KASE

AI IN STOCK MARKETS:

International Experience, Cases and Regulatory Challenges

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Contents

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I. Abstract

Digitalization continues to rapidly change the landscape of global financial markets, and artificial intelligence (AI) technologies are increasingly finding application in stock exchange infrastructure. They help make trading and post-trading processes more transparent, efficient and secure.

This report contains international experience in introducing AI on exchanges - from Nasdaq and LSEG to HKEX and Borsa Istanbul. We looked at practical cases of using the AI technologies in such areas as supervision and monitoring, compliance, algorithmic trading, automation of operations and ESG analytics.

Particular attention is paid to the regulatory environment and recommendations of leading international organizations, in particular the World Federation of Exchanges (WFE) and the Organization of International Securities Commissions (IOSCO).

This report is addressed to the professional community - representatives of exchanges, clearing centers, regulators, trading participants and IT teams involved in development of market infrastructure.

II. Development of AI and its technologies in the financial sector

AI in finance is not new: its development began decades ago. At first, these were simple algorithms and expert systems, then machine learning (ML), which was already actively used 10-15 years ago in advanced investment companies, especially for algorithmic and high-frequency trading.

Over time, the technology has made great strides forward. Increased computing power and growth of data volumes have given impetus to development of neural networks, especially deep ones, which can recognize complex, nonlinear dependencies. And in recent years, a real breakthrough has occurred - with the release of **generative AI** (GenAI) - such models as GPT have learned to create texts, images, program code and even analytical materials.

Generative models have become especially useful where it is necessary to work with unstructured information, for example, with texts. There is a lot of such data in the financial sector: from news feeds and annual reports to issue prospectuses and auditor's reports.

Today, a wide variety of AI technologies are used in finance:

- **Learning with and without a teacher** - helps to assess credit risks, predict defaults and identify client segments.
- **Natural Language Processing (NLP)** - used in chat bots, for analyzing the news and reports, and for speech recognition in contact centers.

- **Generative Models (LLM)** - increasingly used to automate preparation of documents, for responses to customer and employee requests, and generation of analytics.
- **Robotized Process Automation (RPA) and intelligent automation** - take on the routine back-office tasks: processing of applications, reconciling of data, preparing of reports.
- **Computer Vision** - already used in insurance (for example, to assess damage from a photo), as well as in biometric identification of clients.

AI in the financial industry has long since gone beyond the realm of experimentation. It is used in a wide variety of areas, from trading and risk management to customer service. As noted Ed Knight, executive vice chairman of Nasdaq, **the first wave of mass AI adoption on global markets has already generated a lot of interest, and this trend is only getting stronger.**

AI has become an integral part of digital transformation of the financial sector. And while we are still a long way from fully autonomous AI agents capable of acting without human intervention, the potential of new technologies, especially GenAI, promises a real revolution in approaches to management, analysis and decision-making.

III. How AI is applied in the financial sector

AI has already proven its effectiveness in the financial sector, and not only at the theoretical level, but also in real business results.

Thus, according to data from **Statista Research Department** (May 2025), about **70% of companies in the financial services sector report 5-10% revenue growth** thanks to use of AI. A McKinsey study "The State of Artificial Intelligence" (March 2025) shows that most companies **introduce AI in at least three business functions** - this is no longer an isolated experiment, but a large-scale rethinking of processes.

Kazakhstan is also not standing aside from these trends. According to a report by the National Bank of the Republic of Kazakhstan (NBRK), **31% of the country's financial institutions already use AI**, and many of them intend to continue investing in technology, based on the initial successful implementation experience.

III.I AI in the banking industry

Banks are the undisputed leaders in use of AI. In Kazakhstan, according to the National Bank of the Republic of Kazakhstan, **60% of second-tier banks use AI.**

Global experience shows that banks use AI in three key areas:

- **Risk management and credit scoring.** Thanks to ML models, the banks more quickly and accurately assess the clients' solvency, automate the application approval, and minimize the credit risks.

- **Fighting fraud.** Modern AI systems analyze transactions in real time, identifying suspicious patterns, from cyberattacks to money laundering. For example, **Mastercard** uses generative AI in conjunction with graph databases to anticipate threats and protect future transactions.
- **Customer service.** NLP platforms in chatbots and voice assistants (e.g. **Erica** from Bank of America or **Salut** from Sberbank) process typical requests around the clock, relieving the load on operators. According to **EY**, the North American banks are actively purchasing even the specialized chips from NVIDIA for AI computing - so much has the interest grown in scaling of these solutions.

III.II AI for brokers and asset managers

In the investment business, AI is actively used for **algorithmic trading**, news analysis, market trend forecasting and **portfolio optimization**.

Hedge funds were among the first to use self-learning algorithms to find signals in huge amounts of market data.

Brokers are introducing **AI modules to generate trading ideas** and **robo-advising** - automatic consulting of investors on asset management based on their profile.

In the area of **compliance**, AI analyzes internal correspondence, monitors traders' actions for compliance with regulatory standards, for example, to prevent front-running or identify unauthorized transactions.

