviour, mandatory disclosures concerning unpublished price sensitive information (UPSI), and periodic reporting duties imposed upon companies and intermediaries. These measures were drafted in a regulatory climate where human actors directors, officers, employees, or connected persons were presumed to be the principal subjects of enforcement. The same architecture, though effective in exposing conventional instances of insider trading, does not adequately capture the realities of a digitalised trading environment.²²

The difficulty lies in the fact that machine-driven systems do not act in the manner of human insiders. Algorithms today are capable of drawing inferences by linking unrelated data points ranging from open-source news to satellite imagery of supply chains. Such activity may anticipate market outcomes without any breach of statutory disclosure duties. In this sense, the traditional idea of UPSI becomes less meaningful, since the information advantage is created not by access to confidential corporate material but through computational analysis of publicly scattered data. Alongside this, the growing use of "dark pools" and cross-border trading platforms complicates SEBI's capacity to trace or attribute accountability. Together, these developments reveal a regulatory blind spot and underline the need for SEBI to reconsider whether its existing model, designed essentially for human insiders, is adequate for the challenges posed by AI-based trading practices.

IX. TOWARDS A FUTURE READY REGULATORY TOOLKIT FOR SEBI

SEBI has already taken early steps toward adopting data analytics and machine learning for market surveillance. By collaborating with technology providers, it has begun deploying big-data models that scan vast volumes of trades to detect suspicious clusters and coordinated strategies. These tools have proven effective in identifying patterns such as consistent pre-

²¹ SEBI, Consultation Paper on Algorithmic Trading by Retail Investors, Securities and Exchange Board of India (Jan. 2022), https://www.sebi.gov.in/reports-and-statistics/reports/jan-2022/consultation-paper-on-algorithmic-trading-by-retail-investors_55578.html.

²² Umakanth Varottil, *Insider Trading Law in India: A Historical and Comparative Perspective*, 6 NUS L. Working Paper Series 1 (2016), <https://ssrn.com/abstract=2727922>.

announcement trading gains or unusual volumes in illiquid securities. Yet, while promising, such measures represent only the first layer of what a future-ready regulatory framework should look like in an era dominated by algorithms and AI-driven trading.²³

One possible evolution lies in the creation of real-time algorithm audits. At the moment, firms only make routine disclosures about using such systems, which gives SEBI little insight into how the code actually behaves. A stricter method would require every algorithm to be registered with SEBI and tested in controlled conditions before being put into live trading.

The reporting process also needs to change. Earlier, insider trading cases often depended on tips from people. In a digital environment, however, the machines themselves can act as whistleblowers. Surveillance systems could automatically raise alerts when they detect irregular or suspicious trades and send them straight to the regulator.²⁴

Another safeguard is the use of kill-switches. There have been many examples globally of algorithms triggering flash crashes within minutes. Brokers and exchanges should therefore have the power to shut down faulty or malicious code instantly, in the same way that circuit breakers halt extreme volatility. Liability is also a difficult but essential question. If an autonomous program engages in manipulation, regulators must know who is answerable. A system of organizational liability, where the firm that uses the program remains strictly responsible, may be the most practical solution.

Global regulators offer useful lessons. The U.S. SEC's MIDAS system examines billions of trades every day, while the U.K. FCA has invested heavily in "reg-tech" collaborations to monitor high-frequency strategies. India could borrow from these practices, but at the same time, adapt them to its own market, where retail activity is high and the trading structure is still developing. Cross-border activity complicates things further. Indian investors now trade on foreign crypto and derivatives platforms, making it hard for SEBI alone to regulate. Stronger cooperation with agencies such as the SEC, ESMA, and MAS will therefore be necessary.²⁵

²³ SEBI, Consultation Paper on the "Guidelines for Responsible Usage of AI/ML in the Indian Securities Market", Securities and Exchange Board of India (June 20, 2025), <https://economictimes.indiatimes.com/markets/stocks/news/sebi-proposes-5-point-ai-rulebook-for-securities-market-check-details/articleshow/121976254.cms>.

²⁴ SEBI, Framework on Artificial Intelligence (AI) Tools: A Push Toward Accountable AI, Chambers India (2025), <https://chambers.com/articles/sebi-s-framework-on-artificial-intelligence-ai-tools-a-push-towards-accountable-ai>.

