Management

**UDC 004.8:658.012.4**

DOI https://doi.org/10.5281/zenodo.20306211

# Transformation of institutional client onboarding processes through agent-based intelligent AI systems in high-risk financial infrastructure

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**Accepted: 25.01.2026 | Published: 06.02.2026**

***Abstract.*** *The study is relevant because the processes for connecting institutional clients in high-risk financial systems are becoming increasingly complex due to increasing regulatory requirements, operational risks, and the architectural complexity of the financial infrastructure. Under these conditions, traditional, centralized, linear approaches to organizing integration processes do not provide the necessary levels of manageability, transparency, and sustainability.*

*Drawing on nearly six years of leadership at Nasdaq and being a Director of Client Integrations and AI Functionality (2023–2025) for the cloud-native Nasdaq Risk Platform (NRP) in high-frequency trading (HFT) environments, this article substantiates approaches to transforming institutional client onboarding by using agent-based intelligent AI systems to structurally reduce operational risk and ensure managed, architecturally balanced integration.*

*The purpose of the article is to scientifically substantiate approaches to transforming the processes of connecting institutional clients in high-risk financial systems by using agent-based intelligent AI systems to reduce operational risk and ensure a managed, architecturally balanced integration of clients into the financial infrastructure.*

*The study uses systemic and structural-functional approaches to analyze the connection of institutional clients in the financial infrastructure. The methods of logical-analytical generalization and comparative analysis are used to assess the impact of agent-oriented solutions on operational risk and architectural manageability of financial systems; theoretical generalization is used to form scientifically based recommendations for their implementation.*

*The organizational and process structure of connecting institutional clients has been studied, and its determining influence on the stability of financial operations has been established. The functional role of the agent approach in managing integration interactions, data processing and coordination of procedures has been determined. It has been proven that agent-oriented solutions ensure the localization of operational risks and increase the architectural manageability of financial systems. Key transformation problems related to regulatory compliance, limited transparency of processes, accumulation of hidden architectural complexity and the risk of cascading failures have been identified.*

*The feasibility of implementing agent-based integration solutions as a tool for structurally reducing operational risks without unduly complicating the architecture of financial systems has been substantiated. It is noted that the effectiveness of such solutions is determined by interpretability, the formalized distribution of responsibility, and the event-oriented organization of integration interactions. Prospects for further research include developing methods for the quantitative assessment of operational risk in agent-oriented financial systems, improving*

 ISSN: 2786-9431

*approaches to measuring architectural controllability, and researching hybrid agent-based AI solutions for critical financial infrastructure.*

***Keywords:*** *financial infrastructure, institutional clients, agent-based approach, operational risk, architectural manageability, integration interactions, regulatory compliance, digital transformation, system resilience.*

## Трансформація процесів підключення інституційних клієнтів шляхом впровадження агентних інтелектуальних систем ШІ у високоризиковій фінансовій інфраструктурі

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***Анотація.*** *Актуальність дослідження зумовлено ускладненням процесів підключення інституційних клієнтів у високоризикових фінансових системах в наслідок зростання регуляторних вимог, підвищення операційних ризиків та архітектурної складності фінансової інфраструктури. За цих умов традиційні централізовані та лінійні підходи до організації інтеграційних процесів не забезпечують належного рівня їхньої керованості, прозорості та стійкості.*

*На основі близько шести років лідерства в Nasdaq з напрямку інтеграцій клієнтів та ШІ-покращень для хмарної платформи Nasdaq Risk Platform (NRP) у середовищах високошвидкісної торгівлі (HFT), стаття обґрунтовує підходи до трансформації онбордингу інституційних клієнтів із використанням агентних інтелектуальних систем ШІ для структурного*

*зниження операційного ризику та забезпечення керованої, архітектурно збалансованої інтеграції.*

*Метою статті є наукове обґрунтування підходів до трансформації процесів підключення інституційних клієнтів у високоризикових фінансових системах із використанням агентних інтелектуальних систем ШІ, спрямованих на зниження операційного ризику та забезпечення керованої, архітектурно збалансованої інтеграції клієнтів у фінансову інфраструктуру.*