Asset managers are using AI to **forecast the liquidity flows,** dynamically hedge the risks, and even **automatically generate the analytics**. According to **IMF, generative AI** is already beginning to be used to prepare investment reviews, freeing analysts from routine work and allowing them to focus on strategy.

III.III AI in payment systems and fintech

For payment systems and fintech companies, AI has become not just a tool, but the basis of customer experience and data protection:

- **PayPal, Visa, Tencent and others** implemented behavioral models that block suspicious transactions in real time. As a result, the accuracy of fraud detection has increased, and the number of false positives has decreased by tens of percent.
- **Biometrics** is actively used, which is AI-powered face and voice recognition for secure user identification.
- Fintech super apps utilize **recommendation algorithms** offering suitable financial products (insurance, loans) based on behavioral data.
- **In insurance**, AI analyzes photos of accidents, calculates premiums, identifies attempts at insurance fraud - all this makes the process faster and more transparent.

III.IV Regulatory Technologies (RegTech)

AI is also changing the approach to **regulatory reporting and compliance**. Financial companies are daily required to filter a huge flow of transactions against sanctions lists, monitor for possible money laundering (AML) and submit reports to the regulators.

In this matter, ML **significantly reduces the number of false positive signals**, increasing the accuracy of checks. AI helps **automatically fill out reports**, monitor its correctness and monitor the updates in regulatory requirements.

For example, HKEX (Hong Kong Exchange) has introduced an AI model that **analyzes the issuers' annual reports** for compliance with listing requirements. The system independently finds missing or abnormal data, helping to speed up and simplify the work of the listing department.

IV. How the exchanges introduce AI: global cases

AI has already become an integral part of the digital transformation of stock exchanges and clearing houses. It helps not only to increase the transparency and stability of trades, but also to automate supervision, speed up settlements and improve the customer services.

Below is an overview of how the world's leading markets are applying AI in practice.

Nasdaq	**Nasdaq has long been a technology leader, and AI here is not a trend, but a working tool. The flagship solutions include:** • **Generative AI in trade supervision** - used to analyze the context of transactions and speed up investigations of suspicious activities. • **Dynamic M-ELO** - an AI-supported order type that helps the market participants to optimize the order execution. • **Nasdaq SMARTS** - an AI-powered monitoring platform recognized as an industry standard and used by other exchanges, including HKEX.
HKEX	**Hong Kong exchange bets on automation of regulatory processes:** • Implemented **the Nasdaq SMARTS platform** with machine learning in supervision.

	• Developed **the NLP and ML models** for automatic verification of the issuers' annual reports, reducing the manual work and improving the quality of disclosure.
LSEG	**LSEG is actively promoting its partnership with Microsoft, betting on cloud technologies and AI:** • Migration of platforms to **Azure cloud** and introduction of **Copilot GPT functions** into analytical services. • **ML algorithms** are used in calculating the indices and in trading systems for stability and forecasting. • Ai-powered integration of **Refinitiv** analytics with Microsoft Teams makes data more accessible to customers in real time.
Borsa Istanbul	**Turkish exchange Uses AI:** • **Social monitoring** - analyzes social media posts and correlates them with stock price movements, identifying potential manipulations. • Uses **ML algorithms to detect illegal shorts** and suspicious orders, increasing the accuracy of supervision. • Actively develops cooperation with universities in the field of AI and digital transformation.
KRX	**The Korean exchange is one of the most technologically advanced in Asia:** • Uses its own **AI system EXIGHT** to monitor trading anomalies - analysis that used to take days can now be done in hours. • KRX is actively developing AI infrastructure with government support, expanding the potential for national and cross-border markets.
Deutsche Borse	**The exchange group applies AI at several levels at once:** • **Xetra** uses AI algorithms to manage the auctions and predict volatility. • **Eurex Clearing** tests ML models for stress tests and real-time margin calculations. • The exchange invests in AI through **corporate venture fund**, supporting startups in trading and post-trade. • Partnership with **Kaiko** - development of AI analytics for crypto markets. • In collaboration with **NVIDIA**, a cloud platform for developing and testing the AI models has been created.

Middle East	**The region's stock exchanges are actively investing in AI to improve customer experience and ESG analytics:** • **DFM (Dubai)** introduced **the Smart Disclosures modules** - automatic summarization of corporate news and generation of financial reviews of the issuers. • **Tadawul (Saudi Arabia)** created **a separate AI team** and develops a partnership with **Clarity AI** for in-depth ESG analytics.

The following subsections provide detailed information on the cases.

IV.I Nasdaq: AI as the foundation of market infrastructure

American exchange **Nasdaq** is a leader in application of AI, both in trading technologies and in the internal processes. In 2023-2024, Nasdaq introduced the world's first **exchange order type with AI - Dynamic M-ELO**. Using machine learning, this tool dynamically optimizes midpoint order parameters, improving trade execution efficiency.

Nasdaq not only uses AI internally, but also offers its solutions to the market.

Nasdaq became the first exchange to incorporate **generative AI into market supervision system.** Based on GPT models, the system helps analysts quickly investigate signals of suspicious trading, automatically collects information on low-profile issuers by analyzing news, corporate events and transaction context. The result is a 30% reduction in analysis time already at the pilot stage.

SMARTS Surveillance platform based on ML elements is used by regulators and exchanges around the world, including HKEX (Hong Kong).

