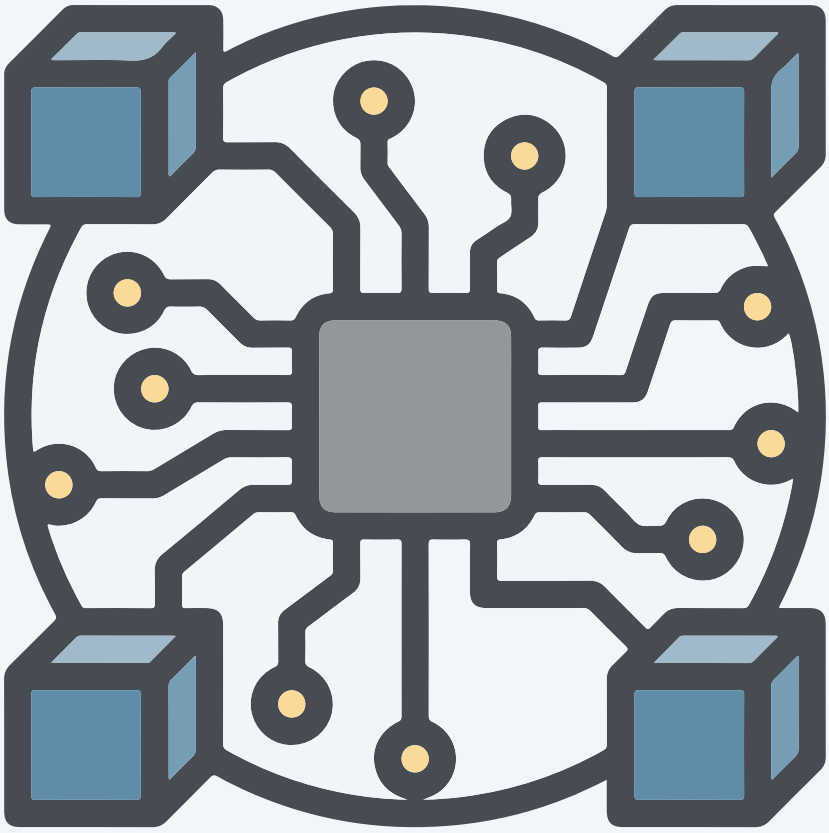
SECP

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

CONCEPT PAPER

REGULATING ALGORITHMIC TRADING IN PAKISTAN'S CAPITAL MARKET



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1. Introduction

Trading in the securities market has evolved significantly overtime, transitioning from open outcry trading system, to electronic trading. This dates back to the early 1970's with the establishment of the first electronic exchange, the NASDAQ. This instigated a global shift from manual trading to electronic trading transforming the financial sector landscape considerably. Later enhanced computing power and increase in data availability paved the way for the emergence of algorithms. Earlier algorithms were relatively simpler mainly used for trade execution. In 1990s, algorithmic trading gained significant traction with the emergence of sophisticated algorithms. The 2000s saw further advances in the algorithmic trading with the integration of machine learning and artificial intelligence. As such, capital market participants have also embraced these innovations for trading in the stock market. Today, trading in the capital markets is no longer measured in minutes or seconds but in time units such as milliseconds and microseconds.

2. Algorithmic Trading: Evidence from India, Australia, EU and the US.

Algorithmic trading has become increasingly prevalent across developing and developed capital markets. Below are key statistics highlighting the extent of algorithmic trading in competitive capital markets:

- In the United States, machine-led orders accounted for 80% of the daily trading volume in equity market in 2018[1].
- In India, more than 50% of total orders on the National Stock Exchange (NSE) and Bombay Stock Exchange (BSE) are client-side algorithmic trades, while prop-side algorithmic trades constitute over 40%. Notably, more than 80% of these algorithmic orders are generated from colocation facilities at both exchanges[2].
- As per a report published by the European Central Bank, algorithmic trading has been growing steadily since the early 2000s and, in some markets, is already used for around 70% of total orders[3].

These figures demonstrate that the concept of algorithmic trading has been around for a considerable amount of time in multiple jurisdictions.

3. What is Algorithmic trading?

Descriptions and Legal Definitions

There is no standardized or universally accepted definition of algorithmic trading as such each, securities regulator has adopted its own definition. Based on the jurisdictions reviewed the following definition is proposed:

Algorithmic trading: any order of trade that is fully or partially submitted, generated or executed using automated execution logic, or employs automated strategies using programmable logic.