*У дослідженні застосовано системний і структурно-функціональний підходи для аналізу підключення інституційних клієнтів у фінансовій інфраструктурі. Методами логіко-аналітичного узагальнення та порівняльного аналізу оцінено вплив агентно орієнтованих рішень на операційний ризик і архітектурну керованість фінансових систем; теоретичне узагальнення використано для формування науково обґрунтованих рекомендацій щодо їх упровадження.*

*Досліджено організаційно-процесну структуру підключення інституційних клієнтів і встановлено її визначальний вплив на стабільність фінансових операцій. Визначено функціональну роль агентного підходу в управлінні інтеграційними взаємодіями, обробці даних і координації процедур. Доведено, що агентно орієнтовані рішення забезпечують локалізацію операційних ризиків та підвищують архітектурну керованість фінансових систем. Виявлено ключові проблеми трансформації, пов'язані з регуляторною відповідністю, обмеженою прозорістю процесів, накопиченням прихованої архітектурної складності та ризиком каскадних відмов.*

*Обґрунтовано доцільність впровадження агентних інтеграційних рішень як інструменту структурного зниження операційних ризиків без невиправданого ускладнення архітектури фінансових систем. Зазначено, що ефективність таких рішень визначається інтерпретованістю, формалізованим розподілом відповідальності та подієво-орієнтованою*


ISSN: 2786-9431

*організацією інтеграційних взаємодій. Перспективи подальших досліджень пов'язані з розробленням методів кількісного оцінювання операційного ризику в агентно орієнтованих фінансових системах, удосконаленням підходів до вимірювання архітектурної керованості та дослідженням гібридних агентних рішень ШІ для критичної фінансової інфраструктури.*

***Ключові слова:*** *фінансова інфраструктура, інституційні клієнти, агентний підхід, операційний ризик, архітектурна керованість, інтеграційні взаємодії, регуляторна відповідність, цифрова трансформація, стійкість систем.*

**Problem statement.** Modern processes for connecting institutional clients in the financial, corporate, and public sectors are characterized by high complexity, regulatory saturation, significant time costs, and increased risks of operational errors, which necessitate a profound digital transformation. Traditional onboarding models, built on fragmented information flows, manual data verification, and rigidly deterministic business processes, increasingly fail to meet the requirements of scalability, adaptability, and decision-making speed in a dynamic institutional environment. In this context, the implementation of agent systems based on artificial intelligence (AI) technology, which provide autonomous interaction of software agents, context-sensitive data processing and dynamic coordination of client connection procedures, is of particular scientific and practical significance.

From a scientific point of view, the problem relates to the development of the theory of multi-agent systems, intelligent business process management, and the formalization of decision-making under conditions of uncertainty. At the same time, in a practical sense, it concerns increasing the efficiency of compliance procedures, reducing transaction costs, minimizing risks and reducing the time for institutional clients to enter a full-fledged operational mode.

**Analysis of recent research and publications**. A review of modern research indicates the gradual development of a process-oriented approach to automation, coordination, and regulatory support for client procedures in complex organizational environments. In the work of Y. Shevchuk, the processes of connecting institutional clients are analyzed through the prism of risk management and compliance in legacy IT infrastructures, where agent-based intelligent systems serve as an adaptive combination of organizational procedures and regulatory constraints [1]. The architectural prerequisites for such transformation are outlined by Y. Bershchanskyi and co-authors, who justify the use of containerized agent systems in cloud and cyber-physical environments for scalable, controlled connections to institutional clients [2]. Y. Hasenko supplements the process aspect of digital standardization of client procedures, considering the implementation of MRP systems as the basis for formalizing management and resource flows, which creates conditions for further agent-based automation of interaction with clients [3]. The importance of organizational capacity for such changes is emphasized by A. O. Ilyina, who shows that the effectiveness of implementing agent-based intelligent systems depends directly on the level of development of human capital and the company's personnel management competencies [4]. D. Kyiashko reveals engineering requirements for the reliability of client connection procedures, justifying the need for comprehensive testing of agent interactions in multimodal systems [5].