Nasdaq also develops a **generative copilot for banks** - a service that helps identify cases of money laundering and other financial crimes.

Nasdaq's entire AI strategy is built on two pillars:

1) Increase of internal efficiency (GenAI tools are available to all employees).
2) Integration of AI into customer products and technologies.

IV.II HKEX: listing automation and disclosure control

HKEX (Hong Kong) exchange actively develops AI solutions in both supervision and listing management:

In partnership with Nasdaq, the exchange introduced **the SMARTS platform** for ML-based market monitoring back in 2018.

One of the flagship RegTech projects was **its own AI model for analyzing the issuers' annual reports**. The algorithm can find key elements of reporting (for example, attendance at meetings of the board of directors, ESG disclosure) even in tables and footnotes. This allowed to reduce the manual labor and increase the transparency on the market.

It can be said that HKEX uses a mixed approach, a combination of ready-made solutions from vendors and development of its own AI tools within the Innovation Lab.

IV.III LSEG: partnership with Microsoft and smart products

London Stock Exchange (LSEG) is betting on a massive digital transformation, including through a strategic alliance with Microsoft, concluded in 2022.

The exchange has moved key analytical products, including **Refinitiv and Workspace** to the Azure cloud.

Integration of **GPT models (Copilot)** into the Microsoft ecosystem allows the traders to automatically generate code for calculating the derivatives and share the results in Teams.

AI is also used in FTSE Russell for calculating the indexes and work with Big Data.

LSEG Technology develops solutions for other exchanges, including **matching engine and clearing platforms** supplemented with ML modules.

LSEG aims to transform the way we work with financial data: make it interactive, adaptive and intelligently processed in real time.

IV.IV Borsa Istanbul: AI and digital security

Borsa Istanbul uses AI to combat the market manipulations and improve the transparency.

In 2023, the exchange launched **a pilot project for social media analysis** - the system compares the stock mention activity with the price movements for early detection of manipulation attempts.

Together with universities, the exchange develops **research in the field of AI and Big Data,** focusing on the digital transformation of the entire infrastructure.

Although the exchange does not have a public AI strategy, individual initiatives indicate systematic work in this area.

IV.V Korea Exchange: EXIGHT and state support of AI

Korea Exchange (KRX) became one of the pioneers in automation of supervision. Already in 2018, **the EXIGHT AI system** was introduced, analyzing transactions by 54 parameters. This allowed **to reduce the analysis time from several days to one hour**, and the full investigation cycle from two months to 40 days.

AI is used by KRX to combat insider trading, identify manipulations and anomalies in actions of participants.

In 2025, South Korea became the first in APAC to adopt **comprehensive AI legislation**, stimulating its implementation in the real sector, including the exchange infrastructure.

IV.VI Deutsche Börse: reliability and deep analytics

Deutsche Börse (Germany) integrates AI into the core of its technology platforms:

- **Xetra** uses algorithms to predict volatility and manage the auctions.
- **Eurex Clearing** uses ML models for margin calculations and stress tests **in real time**, with an emphasis on identifying the atypical correlations and risk scenarios.
- In 2023, the exchange entered into a **partnership with NVIDIA** to speed up the development and training of AI models.

Although Deutsche Börse does not make bold statements, its practical steps confirm the deep integration of AI into the market processes.

IV.VII Exchanges of the Arab region

Middle East exchanges are gradually integrating AI into their customer and analytical services:

- **Dubai Financial Market (DFM)** in 2025 introduced two AI tools into the iVestor app:

  – **Smart Disclosures** automatically shortens and summarizes the corporate announcements;
  – **Financial Summary** forms a brief overview of the key financial indicators of companies.

- **Tadawul (Saudi Arabia)** created **an AI team** and entered into a partnership with **Clarity AI** to improve ESG disclosures. This enhances the transparency of non-financial information and makes it comparable across the issuers.
- The region has launched government initiatives to support AI, e.g. **UAE AI Office** finances exchange AI projects as part of the national technological modernization program.

While many projects are still in their early stages, **the trend towards AI use is also affecting the Arab region exchanges.**

IV.VIII Strategies for AI development at exchanges: from experiments to systemic transformation

The world's largest exchanges are increasingly viewing AI not just as a technology, but as a strategic asset. It becomes a part of their digital transformations, influencing product lines, processes and organizational culture.

Below are the key areas and initiatives implemented by exchanges as part of AI strategies.

NASDAQ: DUAL FOCUS - INTERNAL EFFICIENCY AND MARKET PRODUCTS

Nasdaq's 2024-2025 strategy is built on a two-tiered approach:

- **AI for internal productivity (on the business):**
  All 100% of employees received access to the internal **GenAI** platform. It helps automate the reports, process the document files, prepare the client responses - all as part of corporate security policy.
- **AI in products (in the business):** Nasdaq Integrates AI into the market services. **Dynamic M-ELO** and **AI Copilot** (analysis of financial crimes) solutions are launched.

The next step will be scaling AI to other business areas: index management, support for private companies, infrastructure services.

The company is actively developing the partnerships (for example, with **AWS**) and its own R&D centers, where one of the priorities now is the development of AI areas.