[1] https://www.cnbc.com/2018/12/05/sell-offs-could-be-down-to-machines-that-control-80percent-of-us-stocks-fund-manager-says.html
[2] https://www.ajnifm.ac.in/sites/default/files/uploadfiles/Compendium.pdf
[3] https://www.bankingsupervision.europa.eu/press/supervisory-newsletters/newsletter/2019/html/ssm.nl190213_5.en.html

4. Advantages of Algorithmic Trading

The growing adoption of algorithmic trading can be attributed to its numerous advantage.

a) Improves market liquidity

Algorithmic trading enables traders to automate the execution of trades, resulting in faster and efficient transactions. The automation and speed ensure constant supply of buy and sell orders across various asset classes. This constant presence in the market enhances liquidity by narrowing bid-ask spreads and providing counter party for trades. Research conducted by Columbia Business School found a strong impact of Algorithmic trading on market liquidity, it was found that increase in algorithmic trading is strongly associated with more liquidity in the equity markets. The study utilized panel regression over five years of New York Stock Exchange (NYSE) stocks[4].

b) Reduce costs for brokerage firms

Automation eliminates the need for human intervention, significantly reducing staff costs and errors. It also cuts transaction costs by reducing the necessity for constant market monitoring, saving time and decreasing opportunity costs. Institutional investors execute large trades in the market which is usually larger than what the market can absorb without impacting the price. Algorithmic trading strategies like TWAP (Time-Weighted Average Price) and VWAP (Volume-Weighted Average Price) are used to split large orders into small orders which will be executed electronically throughout the day over a specified time period. This can be beneficial for large institutional investors, such as banks.

c) Greater speed and reduced human error

Algorithmic trading offers much higher speed and efficiency over humans. This speed advantage enables traders to capitalize on fleeting market movements that human traders may miss. Algorithms can operate 24/7 without any burnout or fatigue. They lack human emotions such as greed, fear, overconfidence, tiredness etc. Algorithms can process and analyse vast amounts of data and can handle complex calculations quickly and accurately, reducing the risk of miscalculations or manual mistakes. This increased accuracy and efficiency make algorithmic trading a valuable tool for improving the reliability and effectiveness of trading strategies.

5. Disadvantages of Algorithmic Trading

a) Investment in technical capabilities and resources

Algorithmic trading requires investment in technical capabilities which includes specialized software, and data infrastructure to develop and maintain sophisticated trading algorithms. Institutional investors are the main benefactors of this technology as the procurement cost of this technology particularly high frequency trading and co-location services is on the higher side. As number of market participants adopting algorithmic trading increases, the competition shifts to algorithms competing against each other. This intensified competition can result in diminishing returns for participants who are unable to keep up with the speed and sophistication of the algorithms, further concentrating market power among those with the best technology.

[4] https://business.columbia.edu/sites/default/files-efs/pubfiles/4051/Does%20Algorithmic%20Trading%20Improve%20Liquidity.pdf

b) Market Manipulation

Algorithmic trading and HFT can be used to manipulate markets using techniques like quote stuffing, layering, spoofing and momentum ignition. Evidence suggests that market manipulation algorithms lead to decreased liquidity, higher trading costs, increased short term volatility. In one such instance, US CFTC charged a trader N.Sarao who employed layering algorithm and repeatedly submitted large sell limit orders away from the best quotes in the E-Mini S&P500 futures limit order book, without intending these orders to be executed.

c) Systemic Risk

The widespread use of algorithmic trading, especially in high-frequency trading (HFT), can introduce systemic risks to the financial markets. Algorithms which are designed to react instantly to market changes, can exacerbate price fluctuations during periods of market stress. For example, when multiple algorithms are programmed to respond to the same signals (such as price declines), this can lead to rapid, widespread selling, amplifying price drops and contributing to phenomena like flash crashes. Flash crashes, such as the infamous 2010 "Flash Crash" in the U.S. stock market, were partially attributed to the actions of algorithms. In that event, the rapid automated sell orders from high-frequency traders led to a temporary but significant plunge in stock prices.