²⁵ Guardrails Ahead for Trading Algos, *Econ. Times* (Jan. 2025),

Essentially, SEBI's system must shift from a compliance-driven approach to one where technology itself becomes part of the regulatory design. Only by preparing for risks in advance, instead of reacting afterwards, can the regulator protect the integrity of India's markets in the digital age.

X. CROSS-BORDER ENFORCEMENT & JURISDICTIONAL CHALLENGES IN AI-DRIVEN INSIDER TRADING

The regulation of insider trading in the digital era is no longer limited to the walls of traditional stock exchanges. Modern markets operate at high speed, are globally linked, and depend heavily on digital platforms. Capital now moves across borders in ways that were unthinkable only a few decades ago. The rise of artificial intelligence and algorithmic trading has intensified this change, making it possible for transactions to take place within microseconds. These trades are often based on large datasets collected from multiple sources around the world. Such developments have improved liquidity and efficiency, yet they have also opened gaps in regulation. When trading activity crosses national boundaries, enforcing insider trading laws becomes a complex task, and regulators face significant difficulties in keeping pace.

The Jurisdictional Mismatch

One of the foremost challenges is the jurisdictional mismatch between national regulators and the global scope of AI-driven trading. Insider trading traditionally falls within the purview of domestic securities regulators such as SEBI in India, the SEC in the United States, or the FCA in the United Kingdom. However, an algorithm deployed in one jurisdiction can seamlessly trade in another, bypassing physical or institutional borders. For example, an AI system hosted on a server in Singapore may execute trades in Indian securities, based on data aggregated from global financial news, social media, and predictive models.²⁶

While SEBI may have suspicions of insider trading, pursuing the case requires access to algorithmic codes, trading logs, and datasets located outside India's legal reach. This creates a gap in enforcement capacity, as domestic regulations were never designed for borderless, machine-driven trading ecosystems. Unlike human traders, AI systems do not communicate in

<https://economictimes.indiatimes.com/opinion/et-editorial/guardrails-ahead-for-trading-algos/articleshow/122009806.cms>.

²⁶ Rajesh Chakrabarti, *Algorithmic Trading and Regulatory Challenges in Emerging Markets*, 44 VIKALPA: J. Decision Sci. 1 (2019), <https://journals.sagepub.com/doi/full/10.1177/0256090919838664>.

ways that leave evidence trails such as emails or recorded conversations. Instead, they rely on machine learning models that operate through complex statistical correlations, often opaque even to their creators. This “black box” nature of AI complicates the task of attributing culpability and establishing intent two key requirements in insider trading cases.

Regulatory Arbitrage and Fragmented Standards

Another dimension that needs to be taken into consideration is regulatory arbitrage, where actors exploit inconsistencies between different jurisdictions. For instance, India’s SEBI (Prohibition of Insider Trading) Regulations, 2015, adopt a relatively broad definition of “unpublished price-sensitive information” (UPSI) and impose stringent restrictions on its use. In contrast to this, some jurisdictions have incorporated much narrower definitions or less robust enforcement mechanisms in their regulations. Perpetrators tend to exploit these gaps by structuring their operations in jurisdictions with weaker insider trading regulations, while still influencing markets elsewhere.

The absence of harmonized global regulatory standards for defining, detecting, and prosecuting AI-driven insider trading has led to the persistence of these discrepancies. Even though international organizations like IOSCO (International Organization of Securities Commissions) have undertaken reforms to promote cooperation, the pace of harmonization is slow compared to the rapid adoption of AI technologies in trading. This results in perpetrators remaining several steps ahead of the regulators.

Cross-Border Data Access and Privacy Conflicts

Enforcement also comes into conflict with various cross-border data privacy laws of different jurisdictions. While conducting an investigation of AI-based trades, access to proprietary algorithms, trading records, and cloud-stored datasets is often required. However, such data may be stored in multiple jurisdictions, each with its own distinct set of legal protections. For instance, the European Union’s General Data Protection Regulation (GDPR)²⁷ Imposes strict rules on data transfers and privacy protections, making obtaining critical information difficult & time-consuming for regulators like SEBI. This conflict between data privacy and financial

²⁷ Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 Apr. 2016 on the Protection of Natural Persons with Regard to the Processing of Personal Data and on the Free Movement of Such Data (General Data Protection Regulation), 2016 O.J. (L 119) 1, <https://eur-lex.europa.eu/eli/reg/2016/679/oj>

enforcement plays the role of creating an additional barrier to cross-border cooperation.