LSEG: "EXCHANGE OF THE FUTURE" BASED ON AI AND CLOUDS

In 2022, **LSEG** presented a large-scale digital transformation strategy, where AI became one of the central elements:

- **10-year partnership with Microsoft** has been signed: migration of services to Azure, development of new AI products in collaboration with OpenAI.
- Introduction of **generative models into the Workspace terminal** is planned, creation of an intelligent assistant for Refinitiv users, automation of data analysis.
- The exchange is forming **the AI teams and internal centers of expertise**, retraining the personnel, conducting the corporate trainings.

As LSEG management points out: "AI isn't just improving the processes, it's reshaping the financial services landscape itself." And LSEG aims to be among the first to offer these changes to the client.

HKEX: BETTING ON ISOLATED CASES WITH SCALABLE EFFECT

HKEX identified technology as one of the growth pillars in the Marketplace of the Future strategy (2022). Back in 2017, the exchange created **Innovation Lab**, one of which focuses is the practical application of AI.

- One of the flagship cases is **analysis of issuers' annual reports** using NLP/ML. Thanks to this system, in 2024 it allowed to **check the ESG reporting of all 2489 issuers**, which was previously done selectively.
- HKEX develops **RegTech and AI projects**, focusing on scalable effects and support from the HKMA.

While there is no formal AI roadmap yet, current projects demonstrate a mature strategy for integrating AI into regulatory and market infrastructure.

BORSA ISTANBUL: INTEGRATING AI INTO THE GOVERNMENT'S DIGITALIZATION PROGRAM

The Turkish exchange has not published a separate AI strategy, but in its 2023 annual report it clearly stated: AI and Big Data are becoming key to the transition to a data-driven management model.

- These goals are in line with the national program **Digital Turkey 2024–2028**, where AI is designated as an efficiency driver.
- The exchange is gradually automating the processes, including **social monitoring and warning systems**, and it is quite possible that in the future it may create a separate AI division, similar to HKEX.

WFE and global coordination: standards, training and ethics

In 2024, **World Federation of Exchanges (WFE)** released a policy document on AI. Its main point is **maximizing the AI benefits in risk management using traditional means,** without forcing the premature regulation.

WFE created **an AI working group** that includes representatives of the largest exchanges. Goals: exchange of experience, development of standards (e.g. for model audits), joint educational initiatives.

Also, **the AI training programs for the exchange employees** have been launched, supported by industry associations (including IOSCO, Federation of Euro-Asian Stock Exchanges - FEAS).

General conclusions: how the exchanges build the AI strategies

AI is not a separate module, but a booster in the exchange's mission. It is used in supervision, risk management, ESG analysis, services for the issuers and investors.

Focus on applied use cases with clear benefits (reduced time, increased coverage, reduced costs).

Growth of culture and competence: cross-functional teams are created, the roles of "AI ambassadors" are introduced in the departments, AI hackathons are held to find internal initiatives.

Technological base: the exchanges invest in data, APIs, platforms and partnerships, from Azure to NVIDIA.

AI Governance - ethics, risks, security, control over AI - becomes part of strategic management.

As McKinsey and other consultants recommend, a successful AI strategy should include:

- reliable **technological platform,**
- launch of **pilot cases with real benefits,**
- and well-developed **personnel management and training system.**

Analysis shows that most exchanges are following this approach, and have already made significant progress.

V. Regulation of AI use in the financial sector: current framework and principles

The rapid adoption of AI technologies in the financial sector inevitably poses for regulators the challenge to adapt the regulatory environment. While some jurisdictions are developing new laws, others prefer to apply existing rules on risk management and customer protection, regardless of whether the AI or traditional methods are used. However, as models become more complex and AI's influence on market processes grows, the issue of regulation becomes increasingly relevant.

V.I International Standards: principles, not prohibitions

Back in 2020, **IOSCO** released the first recommendations on use of AI and ML for participants of the securities market. The document formulates **the six key principles**, among which:

- availability of a responsible person at the top management level;
- regular testing and monitoring of models;
- transparency and explainability of AI decisions for clients and regulators;
- quality control of source data and bias prevention;
- risk management when using third-party solutions.

In 2023–2024, IOSCO expanded its recommendations to provide a more in-depth analysis of cases, risks and legal challenges. For example, the issue of responsibility for AI services provided by unregulated vendors was raised.

IOSCO maintains **a technologically neutral approach:** AI does not require fundamentally new regulation, as long as the used technologies comply with existing requirements on risk, transparency and investor protection.

WFE takes a similar stance. In 2024, it stressed that regulation must remain principled and not tool-oriented. The emphasis is on risk management rather than on imposing rigid boundaries on specific technologies.

V.II. European Union: AI Act and revision of traditional rules

The EU is actively shaping its own regulatory architecture:

AI Act, currently at the approval stage, introduces a classification of AI systems according to the risk degree. Many financial applications (e.g. credit scoring, algorithmic trading) will fall under **the "high risk" category**, with the corresponding requirements:

- documentation of algorithms;
- data quality control;
- explainability of decisions;
- mandatory **human supervision**.