6. Prohibited Activities in Algorithmic Trading

While recommending principles for the adoption of algorithmic trading, the Securities and Exchange Commission of Pakistan (SECP) expects that securities brokers adhere to the following restrictions. These restrictions are intended to ensure that the introduction of algorithmic strategies does not compromise market integrity, transparency, or investor protection. Brokers must ensure that their use of algorithmic trading remains fully compliant with these restrictions:

1. Market Abuse:

Engaging in false or fraudulent trading, or in any form of market manipulation or deceptive practice, as defined under the Securities Act, 2015, is strictly prohibited. This also includes, but is not limited to, placing orders without a genuine intention to execute for the purpose of misleading the market by creating an illusion of market interest, price movement, or trading volume, as well as submitting a high volume of orders in rapid succession with the intent to overwhelm market systems and disrupt the trading activity of other participants.

2. Non-Compliance with Client Segregation Rules:

Using the same algorithm to manage orders for multiple clients without implementing clear client-level segregation or without ensuring that each client's trades are handled independently, fairly, and without preferential treatment.

3. Disruption of Market Orderliness:

Deploying algorithms that could cause or exacerbate volatility, instability, or latency in the market, leading to disorderly trading.

4. Bypassing Surveillance or Controls:

Circumventing or interfering with any regulatory, exchange, or broker-level monitoring systems, including audit trails or controls.

7. Recommendations for Algorithmic Trading Framework

The following recommendations given below are derived from international regulatory best practices that should be considered for inclusion in guidelines to be issued for Algorithmic trading.

Responsibilities of the Exchange:

1. Prior intimation and Registration with the Exchange

Securities Brokers that intend to employ algorithms for trading in the securities market must seek prior approval from the Exchange and register their algorithms along with the associated strategies. To facilitate this process, it is recommended that registration forms be developed as part of the guidelines. Interested applicants will be required to submit detailed documentation related to the algorithmic strategies they intend to use, along with controls in place to prevent potential abuse.

In addition to securities brokers, algorithm developers and third-party software vendors whose services are intended to be utilized must also be registered with the Exchange. Disclosures regarding such third-party involvement must be provided at the time of application. Furthermore, securities brokers shall be responsible to report any subsequent changes or modifications to their algorithms. Failure to report such changes or modification in a timely manner should result in strict regulatory penalties.

- In India, the SEBI has mandated that stock exchanges ensure that stock broker shall provide the facility of algorithmic trading only after obtaining prior approval from the stock exchange.
- The Stock Exchange of Thailand (SET) and the Thailand Futures Exchange (TFEX) also require users of algorithmic trading to obtain prior approval.
- In China, the Shanghai Stock Exchange (SSE) requires firms to report their intention prior to engaging in algorithmic stock trading for first time. Algorithmic trading can only commence after the SSE confirms the receipt of the report.
- US SEC and FINRA require algorithmic trading developers to register as securities trader. Additionally, they are required to pursue a qualification exam and are subject to continuing education requirements.

2. Testing of Algorithms by the Exchange

All algorithms and related strategies requiring prior approval from the Exchange, must undergo an Initial Conformance Test. Before going live, all algorithms must be tested by the securities brokers in PSX UAT environment. This test is essential to evaluate whether a particular algorithm will function effectively in the real market conditions. Such testing can uncover performance issues, market manipulation algorithms or faulty algorithms. Following the initial conformance test, subsequent periodic testing should be scheduled accordingly.

- **IOSCO:** Regulators should require firms to adequately test and monitor the algorithms to validate the results of an AI and ML technique on a continuous basis. The testing should be conducted in an environment that is segregated from the live environment prior to deployment to ensure that AI and ML: (a) behave as expected in stressed and unstressed market conditions; and (b) operate in a way that complies with regulatory obligations.
- Indian stock exchanges are required to conduct initial conformance testing and schedule subsequent conformance tests.
- In Thailand, the exchange is required to conducts risk management test under the testing environment provided by itself.
- In its guidelines SFC Hong Kong has also emphasised the need for licensed corporations (LCs) to test algorithmic trading system and trading algorithms.
- FINRA requires firms to develop policies and procedures for testing and system validation. This includes ensuring that testing verifies the core code components function as intended. Additionally, a quality assurance process must be in place, ensuring that testing is conducted independently of the code development process.