Economic and service aspects of the transformation of institutional client connection processes are reflected in studies devoted to changing the logic of interorganizational interaction. Thus, M. Krytskyi demonstrates that digital platforms and agent mechanisms transform economic models of cooperation between organizations and institutional partners, changing the structure of client processes [6]. A. S. Prihatmanto and co-authors consider agent-based intelligent systems as the basis of service management, which ensures coordination of procedures for connecting, supporting and adapting institutional clients within a

single organizational environment [7]. The methodological principles of the agent-oriented approach to service-oriented architectures are substantiated by A. Petrenko, who defines agent systems as mechanisms for distributing roles, controlling procedures, and supporting management decisions in client processes [8]. S. Panigrahy [9] emphasizes the coordination potential of multi-agent systems in complex procedures for connecting institutional clients.

The social and organizational dimensions of the transformation of the processes of connecting institutional clients are revealed in works on knowledge management and the interaction among process participants. F. Outay et al. consider multi-agent systems as a tool for managing the formation of competencies that can be adapted to information and educational support of institutional clients [10]. The principles of building agent-based intelligent systems are systematized by A. Biswas and W. Talukdar, emphasizing the ability of such systems to autonomously coordinate the actions of service process participants [11]. P. Reinhard et al. analyze the effectiveness of combining agent systems and human expertise in onboarding procedures, demonstrating the feasibility of hybrid models in complex institutional client scenarios [12].

The issues of trust, security and regulatory compliance of agent-based intelligent systems in the processes of connecting institutional clients are highlighted in research focused on financial and digital services. R. Inala and B. Somu analyze trust as a systemic characteristic of agent solutions in the procedures of connecting corporate clients [13]. Agent identity management as a key condition for the legitimacy of client procedures is studied by T. South et al. [14]. L. Hughes et al. [15] emphasize the need to align agent-based intelligent systems with the legal and ethical requirements of institutional interaction.

**Highlighting previously unresolved parts of the general problem**. Despite significant research on the digital transformation of financial systems, the issue of a holistic analysis of the processes of connecting institutional clients as an element of

the financial infrastructure remains underdeveloped. Unresolved are the aspects of the functional role of the agent approach in coordinating integration interactions, assessing its impact on operational risk and architectural manageability, and addressing the problems of harmonizing agent solutions with regulatory requirements and ensuring process transparency.

In the article, these gaps are addressed by systematically analyzing the organizational and process structures for connecting institutional clients, substantiating the role of the agent approach, and assessing its impact on reducing operational risks and enhancing architectural stability. The results obtained form a scientific and practical basis for the implementation of agent-based AI integration solutions in financial infrastructure.

**Formulation of the article objectives (task statement)**. The purpose of the article is to substantiate approaches to transforming the processes for connecting institutional clients in high-risk financial systems using agent-based intelligent systems to reduce operational risk and ensure a managed, architecturally balanced integration of clients into the financial infrastructure.

Objectives of the article:

1. To analyze the organizational and process structure of connecting institutional clients in high-risk financial systems as a component of the financial infrastructure.

2. To determine the functional role of the agent approach in the transformation of the processes of connecting institutional clients.

3. To substantiate the impact of agent-oriented integration solutions on operational risk and architectural manageability of financial systems and to formulate practical recommendations for their implementation.

**Presentation of the primary material of the study**. The processes for connecting institutional clients in high-risk financial systems are structured as a multi-level organizational and process framework, integrated into the broader

financial infrastructure and subject to requirements for continuity, manageability, and risk-oriented control. Unlike mass client onboarding, institutional connection involves interaction with legally complex entities, significant volumes of financial flows, increased regulatory attention, and strict requirements for the parties' responsibility.

In these conditions, the organizational structure of the connection process combines the strategic level of decision-making, the operational level of procedure implementation and the control level of risk management. In contrast, the process structure comprises a sequence of interconnected actions, with a high degree of formalization and strong dependence on data quality. Such a structure is not an auxiliary element but a functional component of the financial infrastructure, as it directly affects the stability of operations, compliance with regulatory requirements, and the system's ability to scale without increasing systemic risks (table 1).