Furthermore, **related acts** are already in force in the EU:

- **GDPR** - prohibits decisions based solely on automated data processing without the right of human intervention;
- **MiFID II / MiFIR** - regulate algorithmic and high-frequency trading, including requirements for testing, notifications for the regulator and emergency shutdown mechanisms (kill switch);
- **Data Governance Regulation** - prohibits discrimination of AI algorithms depending on a data source.

The AI Act thus complements the existing landscape and forms **a comprehensive framework for AI regulation in the EU.**

V.III. USA, UK and other jurisdictions: flexible approaches

Outside the EU, AI regulation is developing more flexibly, without creation of separate laws, but with increased oversight and recommendations.

Back in 2019, **FCA (UK) and Bank of England** launched a joint AI Public-Private Forum that developed principles of fairness, explainability and accountability of AI models.

In USA:

- In 2023, the Ministry of Finance collected broad feedback from the industry. The main requirements are unification of concepts, data protection and proportionality of regulation.
- Several agencies (CFPB, FTC, etc.) have stated that **the current regulations** on consumer protection, lending, non-discrimination are **also applicable to AI**. Use of AI does not relieve a company from liability.

USA and UK also create **expert working groups under regulators and parliaments**, which examine the long-term risks, ethics and governance architecture of AI.

V.IV. Transparency, reporting and explainability

One of the most pressing issues in AI regulation is **explainability of decisions**. Many AI models operate as black boxes, which makes the regulatory supervision more difficult.

IOSCO and the Monetary Authority of Singapore recommend implementing the model interpretation and logging tools so that you can understand at any time what data and parameters influenced a specific decision.

Back in 2018, Singapore proposed **the FEAT (Fairness, Ethics, Accountability, Transparency) principles** - the largest banks and fintech companies adhere to them, including mandatory reporting to the board of directors.

A new profession is emerging - **AI model auditor**. Companies hire external or internal validators to check the correctness and robustness of AI algorithms, especially in high-stakes areas (lending, capital, reserves).

V.V. Algorithmic trading: regulation at the intersection of AI and HFT

The field of algorithmic and high-frequency trading has long been regulated, but as AI is introduced, the requirements for participants and exchanges are becoming more stringent:

After such incidents as *Flash Crash* in 2010, the following became mandatory:

- stress tests and testing in an isolated environment;
- volatility protectors (trading pauses);
- mechanisms for disabling the algorithms in case of failures;
- limits on frequency of order submission.

European Securities and Markets Authority (ESMA) in 2024 supplemented these requirements with new recommendations for investment companies:

- evaluation of a model at the design stage;
- readiness for adjustment or shutdown;
- mandatory supervision of AI algorithms.

Thus, the focus shifts from simply "testing" to **model lifecycle management**.

V.VI. Conclusions: where the regulation is heading

Today we are in a transitional phase: regulation of AI in finance is not yet complete, but the outlines of future architecture are already emerging. **General vector** - balance between supporting the innovation and risk management.

Regulators so far prefer flexible guidelines and principles rather than rigid restrictions. **Exchanges and market participants** themselves form the internal policies for AI management, following the international standards.

Mandatory standards appear in specific instances - for example, in cases where AI influences significant customer or financial decisions. On the horizon - AI Act in the EU and the possible emergence of similar legislative initiatives in other countries.

In general, the exchange community is in favor of technologically neutral regulation: standards should be based on the risk nature, not on the origin of the technology. This will allow AI to become an organic part of the financial market infrastructure, while maintaining stability and investor confidence.

VI. Risks of AI applications and how to deal with them

AI brings enormous opportunities - it speeds up processes, reduces costs, and opens up new horizons of analytics. But along with the advantages, it also brings new risks - for the companies, clients and the entire financial system. Below are the key categories of these risks and how they are managed in practice today.

Algorithmic fairness and model bias

AI algorithms are trained on historical data, meaning they can unknowingly reproduce (and sometimes reinforce) the old biases. If there is a gender or racial bias in the training sample, the model may accept it as the norm.

Example: in 2020, one major American bank discovered that the AI used to calculate credit limits **systematically lowered limits for women** with profiles identical to men's. The reason was the training sample, which reflected historical discrimination.

How they manage:

- Checking the data for representativeness.
- Using of debiasing methods (weight redistribution, augmentation).
- Implementation of regular audit of models.
- Control over model drift - the deterioration of the model quality over time due to changes in context.

Transparency and explainability

Modern AIs, especially neural networks, often act as a black box, it is difficult to understand why a model made a particular decision. And in finance it is important to be able to explain: why an order was rejected, why an alarm signal was triggered, etc.

Problem: If an algorithm unexpectedly causes volatility to increase, and analysts cannot quickly understand its logic, this is an operational risk.

What they do:

- More interpretable models (decision trees, logistic regression) are used for critical processes.
- **LIME, SHAP** tools are used to explain the neural networks.
- Maintain documentation: model version, parameters, data sources - for audit and control.
- They enter into contracts with vendors that require them to disclose model parameters or provide proxy interpretation.

Cyber risks and new threats

AI itself helps fight cyber threats, for example, it detects anomalies in traffic and analyzes logs. But attackers also use AI:

- **Generative phishing emails** - written in such a way that they are almost indistinguishable from the real thing.
- **Deepfakes** - forging a video or voice of a top manager to steal funds.
- **Adversarial attacks** - a slight change in the input data can fool an algorithm (for example, allow a fraudulent transaction to pass).