3. Service Level Agreements

The increasing complexity of financial markets necessitates standardised service level agreements (SLAs) and contracts in place between the market participants to ensure transparency and avoid potential disputes. These agreements must clearly define the rights, responsibilities, and obligations of each party. The different types of existing agreements are listed below:

i. Agreement between the Exchange and Broker
ii. Agreement between the Broker and Third-party algorithms provider
iii. Agreement between the Broker and Client

Based on a review of a few publicly available contracts, the following key components, among others, have been identified that should be considered for incorporation when drafting contracts. It is important to note that this list is not exhaustive and may require further clauses based on specific requirements.

i. Agreement between the Exchange and Broker

Exchange:

- The Exchange will ensure that its systems are available for algorithmic trading, with clear maintenance schedules and system updates communicated in advance to minimize disruption.
- Must establish and maintain robust procedures for responding to technical issues or platform failures, ensuring timely access to support for users and transparent reporting mechanisms for incidents.
- Regularly assess the performance of its IT systems and undertake necessary upgrades to support the growing speed and complexity of trades resulting from algorithmic trading.
- The Exchange will not attempt to break, reverse-engineer or replicate brokers algorithms or strategies.
- The Exchange reserves the right to periodically assess the algorithms and related systems to ensure continued compliance with the registration criteria.

Brokers responsibilities:

- Maintain compliance with all applicable laws and regulations, set by the exchange and regulatory authorities.
- Notify the exchange promptly about any updates or modifications to their algorithms related systems or processes.
- Implement appropriate risk management systems to monitor and control algorithmic trading activities, ensuring that the systems are capable of preventing potential market disruptions.
- Implement strong cybersecurity measures to safeguard their algorithmic trading systems and protect any sensitive data and client information, from unauthorized access, hacking, or data breaches.

ii. Agreement between the Broker and Third-party algorithms

Third Party algorithms provider:

- Ensure that algorithms comply with the applicable laws, regulations and restrictions set by the Exchange and regulatory authorities.
- Complete and pass required testing and approval process before deploying the algorithm for live trading.
- Guarantee the algorithms meets agreed-upon performance benchmarks and adheres to risk management protocols.
- Provide dedicated support services to users for troubleshooting and addressing issues promptly.

- **IOSCO:** Regulators should require firms to understand their reliance and manage their relationship with third-party providers, including monitoring their performance and conducting oversight. To ensure adequate accountability, firms should have a clear service level agreement and contract in place clarifying the scope of the outsourced functions and the responsibility of the service provider. This agreement should contain clear performance indicators and should also clearly determine rights and remedies for poor performance.

iii. Agreement between the Broker and Client

Brokers :

- Maintain transparency in communicating risks and operational aspects of algorithmic strategies to clients.
- Provide a reliable infrastructure and update technology as needed to support algorithmic trading activities.
- Retain the right to terminate the agreement if the client fails to adhere to terms and conditions or breaches legal requirements.

Client:

- Confirm understanding of risks (e.g., system failures, incorrect algorithm execution, market volatility).
- Follow all exposure limits, trading guidelines, and restrictions set by the broker, exchanges and regulatory authorities.
- Ensure timely payment of applicable brokerage, fees, and statutory charges, ensuring they adhere to prescribed maximum limits.
- Accept responsibility for penalties, damages, or costs arising from breaches, errors, or other issues linked to algorithmic trades.

- **IOSCO:** Regulators should consider what level of disclosure of the use of AI and ML is required by firms, including: (a) Regulators should consider requiring firms to disclose meaningful information to customers and clients around their use of AI and ML that impact client outcomes. (b) Regulators should consider what type of information they may require from firms using AI and ML to ensure they can have appropriate oversight of those firms.

4. Issuance of Unique Code

The Exchange prior to granting approval to securities broker for trading via algorithms in the securities market must issue a unique code to all algorithms. The tagging of algorithms with unique codes will enable the clear identification of each algorithm or end user, facilitating precise post-trade analyses and audit.

- SEBI requires that all algorithmic orders are tagged with a unique identifier provided by the stock exchange in order to establish audit trail.
- In other jurisdictions regulators like SET, SFC, FCA, CSRC, SGX and FINRA require firms to have proper identification and oversight systems in place.

5. Stress Testing

Stress testing involves the use of a simulated market environment to evaluate the performance of an algorithm. The algorithms are exposed to extreme market conditions to evaluate its performance and ability to handle high-pressure scenarios like sudden price movements, high order volumes or illiquid markets before deploying the algorithms in real trading environments. Stress testing help regulatory bodies identify any potential flaws or vulnerabilities by mimicking volatile market condition. Regulators in other jurisdictions require either the Exchange to stress test the algorithms or require brokerage firms to conduct stress test on their own and submit testing results to the Exchange.