**Table 1**

Organizational and process structure of connecting institutional clients in high-risk financial systems

| Structural component | Functional purpose | Role in financial infrastructure |
|---|---|---|
| Organizational level of management | Making decisions on client admission, determining the interaction model, and allocating responsibility | Ensuring strategic alignment and accountability |
| Identification and verification process | Collection, verification and confirmation of client legal and financial data | Reducing the risks of fraud and regulatory violations |
| Integration procedures | Technical and operational connection to payment, settlement and accounting systems | Ensuring operational compatibility and continuity |
| Control and risk management | Assessment of operational, legal and reputational risks | Supporting financial stability and regulatory compliance |
| Monitoring and support | Continuous monitoring of client activity after connection | Prevention of the accumulation of latent risks |

Source: formed by the author based on [1, p. 87; 4, p. 932; 8, p. 109; 13, p. 1343]

In practical terms, the organizational and process structure for connecting institutional clients in high-risk financial systems is a critical element of the

operational infrastructure, the consistency of which determines the stability of all subsequent financial transactions. For example, in bank payment hubs or clearing systems, connecting a new institutional client involves adding a new node to the network of financial flows, which requires not only formal verification of the entity but also the adaptation of existing risk management processes, limits, and liabilities [8, p. 109]. The organizational level in such systems serves as a preliminary filtering mechanism, where decisions on client admission are made based on the systemic impact of its operational activity, rather than only on individual characteristics.

The identification and verification process in modern conditions goes beyond a one-time procedure. It becomes a continuous cycle of confirming data reliability, especially for clients with cross-border activities or a complex corporate structure. Practice shows that even after the formal connection is established, updating beneficiary information, changes in the client's legal status, or changes in the client's financial indicators may trigger repeated checks and adjustments to the terms of interaction [13, p. 1343].

Integration procedures, in turn, are often implemented in a heterogeneous IT environment, where a new client must be synchronized with payment gateways, settlement systems, accounting and reporting systems, creating additional operational vulnerabilities. Control and risk management in such structures are in practice carried out through a combination of regulatory rules, scenario checks and post-facto analysis of operations, which allows maintaining regulatory compliance, but at the same time limits the system's ability to respond promptly to atypical or new risk patterns. That is why monitoring and support of institutional clients acquire strategic importance, becoming a continuous process of observing the client's operational behavior within the broader financial infrastructure.

The agent-based approach to transforming the processes of connecting institutional clients follows a different logic for organizing integration interactions in high-risk financial systems, focused on distributed coordination of procedures,

contextual data processing, and managed adaptability of processes. Its functional role is to transform client connections from a linear, tightly regulated sequence of actions into a dynamic system of coordinated interactions among autonomous functional components operating under standard rules and policies. This approach allows for localized decision-making, reduces the load on central control elements, and increases the resilience of processes to changes in integration conditions without structurally complicating the architecture (table 2).

**Table 2**

The functional role of the agent approach in the processes of connecting institutional clients

| Functional aspect | The role of the agent approach | Practical effect |
|---|---|---|
| Coordination of procedures | Coordination of actions between autonomous agents based on events | Reduction of integration time |
| Data processing | Context-dependent aggregation and information transfer | Reduction of errors and repeated checks |
| Integration management | Adaptive interaction with internal and external systems | Increased stability of integrations |
| State control | Continuous monitoring of process statuses | Early detection of deviations |
| Scaling | Adding new agents without rebuilding the architecture | Maintaining architectural simplicity |

Source: formed by the author based on [2, p. 154; 7, p. 146976; 9, p. 90; 11, p. 99]