Moreover, companies themselves often claim proprietary rights over their algorithms and trading models, resisting disclosure to regulators. This raises the question of whether traditional regulatory frameworks built for a paper-based era of stockbrokers and human traders are adequate to compel transparency in AI-driven trading environments.

Toward a Global Enforcement Strategy

A two-pronged strategy is required for addressing these jurisdictional and enforcement challenges. Firstly, SEBI must enter into bilateral and multilateral Memoranda of Understanding (MoUs) in order to deepen its cross-border cooperation. Such agreements would play the role of facilitating information exchange, joint investigations, and real-time surveillance of cross-border trades. SEBI's active engagement with IOSCO is a step in this direction, but more tailored collaborations with AI-intensive jurisdictions such as Singapore, the U.S., and the EU are necessary.²⁸

Secondly, a pressing requirement is to establish globally harmonized standards for AI and algorithmic trading oversight. Just as the Basel Accords harmonized banking regulations worldwide, a similar framework is needed in the current sector in discussion that would define minimum standards for algorithm registration, auditability, and liability in the context of AI-driven insider trading. Without global coordination, regulatory gaps will remain fertile ground for exploitation.

XI. A FORWARD-LOOKING PERSPECTIVE

It is clear that the enforcement of insider trading in the AI era illustrates a deeper structural gap. Financial crimes today are global, digital, and instantaneous, while enforcement remains local, manual, and slow. To bridge this structural gap, regulators such as SEBI need to not only upgrade their technological toolkit but also advocate for a more coordinated international legal order. Achieving this objective requires SEBI to assert its role as a progressive regulator that keeps parity between national interests & global cooperation.

²⁸ Int'l Org. of Sec. Comm'ns (IOSCO), *Multilateral Memorandum of Understanding Concerning Consultation and Cooperation and the Exchange of Information* (May 2012), <https://www.iosco.org/library/pubdocs/pdf/IOSCOPD126.pdf>.

In the current digital age, insider trading cannot be solely regulated by domestic law. The need of the hour is a global, technology-driven enforcement regime recognizing AI-enabled financial markets' borderless nature. Without it, regulators will be left reacting to problems long after algorithms have reshaped the trading landscape.

Balancing Innovation and Regulation: Avoiding Overreach in AI Governance

The rapid incorporation of artificial intelligence (AI) into financial markets has led to a transformation in the way trade, monitoring & regulation of securities takes place. Although it is undeniable that AI has led to improvement in efficiency, better detection of fraud & expansion of market access, but at the same time, it has raised critical concerns regarding regulatory overreach. Therefore, a major pressing policy challenge presented to SEBI & other global regulators is striking a balance between enabling innovations & concurrently ensuring market integrity. This is because imposing excessive regulation presents the risk of stifling creativity and pushing innovators to less restrictive jurisdictions, whereas under-regulation risks unchecked misuse of AI, including sophisticated insider trading and market manipulation.

The Innovation Regulation Dilemma

For regulators like SEBI dilemma stems from the dual character of AI. On one hand, AI tools help regulators themselves by enhancing surveillance, automating compliance checks, and identifying unusual trading behaviour faster than human teams ever could. From a regulatory perspective, AI has emerged as a valuable instrument, strengthening surveillance, automating compliance checks, and identifying irregular trading patterns with far greater speed and accuracy than traditional human-led processes. Yet, without proper safeguards, these very technologies can also be misused by market participants, who may rely on predictive models to anticipate price movements in ways that closely resemble or even substitute for the exploitation of insider information.

If regulators take the excessively stringent path of imposing a blanket ban on AI trading models or mandatory disclosure of proprietary algorithms, they risk discouraging financial institutions, startups, and fintech firms from experimenting with beneficial applications of AI. This could act as an impediment to India's ambition of becoming a global hub for financial innovation, particularly in areas like algorithmic trading, robo-advisory services, and blockchain-based

securities settlement.²⁹

XII. LESSONS FROM OTHER JURISDICTIONS

For developing a forward-looking regulatory framework for AI-driven trading in India, examining & taking inspiration from other jurisdictions regarding the approach taken by them to deal with such challenges will prove to be fruitful. Even though none of these models is flawless, each provides its own important set of lessons on striking a balance between market efficiency, innovation, and investor protection.