- SGX requires trading members to consider the following stress test scenarios:
  - **Extreme Market Conditions** such as periods of extreme volatility, price movement, or liquidity stresses.
  - **Capacity Testing** assess evaluates system performance during volume spikes, ensuring systems can handle volatility without compromising functionality.
  - **Multiple algorithms** operate simultaneously, they may unintentionally impact the market, such as driving prices in one direction without proper limit controls. Members should test algorithms together to ensure their combined behaviour does not cause unintended consequences.
  - **External Connectivity** issues such as delays, disconnections, or rejected orders from trading platforms can affect algorithms performance. Trading members should ensure that these algorithms are able to detect these problems, pause trading or adjust.

- The ESMA in its directive requires investment firms to stress test its trading systems and the procedures and controls.
- Similarly, the SFC Hong Kong requires capacity stress testing Licensed Corporations (LCs) formulate stress test scenarios and assess the system under different adverse market conditions.
- In Thailand SET and TFEX provide testing environment for testing of algorithms.

6. Order to Trade Ratio

The order to trade ratio measures the total orders submitted to the number of orders actually filled. A high ratio means that market participants are placing orders but not executing most of the orders. The underlying cause for this could be the use of market manipulation algorithms, where orders are placed to drive volumes to a point and then cancelled. Regulators around the world penalise market participants if they exceed a certain threshold set by the regulators.

- Borsa Istanbul: If the ratio of total number of orders submitted, modified and cancelled to total number of trades executed by the member exceeds 5:1, a fixed fee of 0.25 TL is charged for each order transmission /correction/cancellation operations causing this ratio to be exceeded.
- Stock exchanges in India (NSE and BSE) impose a penalty and trading ban for 15 minutes on brokers who have high order to trade ratio.

7. Order placement timing and limit

Algorithmic trading may not be allowed during the pre-open session or through off-hours order collection mechanism at the exchange, as such activities may distort fair price discovery. The exchange may put in place necessary controls for time-stamping to ensure that that algorithmic orders cannot be placed outside regular trading hours. Further, order threshold limits may also be enforced, wherein, algorithmic order management systems (OMS) may be capped at the specified orders per second. The non-algorithmic systems (including OMS) may adhere to a lower limit of orders per second. These measures may be introduced to ensure fair and orderly market operations under the oversight of the Exchange.

Responsibilities of Securities Brokers:

8. Pre-trade Controls

Pre-trade Controls are designed to prevent errors before trades are executed such as:
1. **Price Limits:** These are price bands to be implemented on broker level.
2. **Order Value Check:** This control prevents the execution of orders that exceed the maximum allowed per order limit.
3. **Volume Control:** This control prevents orders with an unusual large order size from entering the order book.
4. **Burst Control:** This mechanism restricts sending excessive number of messages to order books, ensuring that market participants don't flood the system.

- Regulators like FCA, SEBI, SGX and SFC require trading firms to implement appropriate pre-trade controls.

9. Post-trade Controls

Post-trade controls play an important role in identifying and addressing any trading activities or behaviours that may have bypassed the existing pre-trade controls.

1. **Ongoing monitoring:** Real time monitoring by brokerage firms can help in early detection of trading patterns arising from dysfunctional algorithms.
2. **System health checks:** Regular system examinations can help identify system hardware or software related issues. Ensuring optimal performance, and preventing system overloads.
3. **Regular audit reviews:** Independent audit reviews on internal controls and processes related to algorithmic trading activities can help detect potential problems before they escalate.

- **IOSCO recommendation for trading participants:** All order flow of trading participants, irrespective of whether they are direct venue members or otherwise, must be subject to appropriate controls, including automated pre-trade controls. These controls should be subject to the regulatory requirements of a suitable market authority or authorities. In addition, regulators should identify any risks arising from currently unregulated direct members/participants of trading venues and, where any are identified, take concrete steps to address them.

