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Minimizing financial risks of cloud cost volatility through automated resource control

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Abstract. In the context of enterprises' digital transformation, the use of cloud technologies is accompanied by growing financial uncertainty due to volatility in resource consumption, the complexity of pricing models, and a high dependence on global digital infrastructure providers. Limited transparency into costs and fragmented financial controls in cloud environments increase the risk of budget overruns, unproductive expenditures, and reduced overall economic efficiency. In this regard, the need to develop integrated mechanisms for managing digital resources to ensure financial stability and the predictability of cash flows becomes increasingly relevant. The purpose of this article is to substantiate a methodological approach to minimizing financial risks associated with the use of cloud services through the implementation of an automated cost control system and its integration with enterprise financial management tools. The methodological framework of the study is based on systemic and structural-functional analysis, comparative generalization, economic and statistical analysis, managerial process modeling, and logical synthesis. The research employs analytical reports from international consulting companies, statistical data on the development of the cloud services



market, and generalized practices of FinOps and digital control instruments. The article systematizes the main factors contributing to financial instability in cloud environments, substantiates the impact of market concentration on costs, and identifies key risks to enterprise digital infrastructure. An integrated model of automated resource control is proposed that combines monitoring mechanisms, budget regulation, analytical data processing, and financial load forecasting. An operational algorithm for cloud cost management systems is developed, and the relationship between automation tools, types of financial risks, and economic outcomes of their application is generalized. The practical value of the study lies in the applicability of the proposed automated control model to enhance financial resilience, reduce unproductive expenditures, and establish an effective cloud resource management system in the digital economy.

Keywords: digital expenditures, financial stability, resource management, cost forecasting, digital controlling.

**Мінімізація фінансових ризиків волатильності хмарних витрат засобами
автоматизованого контролю ресурсів**

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Анотація. У сучасних умовах цифрової трансформації підприємств використання хмарних технологій супроводжується зростанням фінансової невизначеності, зумовленої волатильністю споживання ресурсів, складністю цінових моделей і високою залежністю від глобальних постачальників цифрової інфраструктури. Обмежена прозорість витрат та фрагментарність фінансового контролю у хмарному середовищі підвищують ризик перевищення бюджетних лімітів, формування непродуктивних витрат і



зниження економічної ефективності діяльності підприємств. У зв'язку з цим актуалізується потреба розроблення інтегрованих механізмів управління цифровими ресурсами, орієнтованих на забезпечення фінансової стабільності та прогнозованості грошових потоків. Метою статті є обґрунтування методичного підходу до мінімізації фінансових ризиків, пов'язаних із використанням хмарних сервісів, на основі впровадження автоматизованої системи контролю витрат та інтеграції її з інструментами фінансового менеджменту підприємства. Методологічну основу дослідження становлять методи системного та структурно-функціонального аналізу, порівняння, узагальнення, економіко-статистичного аналізу, моделювання управлінських процесів і логічного синтезу. У процесі дослідження використано аналітичні матеріали міжнародних консалтингових компаній, статистичні дані щодо розвитку ринку хмарних послуг, а також узагальнення практики застосування інструментів FinOps та цифрового контролінгу. У статті систематизовано основні чинники формування фінансової нестабільності у хмарному середовищі, обґрунтовано вплив ринкової концентрації на рівень витрат і визначено ключові ризики цифрової інфраструктури підприємств. Запропоновано інтегровану модель автоматизованого контролю ресурсів, що поєднує механізми моніторингу, бюджетного регулювання, аналітичної обробки даних і прогнозування фінансових навантажень. Розроблено алгоритм функціонування системи управління хмарними витратами та узагальнено взаємозв'язок між інструментами автоматизації, видами фінансових ризиків і економічними результатами їх застосування. Практична цінність дослідження полягає у можливості використання запропонованої моделі автоматизованого контролю для підвищення фінансової стійкості підприємств, зниження рівня непродуктивних витрат та формування ефективної системи управління хмарними ресурсами в умовах цифрової економіки.

Ключові слова: цифрові витрати, фінансова стабільність, управління



ресурсами, прогнозування витрат, цифровий контролінг.