United States

The United States has historically taken a principle-based approach through the Securities and Exchange Commission (SEC) for the purpose of regulating technology in financial markets. Instead of overly regulating or imposing a blanket ban on algorithmic and AI-driven trading, the SEC places emphasis on accountability and risk management. Rules such as the *Market Access Rule (2010)*³⁰ make it mandatory for brokers and exchanges to maintain strong risk controls, including mechanisms to prevent erroneous trades and manipulative activity. As an important measure, even if a trade is being executed by an autonomous system, the accountability ultimately rests with the broker or firm deploying that system. This ensures that accountability cannot be shifted onto machines. The SEC has also been active in enforcement & penalizing firms that failed to maintain adequate safeguards, thereby sending a clear signal that technological innovation does not provide immunity from regulatory responsibility. For India, the American model demonstrates the value of allowing innovation while firmly holding institutions accountable for outcomes.

European Union

In contrast to the United States, the European Union takes a more prescriptive stance. Under the *Markets in Financial Instruments Directive II (MiFID II)*³¹, firms engaging in algorithmic

²⁹ Chambers & Partners, *Fintech in India: An Overview of the Current Regulatory Landscape*, Chambers Thought Leadership (2025), <https://chambers.com/articles/fintech-in-india-an-overview-of-the-current-regulatory-landscape/>

³⁰ Risk Management Controls for Brokers or Dealers With Market Access, 17 C.F.R. § 240.15c3-5 (2010), <https://www.sec.gov/rules-regulations/2011/06/risk-management-controls-brokers-or-dealers-market-access>

³¹ Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on Markets in Financial Instruments (MiFID II), 2014 O.J. (L 173) 349, <https://eur-lex.europa.eu/eli/dir/2014/65/oj/eng>.

trading must comply with detailed obligations, including stress-testing their algorithms under extreme market conditions and maintaining comprehensive records of every order placed. These requirements create a transparent audit trail, which allows regulators to reconstruct the behaviour of an algorithm at any given point in time. Senior management is also made explicitly responsible for ensuring compliance, meaning accountability cannot be diluted within an organization. While MiFID II has increased compliance costs and created additional burdens for smaller firms, it has also improved market confidence by embedding transparency and accountability into the regulatory system. For SEBI, the EU model suggests the importance of incorporating audit trails and rigorous testing standards, though such measures may need to be adapted to avoid overwhelming Indian firms with excessive compliance requirements.

Singapore

Singapore has established itself as a leader in creating a regulatory environment that supports innovation while maintaining oversight. The Monetary Authority of Singapore (MAS) was one of the first regulators to introduce a regulatory sandbox, giving banks and fintech companies the opportunity to trial AI-based applications within a closely monitored framework before bringing them to the wider market. This approach promotes experimentation while enabling regulators to observe risks as they emerge and put protective measures in place as needed. Alongside the sandbox, MAS introduced the FEAT principles of fairness, ethics, accountability, and transparency as foundational standards to promote the responsible application of AI in the financial sector. What sets Singapore's approach apart is the regulator's willingness to collaborate closely with market participants, researchers, and technology experts in developing its policies. This collaborative ethos guarantees that regulatory frameworks stay practical and pertinent, adapting to the swift transformations occurring in global financial markets.³²

United Kingdom

The approach adopted by the Financial Conduct Authority (FCA) in the United Kingdom is a blend of proportionality and flexibility. Instead of enforcing a uniform framework, the FCA tailors regulatory expectations to the scale and risk profile of the various institutions. Larger

³² Cleary FinTech Update, *Meet FEAT: Singapore's New AI and Data Analytics Principles for the Financial Sector* (Nov. 29, 2018), <https://www.clearyfintechupdate.com/2018/11/meet-feat-singapores-new-ai-data-analytics-principles-financial-sector/>

market players utilizing high-frequency or complex AI systems are subjected to stricter obligations, while smaller firms receive lighter oversight.³³ The FCA also places emphasis on outcomes rather than technical processes. What specifically needs to be taken into consideration is whether a firm's practices preserve market integrity and investor protection, not necessarily the inner workings of its algorithms.