10. Governance and Oversight

Brokers making use of algorithmic trading must establish strong internal controls and ensure effective oversight around its use. Oversight should be managed by designated senior management responsible for overseeing the development, testing, deployment, and control of algorithmic trading. This includes maintaining comprehensive documentation, audit trails, approval records, and testing results. Brokers should also ensure that proper escalation channels are in place, and that staff involved in handling algorithmic systems are adequately trained. Additionally, they should develop policies and procedures around all aspects of algorithmic trading and ensure its implementation.

- **IOSCO:** Regulators should consider requiring firms to have designated senior management responsible for the oversight of the development, testing, deployment, monitoring and controls of AI and ML. This includes a documented internal governance framework, with clear lines of accountability. Senior Management should designate an appropriately senior individual (or groups of individuals), with the relevant skill set and knowledge to sign off on initial deployment and substantial updates of the technology.
- Regulators of jurisdictions reviewed such as SGX, SET & TFEX, SFC and the FCA recommends the following
  - Establish a risk management policy for Algorithmic Trading covering development, testing, deployment, customer supervision, and regular procedure reviews.
  - Designate a supervision unit to ensure compliance, oversee Algorithmic Trading, manage strategy approvals, handle incidents, and regularly review risk measures.
  - Have proper procedure for troubleshooting and escalation.
  - Implement a system to record all Algorithmic Trading related activity for audit trail.

11. Kill Switch Functionality

A kill switch is like an emergency tool designed to immediately halt all trading activities if an algorithm suddenly starts malfunctioning. Kill switch stops new order submissions and cancels all outstanding orders. Brokers that use algorithms to submit their trades must have the capability to activate this function quickly, ensuring prompt shutdown of trade flows to prevent erroneous orders from reaching the market. This safeguard is regarded as a mandatory requirement by numerous regulatory authorities globally.

- Regulators of the jurisdictions reviewed (SGX, SFC, Thailand, FSA Japan, FINRA) mandates members to have the ability to activate kill switch to prevent erroneous orders from being submitted to the market.

12. System Audit

Regulatory bodies in different jurisdictions require brokers engaged in algorithmic trading to undergo regular independent system audits to ensure compliance with existing laws and maintain market integrity. Additionally, brokers are required to maintain audit trails, comprehensive records of algorithmic trading activities, including control parameters, orders, trades, and key data points to facilitate effective oversight and enable the detection of irregularities.

- SEBI demands that all stock brokers submit an annual system audit report. Further the system audit shall be conducted by a system auditor who possesses CISA, DISA, CISM and CISSP certifications. Further, the stock exchange shall subject the stock broker systems to more frequent system audits, if required.
- All the other jurisdictions (Annexure-A) require firms engaged in Algorithmic trading to conduct regular audits and submit the results to the stock exchange.

General Recommendations:

13. Allowing Algorithmic Trading for institutional investors only

As Pakistan is at its preliminary stage of developing its regulatory framework for Algorithmic Trading, it is proposed, that a phased approach be adopted. In the initial phase, only institutional investors will be granted access to algorithmic trading. Regulators around the world also recognize the risks and challenges posed by algorithmic trading for retail traders. Consequently, regulatory bodies have implemented stringent frameworks to regulate this activity and protect investors interests. For example, in 2008 the Indian regulator (SEBI) introduced algorithmic trading for institutional investors only through Direct Market Access (DMA). In 2016, with the introduction of API's retail traders gained access to unregulated algorithmic trading. This also led to a surge in third-party algorithmic providers, which were operating unregulated promising substantial returns and lucrative profits. This led to financial losses for the investors while also impacting the functioning of the Exchange[5]. Later in 2021, the Indian regulator SEBI initiated steps aimed at regulating retail participation in algorithmic trading by issuing a consultation paper in 2021. Subsequent consultation papers on the subject of regulating retail participation were floated in December 2024 and February 2025 for public consultation.

8. Way Forward:

The evolution of technology is reshaping the capital markets around the globe. A broker can no longer fulfil an order flow without using some form of electronic execution. A complete ban on this technology is not practical or advisable. The IOSCO emphasizes the need for regulatory frameworks to manage these risks effectively. Globally, most jurisdictions have long before introduced and implemented comprehensive guidelines for regulating automated trading to mitigate risks and uphold market integrity. At present, Pakistan has no regulatory framework in place to regulate the activities of algorithmic trading. Market surveillance has revealed that some participants are already utilizing this technology and have achieved substantial profits. Therefore, it is prudent to formulate and adopt a thorough approach to regulate the activities of algorithmic trading in Pakistan. As part of this initiative, the Commission has drafted this concept paper to seek public comments and feedback.