Protection means:

- "Zero Trust + AI" principle: strict authentication + AI monitoring of behavior.
- Updating the cyber policies to address new threats.
- Personnel training: don't blindly rely on AI advice.
- **InsurTech tools:** cyber insurance already includes risks associated with AI solutions.

Operational failures and liability

AI systems are additional layers of technological complexity. A model failure or an error in logic can result in a serious incident: from incorrect calculation of balances to suspension of trading.

Operational risk management includes:

- Fallback scenarios.
- Stress tests for "sudden model failure".

- Human control - *human in the cycle* should be a possibility, not an exception.
- Assignment of **the model owner**, setting of KPIs, regular reports.
- Principle: **the company is responsible, not the model**. AI does not release from legal and reputational liability.

Market manipulation and systemic risks

If many market participants use similar AI models trained on the same data, this can create a **resonance effect** - synchronous actions (for example, mass sales) can cause the market to suddenly collapse.

Example: HFT algorithms can simultaneously react to the same news, increasing volatility.

What they do:

- Regulators call for **diversification of IT infrastructure and data providers**.
- Exchanges use protection: limits on the number of messages, automatic shutdown of "lost" algorithms.
- AI tools are actively used to analyze social networks and news - to see suspicious activity in advance (for example, as was the case with GameStop).

AI Risk Frameworks

To integrate all measures into one system, the organizations are implementing **AI Risk Management Frameworks:**

- In 2023, **NIST (USA)** released one of the most reputable frameworks: it covers all stages of the AI lifecycle - from design and data to operation and monitoring.
- Key categories: accuracy, reliability, stability, safety, controllability.

Practices of J.P. Morgan: **AI Governance Committee** created inside, which assigns a risk level to each AI project and allows it to be used only after checking it against a checklist.

Exchanges: use classical risk management approaches (three-linear protection model, audit, stress tests), but adapt them to AI tools.

WFE: supports development of new methods of testing, verification and assessment of ethical risks. But emphasizes: **all this is already the industry's responsibility**, and not just the regulators'.

AI brings new opportunities to the markets, but also requires new discipline. Like any powerful technology, it requires a mature approach: a systemic framework, human control and continuous improvement of control mechanisms.

VII. Key vendors of AI solutions for the exchange and clearing industry

The market of AI solutions for the financial industry is rapidly developing and becoming more mature.

Today it can be roughly divided into three main segments:

- universal cloud platforms,
- specialized fintech and regtech solutions,
- as well as the infrastructure organizations' own developments.

There is a clear trend: **the industry is gradually consolidating around a few global players** providing a powerful technological infrastructure (cloud services, ML platforms, LLM) and **a number of niche experts** offering applied solutions, for example, for supervision, AML or trading strategies.

According to WFE's estimation, in the long term, the market may see emergence of "a few leaders" that will determine the rules of the game in the AI industry for the financial sector.

It is important for the exchanges to closely monitor these dynamics: in some cases, it is safer to rely on a proven solution from a tech giant, while in others, it is safer to develop internal expertise or collaborate with a RegTech startup that provides flexibility and customization.

AI is becoming an integral part of the exchange ecosystem. But choosing the right vendor is not just a technological decision, but a strategic one. It is important for the exchanges to build a flexible, well-thought-out model of interaction with suppliers: avoid dependence on one player, achieve transparency, and provide risk management and security mechanisms.

In an era where data and algorithms are becoming assets, partnership in the AI sphere is no longer an additional project but part of a long-term infrastructure strategy.

Of particular note is **Nasdaq**. It doesn't just use AI in-house, its technology division has become a full-fledged solutions provider for other exchanges. Today, Nasdaq products are used on more than 130 platforms in about 50 countries, from trading engines to supervisory systems. Exchanges without their own R&D capabilities are increasingly looking to Nasdaq to integrate AI capabilities into the existing platforms. As noted by WFE, Nasdaq Matching Engine clients are actively interested in emergence of AI options, for example, for intelligent order management.

Regional suppliers can also occupy a similar role. Thus, CIS exchanges have been working with technological solutions from the St. Petersburg and Moscow exchanges for many years, it is possible that in the future they will also offer AI modules to their clients.

Consulting companies also play an important role, although they do not create software products directly, their influence is difficult to overestimate. The Big Four (PwC, Deloitte, EY, KPMG) and strategic consultants (McKinsey, BCG) help financial institutions select vendors, build solution architectures and develop AI strategies. Their analytics influence the decision-making, and in some cases they act as integrators adapting technologies to the client's needs.

VII.I Global technology platforms (Big Tech)

Such players as **Microsoft Azure, Amazon Web Services (AWS)** and **Google Cloud** have become the basis for most AI initiatives in the financial sector. They offer ready-made infrastructure: powerful GPU clusters, storages, AutoML, pre-trained models and analytics tools.

For example, LSEG uses Azure AI to launch new products, and Google Cloud cooperates with CME Group to provide cloud solutions for processing of market data and building of ML models. The advantage of such partners is scalability and launch speed. But here is also the main risk: the AI services market is concentrated in the hands of a few suppliers, which makes relevant the issue of diversification.