Problem statement. The large-scale implementation of cloud technologies in enterprises' operations has become one of the key factors in the digital transformation of the modern economy, ensuring the flexibility of business processes, scalability of operations, and access to innovative digital solutions [1, p. 66]. At the same time, the growth in the consumption of cloud resources is accompanied by increased financial instability due to the volatility of costs, the complexity of tariff models, and limited transparency in the formation of service costs [2, p. 39]. In such conditions, the increased dependence of enterprises on external digital platforms alters the structure of their operating costs. It heightens the sensitivity of their financial results to changes in the IT service delivery environment. In the absence of effective mechanisms for financial and resource control, uncontrolled scaling of infrastructure, unproductive capacity reservation and fragmentation of cost accounting can lead to exceeding budget limits, the formation of hidden financial losses and a decrease in the overall economic efficiency of enterprises [3, p. 458]. In this regard, the development of systemic approaches to cloud resource management, focused on increasing transparency, predictability and stability of financial results, is becoming particularly relevant. Under such conditions, the need for integrated approaches to cloud resource management, focused on minimizing financial risks, increasing cost transparency, and ensuring the long-term economic efficiency of digital business transformation, is becoming more urgent.

Analysis of recent research and publications. In modern research, issues of cloud resource management and minimizing financial risks are considered through the prism of automation, intellectualization, and the integration of financial and technical processes. In particular, B. Jeong and Y.-S. Jeong analyzed approaches to automatic scaling in cloud-oriented environments and determined their impact on the efficiency and stability of digital infrastructure [4], while P. Nawrocki and



M. Smendowski systematized methods for optimizing resource consumption from the standpoint of economic feasibility and sustainable development [5]. In turn, J. Zhang et al. substantiated the use of hybrid algorithms to optimize workflow planning, thereby reducing costs and improving service quality [6]. The study by S. Chanthati highlights the development of intelligent mechanisms for managing financial transactions in a cloud environment, proposing approaches to the autonomous optimization of migration and resource processes [7, p. 73]. The issue of integrating technical and financial parameters within FinOps management is considered in the works of G. Fragiadakis and colleagues, who developed a decision-making support platform for cloud services pricing policy [8]. The issue of risk management and ensuring the stability of economic systems is revealed in the work of I. Bakalo, who analyzed the mechanisms of adaptation of the financial sector to crisis conditions [9, p. 37], as well as in the study by Y. Hasenko, devoted to the implementation of environmentally oriented and risk-oriented models of their functioning [10]. M. Krytskyi established the patterns of competitive advantage formation through the integration of digital technologies, which indirectly affects the efficiency of cost management in business systems [11]. Analytical and forecasting tools play an essential role in increasing financial stability, as substantiated by the works of N. Teter and O. Lega, who demonstrated the feasibility of using artificial intelligence for strategic planning [3, p. 454]. At the same time, K. Lapuzina focuses on the impact of institutional and logistical barriers on the financial stability of enterprises, which increases their operational risks in the context of digitalization [12]. The problems of digital transformation of the economy and accounting were studied by V. Ivankov and colleagues, who emphasize the importance of digital platforms for increasing the transparency of financial flows [13, p. 69]. The peculiarities of cost formation in serverless architectures were analyzed by M. Hamza and co-authors, who substantiate the dependence of economic feasibility on the type of load [14]. A. Q. Khan et al. systematized the structure of costs for cloud data storage and identified the complexity of pricing



models in multi-cloud environments [15]. The issue of strategic management of the transition to cloud technologies is highlighted in the works of L. Glynchuk, who systematized the costs and risks of cloud migration [2, p. 39], as well as in the study of P. Mykytyuk and co-authors, who identified the role of financial technologies, data analytics and regulatory platforms in increasing the transparency and effectiveness of risk management [1, p. 66].

The generalization of the results of the above studies shows that the modern scientific paradigm of cloud environment management focuses on the development of complex automated systems that integrate technical optimization, financial control, and strategic planning to minimize cost volatility and ensure the long-term financial sustainability of enterprises.

Identification of previously unresolved parts of the general problem.