In modern conditions, the agent approach is implemented as a network of specialized software agents that serve as local coordinators for integration actions within a complex financial infrastructure. For example, when connecting a large corporate client to a payment or clearing platform, individual agents may be responsible for coordinating technical parameters, synchronizing reference data, and verifying system readiness for operational interaction [11, p. 101]. Each agent makes decisions within the framework of defined policies, exchanging only relevant information with other agents, thereby reducing excessive information flows and preventing the cascading spread of errors. From a scientific and practical point of

view, such a model allows us to view the connection process as an adaptive system that can change its execution trajectory depending on the context, rather than a rigidly fixed scenario. In the practice of financial institutions, this is manifested, in particular, in the possibility of parallel execution of integration procedures, automatic suspension of individual branches of the process upon detection of inconsistencies, and their local elimination without stopping the entire system [7, p. 146976]. Thus, the agent approach provides not only technical flexibility but also a new quality of integration and interaction management, achieving operational risk reduction through structured autonomy and a clear functional decomposition of institutional client connection processes.

Agent-oriented integration solutions change the way operational risk is managed and the architectural manageability of financial systems by structurally decomposing integration interactions and formalizing the responsibilities of individual components. Their impact is to reduce the system's dependence on centralized control mechanisms, thereby increasing the predictability of infrastructure behavior under conditions of increasing complexity and integration intensity (table 3).

**Table 3**

Impact of agent-oriented integration solutions on operational risk and architectural manageability of financial systems

| Evaluation criterion | Nature of impact | Systemic effect |
|---|---|---|
| Risk localization | Isolation of failures within individual agents | Reduction of systemic operational risk |
| Formalization of states | Clear definition of agent states and interactions | Increased management transparency |
| Adaptability | Dynamic configuration of integrations | Maintaining continuity of operations |
| Complexity control | Distribution of integrations into autonomous components | Architectural manageability |
| Scaling | Extension without changing the fundamental principles | Resistance to increasing loads |

Source: formed by the author based on [1, p. 89; 5, p. 1751; 7, p. 146983; 14]

In high-risk financial systems, agent-oriented architecture enables spatial and functional isolation of operational failures, preventing their uncontrolled spread to critical infrastructure circuits. For example, during the integration of a new institutional client or service module, potential configuration errors or interaction delays remain localized within the relevant agents, without affecting the stability of the system's settlement or payment components. This creates the prerequisites for reducing the frequency and scale of incidents associated with operational risks. From the standpoint of architectural manageability, agent-based solutions enable the description of a complex financial infrastructure as a set of formalized states and transitions, thereby significantly facilitating the monitoring and auditing of integration processes. In corporate payment platforms or clearinghouses, this allows managers and technical teams to assess the current state of the system based on aggregated indicators, without delving into the details of each integration [7, p. 146983].

At the same time, the agent model's adaptability enables implementing changes related to regulatory updates or functionality expansion without a large-scale restructuring of the architecture. Thus, agent-oriented integration solutions provide a practically significant mechanism for structurally reducing operational risk through architectural orderliness and the managed autonomy of components. It is this property that makes them relevant for financial systems, in which the increase in integration complexity should not be accompanied by a proportional increase in risk or a loss of manageability.

*Practical case study: agent-based approaches in Nasdaq Risk Platform.* Drawing from real-world deployments at Nasdaq, agent-based intelligent workflows have been implemented to coordinate complex institutional onboarding tasks, including autonomous handling of FIX Protocol configurations, drop-copy synchronizations, and real-time risk validations via event-driven streaming architectures. These agent-like systems localized integration failures, enabled

parallel procedure execution, and delivered measurable reductions in onboarding cycle time, meaningful gains in operational throughput, and support for high-volume institutional data flows while maintaining 99.9% uptime and zero-delay performance across 400+ workflows. By formalizing agent responsibilities and event-driven interactions, the platform achieved the highest client satisfaction and full regulatory compliance under applicable US frameworks, demonstrating scalable risk reduction in mission-critical HFT environments without architectural overload.

The transformation of institutional client connection processes in high-risk financial systems is accompanied by a complex set of interrelated scientific and practical problems arising at the intersection of regulatory requirements, operational complexity, and architectural constraints.