VII.II Platforms for AI development and deployment

Among the developers of software for creating and deploying of AI models, **Databricks, DataRobot** and **H2O.ai** stand out, the platforms that allow financial organizations to build their own algorithms, including for combating the fraud and predicting the customer behavior.

Streaming analytics technologies such as **Kafka** (Confluent) and **Apache Spark** are not AI themselves, but comprise the basis of many solutions that analyze large data volumes in real time.

Also, **NVIDIA** is an indispensable supplier of equipment for training the AI models, especially in the exchange infrastructure: many platforms and banks are building AI farms based on its GPUs.

VII.III Specialized solutions for capital markets

The one that stands out most here is **Nasdaq Technology**. Its product **SMARTS Surveillance** is the industry standard for market surveillance with ML elements. Following the acquisition of Verafin, Nasdaq also offers an AI-powered AML platform.

NICE Actimize specializes in trading monitoring, risk management and financial crime prevention. Their solutions are used by the largest banks and regulators.

IBM, although it has left the spotlight in recent years, still offers the Cloud Pak for Data platform, which is valued for its reliability and compliance with security requirements.

Also worth a look is **NEC** (Japan): its **RAPID** system deployed at JPX in Tokyo detects market abuse using ML algorithms and NLP.

VII.IV RegTech and FraudTech startups

New players are constantly appearing in the fight against fraud:

- **Feedzai** - a real-time platform for transaction analysis and fraud prevention.
- **Featurespace** - a British company with patented behavioral analytics, widely used in banks.
- **ComplyAdvantage and Refinitiv World-Check** - focus on KYC automation, checks against sanctions lists and identification of risky counterparties.
- **Behavox** - a system that analyzes internal employee communications (email, chats) for compliance violations.
- **Palantir Foundry** - used by exchanges and banks as a universal data platform with AI elements, with recent integration of LLM modules.

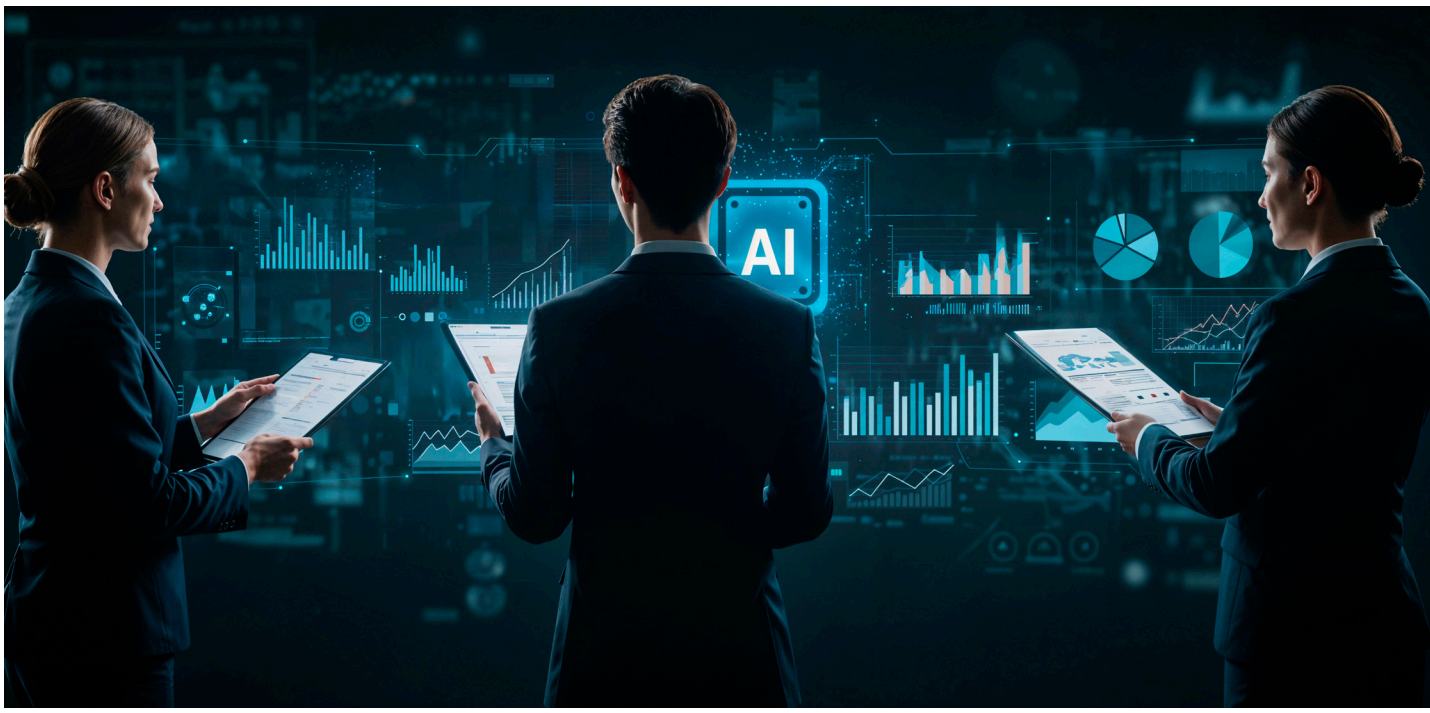
VII.V Data providers with AI functionality

Traditional data providers have also joined the AI race. **S&P Global** and **Moody's** integrate AI into their credit ratings and risk analysis.