To further support innovation in financial services, the FCA set up an "Innovation Hub," a platform designed to guide fintech startups on regulatory compliance as they experiment with new AI-based solutions. This initiative reflects the UK's balanced approach: ensuring that smaller firms are not burdened with excessive rules while still holding larger and more systemically important institutions to a higher standard of oversight. For SEBI, the lesson from the UK experience is clear regulation should be flexible enough to foster innovation but robust enough to safeguard market integrity.

Synthesis for India

When viewed together, these global models highlight the range of strategies regulators have adopted. In the United States, the focus lies on accountability, backed by flexible yet firm rules. The European Union takes a more prescriptive route, insisting on transparency and detailed compliance obligations. Singapore, by contrast, encourages innovation through its use of regulatory sandboxes, while the United Kingdom emphasizes proportionality, tailoring oversight to the size and risk profile of firms. For SEBI, the most practical approach may not be to choose one model over another, but rather to draw selectively from each: combining the SEC's strict enforcement culture, the EU's emphasis on transparency, Singapore's innovation-friendly sandbox, and the FCA's balanced, proportional regulation. A hybrid framework of this kind would strengthen India's ability to protect market integrity while also building its reputation as a global centre for financial technology.

XIII. PRINCIPLES FOR BALANCED AI REGULATION

Designing a regulatory framework for AI in trading requires striking a fine balance: encouraging innovation while preventing risks that could destabilize markets or harm investors. Overly restrictive rules may discourage technological growth, while a lack of oversight could

³³ Finnovation UK, *FCA's Support for Innovation and Spotlight on the Sandbox Initiative* (2023), <https://finnovation.uk/fcas-support-for-innovation-and-spotlight-on-the-sandbox-initiative/>

expose markets to manipulation, systemic failures, and loss of trust. To navigate this balance, SEBI could adopt a set of guiding principles that reflect both global best practices and India's specific market realities.

Technology Neutrality

A core principle for AI regulation should be technology neutrality. Markets evolve rapidly, and new tools from algorithmic trading to machine learning-based decision systems emerge faster than regulations can keep up.³⁴ If SEBI were to design rules targeting a specific technology, such as AI or neural networks, these rules could quickly become obsolete as new systems emerge. Instead, regulation should focus on the effects of trading behaviour, not the technology itself. Whether a suspicious trade is carried out by a human trader, a simple algorithm, or a complex AI system, the regulatory yardstick should remain the same: does the activity distort the market, exploit investors, or undermine fairness? By remaining technology-agnostic, SEBI can future-proof its framework and avoid a constant cycle of rewriting rules for each new technological wave.

Proportionality

Another vital principle is proportionality, which ensures that regulatory oversight matches the level of risk posed by the system. For example, a high-frequency trading (HFT) platform capable of processing thousands of trades per second across multiple exchanges clearly carries more systemic risk than a low-volume AI tool used by a small brokerage for portfolio optimization. Applying the same compliance burden on both types of players would be unfair and counterproductive it could stifle innovation among smaller firms while failing to address the unique challenges posed by larger, high-impact actors. SEBI should therefore tailor its oversight, applying more rigorous risk controls, stress tests, and reporting requirements to large-scale AI-driven systems, while offering lighter, more supportive regulation to smaller firms. This tiered approach would maintain fairness without sacrificing safety.

Regulatory Sandboxes

India has already experimented with regulatory sandboxes in the fintech sector, and extending

³⁴ Int'l Org. of Sec. Comm'ns, *Technological Innovations in Securities Markets: Market Integrity and Investor Protection* (2016), <https://www.iosco.org/library/pubdocs/pdf/IOSCOPD554.pdf>.

this model to AI-driven trading could be a game-changer. A sandbox allows firms to test their algorithms and AI solutions in a controlled, closely monitored environment, where regulators can observe their functioning without exposing the entire market to risk. This benefits both innovators and regulators: firms gain the freedom to experiment without fear of penalties, while SEBI gains valuable insights into how new AI systems work and what risks they might create. Singapore's MAS has demonstrated how sandboxes can foster innovation while ensuring accountability, and India could build on this model by creating specialized sandboxes for capital markets. In doing so, SEBI would encourage the development of cutting-edge AI solutions while maintaining strong guardrails.³⁵