[5] https://timesofindia.indiatimes.com/blogs/voices/the-algo-trading-saga-in-india/

9. Format for sharing feedback/comments on the Concept Paper

Feedback on the draft concept paper for Algorithmic Trading along with any other suggestions on this concept paper may be sent via email to algo.trading@secp.gov.pk as per below format:

Name			
Name of the related Entity			
Sr. No.	**Section No.**	**Views/Proposed Changes**	**Rationale**
Confidentiality			
If you wish to keep all or any part of your submissions and your identity confidential, please indicate the same. In all other cases, your provided comments can be made public, except your contact information.			

Indicative Timeline:

Stage	Date/Timeline	Details
1	30-05-2025	Publication of Consultation Paper
2	Within 15 days of publication of Consultation Paper and placement of same on SECP website	Public comments period
3	Within 30 days of receipt of comments on the Consultation Paper	Consultation sessions
4	Within 30 days of conclusion of consultations	Publication of standardized principles

Annexure-A

Jurisdiction with established Algorithmic Trading Regulations/Guidelines

	India	Thailand	Hong Kong	UK	EU	Singapore	Turkey	US
Regulators	SEBI & exchanges	SET & TFEX	SFC	FCA	ESMA	SGX	Borsa Istanbul	FINRA
Regulatory Framework	Circulars	Guidelines & also part of Regulations	Guidelines	Regulation	Regulation	Guidelines	Guidelines	Guidelines
Prior Intimation & Registration	Yes, prior approval from the Exchange	Require prior approval from Exchanges					Yes, requirement of registration and providing software info	Yes. Registration for code developers
Unique Identifier	Yes, all orders to be tagged with unique identifier provided by Exchange	Proper identification systems & oversight required	Proper identification systems & oversight required	Proper identification systems & oversight required	Unique identification for DEA clients	Proper identification systems & oversight required	Distinctive codes are given to the users	Proper identification systems & oversight required
Audit	Audit required by only certified auditors	Yes. Record keeping and audit requirement	Yes. Record keeping and audit requirement	Yes, Record keeping and audit requirement	Yes, Record keeping and audit requirement	Record keeping and audit requirement		Record keeping and audit requirement
Controls	Yes. Both pre and post trade requirement exist	Requires prevention of Inappropriate Trading Orders e.g. price control, prevention of continuous purchase or sale at several price levels, and prevention of Wash Sale orders etc.	LCs should establish clear and written policies and procedures for reviewing the appropria-teness of pre-trade control limits	Require pre-trade controls such as • Price Collars • Max Order Value • Max Massage Limit		Require controls at all levels of firm e.g. trading phase, flow level, system level, strategy level, desk and Client level	Requires various pre-trade risk controls. •Max order size •Restricted instrument •Price tolerance limit •At- Trade Risk controls •Risk Limits • Duplicate Order Limit	Requires firms to place risk management controls at place
Testing of Algorithms	Requirements of initial conformance and subsequent testing	Require to stress test system in the Exchange environment	Require to test system under adverse market conditions	Prior to deployment testing is required for algorithm systems and strategies	Require stress testing of trading systems and control	Requirement of testing algorithms and controls	Testing of Algorithms software and its controls before and after deployment	Testing of Algorithms software before and after deployment

Governance & Oversight		Designate a supervision unit responsible for ensuring compliance	Define good practice as having gov committees mandate to involve at least one responsible officer from each of the core business lines	Requires a strong governance framework with policies and procedures			Oversight of senior management is required	FINRA requires firms to ensure legal, compliance, and senior management review and approve algorithms before deployment
Kill Switch	Exchange mandates the implemen-tation of a kill switch functionality as a prerequisite for approving algorithmic trading systems	Member must be able to activate Kill Switches, which can promptly halt sending new orders and cancel all outstanding orders sent by Algorithmic Trading.	Yes, kill switch functionality is mandated	Yes. Requires that a firm shall be able to cancel all unexecuted orders	Yes. Requirement for firm to withdraw all or some of its orders	Members are recommen-ded to put in place a kill switch at firm level.	Must be able to quickly stop the order by stopping the servers on which the software programs are operating transmission	Requires highly automated firms to have kill switches to quickly respond to abnormal behaviour by algorithms.