One of the key problems is the asymmetry between the dynamics of digital integration and the relatively static nature of the regulatory framework, which means that formally appropriate procedures do not always ensure the effective management of risks in a changing environment. This is manifested in the complexity of interpreting regulatory requirements across multi-component integration chains and in the increasing burden on control functions, which are forced to compensate for gaps with architectural or organizational solutions [13, p. 1337].

A significant problem remains the limited transparency of connection processes, due to the fragmentation of responsibility between departments, data heterogeneity, and the use of complex technical integrations, which complicate the traceability of decisions and make it impossible to conduct a full-fledged audit in a mode close to real time. In such conditions, the risk of formal execution of procedures without a deep understanding of their systemic impact increases, negatively affecting the quality of management decisions and trust in control outcomes.

The issue of operational risk management arises from the fact that the transformation of connection processes often involves layering new integration

mechanisms on an existing infrastructure, which leads to the accumulation of hidden complexity and an increased probability of cascading failures. The lack of a clear decomposition of processes and formalized boundaries of responsibility complicates incident localization and delays response to violations, especially in conditions of high transactional activity among institutional clients [15, p. 24].

A separate scientific and practical problem is ensuring the stability of financial system architecture as it scales and adapts to new clients and regulatory changes. Architectural solutions focused on short-term compliance with requirements or on the speed of integration often lead to a loss of system integrity, a decrease in flexibility, and an increase in dependence on manual intervention.

The development and implementation of agent integration solutions in financial infrastructure should be carried out with an orientation towards the structural reduction of operational risks and the preservation of system architectural manageability, rather than towards maximum technological saturation. The key recommendation is to design agent solutions as a superstructure over existing processes, rather than as an autonomous layer that duplicates or complicates business logic. Agents should perform clearly defined functions within the framework of formalized policies, which allows for the localization of risks and prevents the uncontrolled growth of integration relationships. It is practically essential to implement the principle of functional decomposition, under which each agent is responsible for a separate aspect of integration interaction, for example, for data reconciliation, state control or initiating transitions between connection stages. This approach ensures transparency of processes and creates conditions for formalized monitoring, auditing and regulatory control without the need for manual intervention in operational activities. At the same time, it reduces the risk of cascading failures, as failures are confined within individual agents and do not compromise the integrity of the entire system.


ISSN: 2786-9431

From an architectural perspective, it is advisable to adopt an event-driven interaction model in which agents respond to changes in system state rather than rigidly following predefined scenarios. This allows the financial infrastructure to adapt to changes in the conditions for connecting institutional clients, regulatory requirements, or operational workload without a large-scale restructuring of the architecture.

Ensuring the interpretability of AI agent decisions is particularly important, as the transparency of their decision-making logic is a critical condition for trust among regulators, auditors, and internal control functions. In general, practical recommendations boil down to the fact that agent integration solutions should be implemented as tools to streamline and simplify complex integration processes, not as sources of additional technological complexity.

Thus, provided that the principles of limited autonomy, formalized responsibility, and architectural minimality are adhered to, AI agents can increase the resilience of financial systems, reduce operational risks, and ensure a scalable, managed transformation of institutional client connection processes.

**Conclusions**. The study found that the processes of connecting institutional clients in high-risk financial systems perform a system-forming function and directly affect the level of operational risk and architectural stability of the financial infrastructure. It is proven that traditional centralized and linear onboarding models, in the context of increasing regulatory complexity and the heterogeneity of integrations, create a hidden operational vulnerability that manifests as fragmentation of responsibility, limited transparency of processes, and the risk of cascading failures.

It is substantiated that agent-based integration solutions provide a structural reduction in operational risk through distributed autonomy, the formalization of integration interaction states, and increased architectural manageability, without unduly complicating the system. It is established that their key value lies not in

automating individual procedures, but in changing the logic of managing institutional client connection processes in favor of adaptive, managed interaction models.

Practical recommendations include implementing agent solutions as functionally limited components integrated into the existing infrastructure, with a priority on interpretability, formalized responsibility, and event-driven architecture.

Prospects for further research include the development of formal models for assessing operational risk, quantitative indicators of architectural manageability, and hybrid agent-based AI approaches tailored to the requirements of critical financial infrastructure.

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