Outcome-Oriented Oversight

One of the greatest challenges in regulating AI is the tension between transparency and intellectual property rights. Firms are often reluctant to disclose their proprietary algorithms, fearing loss of trade secrets and competitive advantage. Instead of demanding full disclosure of algorithms, SEBI could adopt an outcome-oriented approach. This means focusing on whether the system can be audited, tested, and explained, rather than on its internal coding. For instance, regulators could require firms to demonstrate that their AI models are compliant with trading rules, capable of generating an audit trail, and explainable when questioned. This approach strikes a balance between protecting proprietary technology and ensuring that regulators have sufficient visibility to detect and address risks.

Collaborative Governance

Finally, effective AI regulation cannot be a top-down exercise. Given the complexity of AI systems and the speed at which technology evolves, SEBI would benefit from adopting a collaborative governance model. This would involve regulators, industry stakeholders, academic researchers, and technology experts working together to develop guidelines and best practices for ethical AI use in trading. Such a participatory model has two advantages: it ensures that regulations remain practical and grounded in real-world market practices, and it builds trust between industry and regulators. Firms are far more likely to comply with rules they had

³⁵ Luqing Gao, Shusen Qi & Lev Ratnovski, *Regulatory Sandboxes and Fintech Funding: Evidence from the UK*, BIS Working Papers No. 901 (Bank for Int'l Settlements, Sept. 2020, rev. Apr. 2023), <https://www.bis.org/publ/work901.htm>.

a hand in shaping, while SEBI gains the benefit of diverse expertise in crafting forward-looking standards.³⁶

Avoiding the Chilling Effect

One of the risks of regulatory overreach is the chilling effect, where firms avoid innovation due to fear of excessive compliance costs or regulatory uncertainty. This has been observed in some jurisdictions where fintech startups relocated operations to more permissive environments. For India, this risk is particularly relevant because the country's financial ecosystem relies heavily on fintech growth, with AI-powered tools central to its digital finance revolution.

To mitigate this, SEBI should prioritize clarity and predictability in its regulations. Instead of frequent and unpredictable amendments, regulators should publish clear roadmaps, giving innovators confidence that compliance will not become an insurmountable burden. Regulatory flexibility, coupled with transparent consultation processes, will encourage firms to innovate responsibly within India's legal framework rather than seeking opportunities abroad.

XIV. CONCLUSION

The incorporation of artificial intelligence (AI) into capital markets marks a structural shift rather than a mere technological upgrade. AI-driven trading, risk assessment, and surveillance tools are redefining the operations of India's financial system, placing SEBI at a critical juncture. While AI promises faster price discovery, stronger risk management, and improved liquidity, it also carries risks of flash crashes, amplified volatility, and unintended collusion. Regulation, therefore, must not stifle innovation but create safeguards that ensure fairness and investor confidence.

Global experiences highlight different regulatory approaches. The United States stresses accountability of human actors, the European Union emphasizes ethical safeguards and transparency, and Singapore has pioneered sandboxes for controlled experimentation. Each model illustrates the balance between innovation and oversight, showing that effective

³⁶ Organisation for Economic Co-operation and Development (OECD), *The Role of Collaborative Platforms for Responsible AI in the Financial Sector* (2021), <https://www.oecd.org/finance/responsible-ai-in-finance.pdf>.

regulation must be flexible, proportional, and collaborative. For India, adopting a hybrid approach tailored to its retail-heavy markets and fintech growth offers the best path forward.

To achieve this, SEBI must evolve from a compliance enforcer into a proactive guardian of market integrity. This requires investment in advanced data analytics, real-time monitoring, and frameworks that clearly attribute liability for AI-driven actions. With its technological expertise and growing role as a financial hub, India has the opportunity to craft a regulatory model that ensures AI strengthens transparency and inclusiveness while avoiding systemic risks. By embedding accountability and trust, SEBI can transform AI from a potential disruptor into a tool of resilience and set a global precedent in responsible financial innovation.