Bloomberg has developed its own **BloombergGPT**, a large language model trained on financial texts. It is already used to generate the summaries, answer the questions and analyze the news.

Thus, even those companies which specialization was previously exclusively in data are including full-fledged AI options in their solutions and products.

VIII. The Human-in-the-Loop concept and its role in financial infrastructure



No matter how AI technologies develop, the financial infrastructure retains the key principle: **humans must remain in the decision-making loop**, especially where market stability, customer money and regulatory compliance are at stake.

Human-in-the-Loop (HITL) concept is not just a form of supervision. It is a philosophy of building a hybrid human-machine system in which AI assists but does not replaces the humans. This is especially relevant for exchanges, clearing centers and other organizations that play a system-forming role.

Human control is an integral element

Even if AI analyzes data sets, generates recommendations or initiates actions, **the final decisions on important operations are still made by humans.** In trading, for example, an algorithmic strategy may pass technical validation, but its launch is confirmed by a committee. And if an AI algorithm in the market surveillance system flags a transaction as suspicious, an officer still checks the context and decides on investigation.

This is not just a regulatory requirement, it is insurance against errors. As the IMF noted, **the professional community is not ready to hand over the critical powers to AI without the possibility of intervention.** There must be someone who will press "stop" in time if something goes wrong.

Collaborative decision making: human + AI = team

In some cases, AI not just observes or executes, but **works in tandem with a human** - offers solutions, leaving the right of choice to a specialist. This mode is called *Human-on-the-Loop.* For example, if a model recommends the optimal distribution of guarantee funds in the clearing center, a risk manager still evaluates the situation more

broadly, takes into account the liquidity of the participants, external risks and the context. This increases trust: a specialist sees how the AI thinks and can agree or adjust the course.

The scenario of such cooperation is the middle ground. The machine processes the volumes, the person makes the final decision using both intuition and experience.

Feedback as a way to train AI

HITL is not only about control, but also about **mutual learning**. AI learns when a human gives it feedback: marks an error, corrects an interpretation or adds data.

For example, if a surveillance system mistakenly identifies a transaction as suspicious, an inspector rejects it, and the algorithm receives a signal for adjustment. In chatbots, if an operator has rewritten the AI's response, the model will take this example into account in the future. Thus, **the system becomes smarter due to human's participation**.

Legal and ethical aspects: HITL as a commitment

The Human-on-the-Loop concept is also enshrined in regulatory acts. **GDPR** (EU) clearly states: a person has the right not to be the subject of a purely automated decision, especially if it affects important aspects of life - credit, work, access to services.

Financial companies often use **a hybrid model:** an algorithm makes a recommendation (for example, a loan denial), but the final decision is made by a live employee. The same is expected from **AI Act** where the "high-risk" AI systems (for example, scoring or trading algorithms) are subject to mandatory human supervision.

Compensating for AI limitations: context, ethics, responsibility

AI can read quickly, but it has no sense of context. It doesn't know that there has been a sudden political crisis or an unexpected failure in the infrastructure. AI does not have intuition. **But a human has.** This is why the combination of AI and human produces the optimal result: speed and scale from the machine, context and responsibility from the specialist.

In the stock exchange infrastructure, it is especially important to avoid "autopilot". Today's philosophy is: **AI is not a replacement, but an enhancement of a professional.** And every critical process must have a channel for human intervention.

Different roles of a human in the AI loop

A human can perform different functions, from an observer to a final user:

- **Operator** monitoring the AI's operation in real time and capable of manually switching the mode in case of a failure.
- **Moderator/trainer** that corrects the system's behavior - adds a new rule, marks the false positives.
- **Analyst or risk manager** making the final decision, taking into account the AI's opinion as one of the factors.

This makes HITL not just a technical requirement, but **an organizational practice** built into the business processes.

Trends and formalization of HITL in the industry

According to IOSCO surveys, the vast majority of financial institutions consider **absence of a human in the cycle to be a risk that requires management.** The Responsible AI standards from IEEE and ISO enshrine the *Human Agency* principle: a human must retain control and have the right to override a system's decision.

As long as AI technologies remain limited in explainability and generality, HITL will remain mandatory. Even if routine processes become increasingly automated over time, **the strategic decisions - product admission, trade regime changes, dispute resolution - still will be made by humans.**

Exchanges and clearing houses are formalizing HITL procedures: from the model design stage (human participation in training) to the operation stage (dashboards for operators, cancel buttons, manual audit of samples). This is already becoming the industry standard.

Conclusion

Human-in-the-Loop is not a deterrent, but a guarantee of stability. This is the insurance that allows to use AI with confidence: the system remains on track with its purpose, to serve the people.

It is this approach that allows the exchanges and financial infrastructure to use AI responsibly: without giving up on innovation, but maintaining control, transparency and trust.

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