Despite a significant number of scientific studies devoted to optimizing the use of cloud resources, automating management processes, and applying intelligent technologies in the digital environment, several issues remain insufficiently studied. In particular, existing work mainly focuses on technical aspects of scaling, migration, and load planning. At the same time, the management of financial risks arising from cloud cost volatility is addressed only fragmentarily and without proper integration with financial management tools. The issues of establishing a single methodological basis for automated control of cloud resources, coordinating analytical, budgetary, and forecasting mechanisms, and assessing their impact on the stability of cash flows and the long-term economic efficiency of enterprises remain insufficiently researched. The lack of an integrated approach complicates the practical implementation of modern cost management systems and reduces the effectiveness of digital infrastructure.

In this regard, the need to develop integrated management solutions that combine technological, financial, and analytical tools within a single risk-minimization system is becoming increasingly urgent.

Formulation of the article objectives (statement of the task). The purpose



of the article is to substantiate a methodological approach to minimizing financial risks associated with the volatility of cloud costs, based on the development and implementation of an integrated system of automated resource control, aimed at increasing transparency, predictability, and economic efficiency in the use of enterprises' digital infrastructure.

Presentation of the main material of the study. The rapid digitalization of business processes and the spread of cloud technologies have led to a significant increase in financing for enterprises' information infrastructure. The transition of enterprises to SaaS, PaaS, and IaaS models has increased flexibility in managing digital resources and optimizing operational processes. Still, it has also increased the risks of instability and unpredictable costs. This is because cloud services operate on dynamic pricing models that depend on load levels, data storage volumes, and network traffic, creating conditions for financial volatility and complicating budget planning and control [16]. Therefore, costs for cloud platforms are increasingly variable and difficult to predict, which complicates budgeting, financial controlling, and strategic planning. The lack of proper transparency into resource use, uneven consumption of computing power, and real-time scaling contribute to the formation of hidden costs and budget overruns [5]. As a result, cloud cost management is transformed from a technical task into a complex financial and economic problem.

To substantiate the scale and dynamics of the public cloud services market, it is advisable to analyze global trends in end-user spending by major segments. The corresponding indicators for 2024–2025 are given in table 1, which allows to assess structural shifts in the cloud services sector and identify the prerequisites for increasing financial volatility.

Table 1

Global public cloud spending trends, 2024–2025

Cloud services segment	Spending, \$ million	
	2024	2025
SaaS (Software as a Service)	250 804	299 071
PaaS (Platform as a Service)	171 565	208 644



Cloud services segment	Spending, \$ million	
	2024	2025
IaaS (Infrastructure as a Service)	169 818	211 856
DaaS (Desktop as a Service)	3 466	3 849
Total	595 652	723 421

Source: compiled from [18]

The data provided indicates a steady trend towards growth in global spending on public cloud services in 2024–2025 across all major segments. The total market volume over the study period increased from \$595.7 billion in 2024 to \$723.4 billion in 2025, which corresponds to a growth rate of 21.5%. This dynamic reflects the increasing role of cloud infrastructure as a fundamental element of enterprises' digital transformation and, at the same time, creates the prerequisites for the growth of financial risks associated with cost instability. The largest share of the consumption structure is held by the SaaS segment, whose volume in 2025 reached almost \$300 billion. At the same time, the highest growth rates are demonstrated by the IaaS and PaaS segments, with increases of 24.8% and 21.6%, respectively. This indicates the active spread of platform and infrastructure solutions focused on supporting complex digital services, analytical systems, and projects based on artificial intelligence, accompanied by an increase in enterprises' dependence on variable consumption of computing resources. Unlike relatively predictable SaaS subscriptions, infrastructure and platform services are based primarily on actual capacity use, leading to significant short-term cost fluctuations. As a result, the structure of cloud costs is gradually shifting towards components with higher financial uncertainty, which complicates budgeting, control, and strategic planning. The moderate growth rates of the DaaS segment indicate its auxiliary nature within the overall architecture of cloud services; however, even in this regard, there is a gradual increase in enterprises' involvement and the expansion of its practical application areas. This confirms the trend towards comprehensive coverage of business processes by cloud solutions and further complication of the financial flow management system [17].



The financial volatility of cloud costs is driven by dynamic resource scaling based on load, uneven demand during peak periods, inefficient reservation of computing capacity, human factors in administrative processes, and the use of unauthorized or uncontrolled services (shadow IT). The combined impact of these factors leads to deviations of actual costs from planned indicators and weakens the effectiveness of financial control.

The specific structure of cloud costs, combining computing, networking, services, and licensing components, forms a complex financial model of the enterprise's digital infrastructure. The dependence of service costs on the intensity of resource use, dynamic scaling, and external tariff conditions leads to high-cost variability in the short and medium term. Under such conditions, cloud payments acquire the characteristics of unstable financial obligations, which complicates their forecasting and control.

Uneven resource consumption, limited transparency into costs, and the difficulty of identifying individual items lead to hidden financial risks, including budget overruns, increased operating costs, and reduced profitability. As a result, the use of cloud services is increasingly accompanied by the risk of irrational allocation of financial resources and loss of cost control.

In the context of scaling digital platforms, these risks are amplified, transforming local financial deviations into systemic threats to cash flows and the enterprise's financial stability. This necessitates an in-depth analysis of the manifestations of inefficiency in the use of cloud resources and an assessment of their impact on financial performance (table 2).

Table 2

Dynamics of global spending on public cloud services in 2024–2025

Type of financial risk	Share of companies facing risk, %	The primary cause of the occurrence	Financial implications
Overprovisioning	32	Reserving capacity with a margin without taking into account the real	Increased operating costs, formation of unproductive expenditures



Type of financial risk	Share of companies facing risk, %	The primary cause of the occurrence	Financial implications
		workload	
Late detection of overspending	78	Lack of automated monitoring and alerting systems	Budget overruns, violation of financial planning
Insufficient cost transparency	54	Lack of resource tagging and payment detailing	Inability to optimize costs, hidden losses
Difficulty in assessing return on investment	49	Separation of IT and financial analytics	Errors in investment decisions, reduced efficiency
Limited cost identification	70	Insufficient integration of accounting and cloud systems	Distortion of management reporting, irrational allocation of resources

Source: summarized from [17; 19; 20]

The data in table 2 indicate the systemic nature of the financial risks associated with the use of cloud technologies in enterprises' activities. The most common problem is untimely detection of overspending, faced by 78% of companies, indicating an insufficient level of development of operational financial monitoring tools. In the absence of automated mechanisms to control budgetary excesses, ex post facto adjustments are made, making it impossible to adjust spending policy on time. The high proportion of enterprises with limited ability to identify costs (70%) and insufficient transparency into financial flows (54%) indicates the fragmentation of cloud resource management systems. In such conditions, infrastructure costs cannot be clearly linked to individual divisions, projects, or business processes, which weakens the effectiveness of management accounting and complicates cost optimization. The problem of excessive resource reservation, which is typical for 32% of companies, leads to the accumulation of unproductive costs not related to the creation of added value, which are cumulative and, in the long term, negatively affect the enterprise's profitability. At the same time, the complexity of assessing the profitability of investments in cloud technologies, which almost half of the surveyed organizations face, limits the ability to plan digital development strategically. Taken together, these risks form a multidimensional system of



financial threats that covers the operational, investment and strategic levels of management. Their presence necessitates transitioning from fragmented control methods to integrated automated cloud cost management systems focused on increasing transparency, predictability, and the cost-effectiveness of the use of digital resources.

The financial instability of cloud services is also exacerbated by the structural features of the global market for digital infrastructure providers (table 3). The high concentration of providers around a limited number of hyperscalers reduces the flexibility to choose suppliers, limits the potential for price diversification, and increases users' dependence on the tariff policies of dominant companies. In such conditions, price changes, contract term adjustments, or service model transformations directly translate into financial risks for the business.

Table 3

Structure of the global cloud service provider market, 2024–2025

Provider	Market share, %	Primary segment	Geographical presence
Amazon Web Services (AWS)	32	IaaS, PaaS	Global
Microsoft Azure	23	IaaS, PaaS, SaaS	Global
Google Cloud	12	IaaS, PaaS	Global
Alibaba Cloud	6	IaaS	Asia
Others	27	Mixed	Regional

Source: compiled based on [17; 22]

The data presented indicate a high concentration of the global cloud services market among a limited number of providers. The combined share of the three leading companies – Amazon Web Services, Microsoft Azure, and Google Cloud – exceeds 65%, confirming the dominance of hyperscalers in the infrastructure and platform solutions segments. This market structure creates asymmetry in negotiating positions between service providers and consumers and limits enterprises' ability to diversify their sources of digital resources. The dominance of global providers is accompanied by the unification of service models and the centralization of pricing policy, which increases users' sensitivity to changes in tariffs, contract terms, and



technical regulations. In the absence of alternative providers, even minor adjustments to service costs can lead to a significant increase in enterprises' operating costs and threaten financial stability. Companies that use multi-component cloud architectures and substantial computing power are especially vulnerable in this context. At the same time, the limited share of regional and specialized providers in the overall market structure narrows the scope for flexible load redistribution and cost optimization through supplier switching. As a result, an additional financial risk arises from the business's technological and pricing dependence on individual cloud ecosystems.

Under such conditions, the implementation of automated cloud resource management mechanisms focused on increasing cost transparency, preventing overspending and optimizing infrastructure use becomes a priority. The use of monitoring, forecasting, and adaptive management tools partially neutralizes the negative impact of market concentration and helps ensure more stable financial control in an environment dominated by hyperscalers.

That is why it is advisable to consider in detail the mechanisms of automated resource control as a key method for minimizing financial risks when using cloud technologies. In modern conditions, such mechanisms act not only as a means of technical monitoring of infrastructure, but also as an element of financial management aimed at increasing transparency, predictability, and the efficiency of the use of digital resources. These mechanisms are implemented in practice through a system of interconnected cloud resource management tools aimed at ensuring transparency of financial flows, timely detection of deviations and optimization of the use of digital infrastructure (table 4).

The combination of these tools enables continuous monitoring of cost dynamics and a timely response to load changes. Of particular importance is the integration of tools for prompt notification, budget constraints, and resource labeling, which lays the groundwork for a transparent system of financial accounting for cloud infrastructure. This allows to link costs to specific business processes and



assess their economic feasibility.

Table 4

Tools for automated cloud cost control in the financial risk management system

Control object	Financial risk	Minimization risk mechanism	Impact on the management system	Long-term effect
Expense notification system				
Current resource expenditures	Budget overruns	Early detection of deviations	Strengthening operational control	Increasing financial stability
Budget limits				
Budget restrictions				
Funding limits	Financial losses	Blocking overspends	Expense discipline	Cash flow optimization
Resource tagging				
Project-based costs	Hidden costs	Consumption breakdown	Transparency of resource allocation	Increasing the validity of decisions
Automated resource decommissioning				
Inactive (idle) environments	Non-productive expenditures	Elimination of downtime	Infrastructure rationalization	Growth of economic efficiency
Cost forecasting				
Future financial burdens	Financial instability	Scenario building	Supporting strategic planning	Reducing investment risks

Source: based on [18; 19; 21]

The above-mentioned approaches to automated management of cloud resources are implemented using a phased logic for information processing and decision-making. In this context, the automated control system functions as an integrated information and analytical mechanism that provides a continuous cycle of monitoring, evaluation and adjustment of the parameters of the use of digital infrastructure. The general algorithm of its functioning is best presented as a sequential management model (fig. 1).

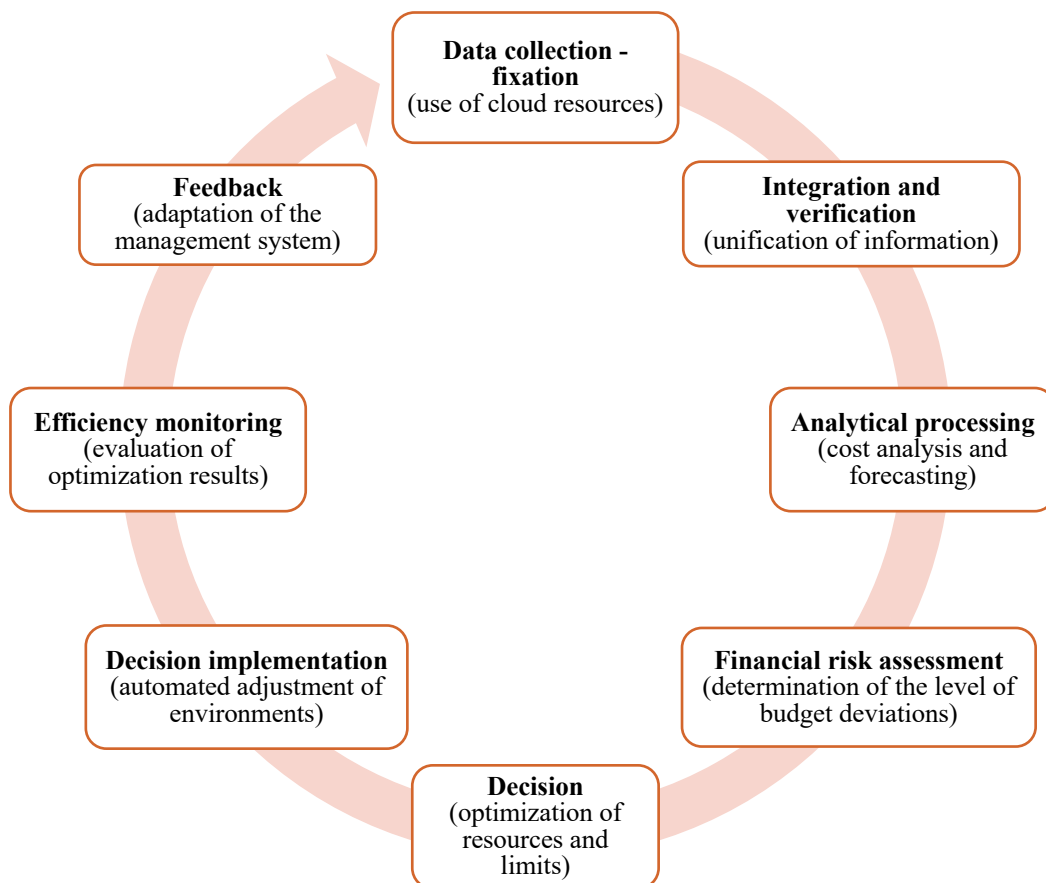


Fig. 1. Algorithm for automated control and optimization of cloud costs of an enterprise

Source: author's development

As can see, automated real-time monitoring first allows to quickly record deviations between actual costs and planned indicators, reducing the risk of uncontrolled budget overruns. The use of budget limitation mechanisms and a system of warning notifications contribute to the development of a preventive approach to financial control. Unlike traditional approaches focused on post-facto analysis, the automated system provides a timely response to potential overspending at the stage of their formation. This allows to significantly reduce the likelihood of cash gaps and disruptions to the enterprise's financial stability. At the same time, the integration of resource marking mechanisms with financial management modules ensures the accurate distribution of costs across projects, divisions, and areas of activity. As a result, the risk of hidden and unjustified costs is reduced, the validity



of management decisions is increased and a system of personal responsibility for the use of digital resources is formed. Automatic shutdown of inactive environments helps minimize the consumption of computing power and reduce operating costs. The use of predictive analytics enables the development of financial scenarios for cloud infrastructure and the assessment of potential risks in the medium and long term. Thanks to this, the enterprise moves from reactive to proactive cost management, thereby increasing cash flow predictability and reducing investment uncertainty.

To systematize the impact of automated control on financial risk levels, it is advisable to summarize the relationships among the main threat types, appropriate management tools, and achieved economic results. This approach allows to clearly reflect the mechanism for minimizing risks in the process of using cloud technologies (table 5).

Table 5

The impact of automated control on minimizing the financial risks of cloud costs

Source of occurrence	Automation tool	Influence mechanism	Economic effect	Management result
Exceeding budget limits				
Uncontrolled scaling	Notification system, budget restrictions	Prompt response to deviations	Reducing overspends	Stabilizing financial flows
Non-productive costs				
Idle resources	Automatic shutdown of environments	Elimination of inactive capacities	Reducing operating costs	Increasing the efficiency of use
Lack of cost transparency				
Lack of granularity	Resource tagging	Distribution of costs by projects	Reducing hidden costs	Strengthening financial control
Low predictability				
Lack of planning	Predictive analytics	Modeling financial scenarios	Improved budget accuracy	Reducing financial uncertainty
Provider dependency				
Market concentration	Comparative monitoring of	Optimization of consumption	Optimization of contract costs	Improved negotiating



Source of occurrence	Automation tool	Influence mechanism	Economic effect	Management result
	tariffs	structure		position
Human error risk				
Human factor	Automated management policies	Standardization of processes	Reducing losses from errors	Improved system controllability

Source: created by the author

The implementation of the proposed measures in the financial control system will contribute to the transition to a proactive model, in which management decisions are based on comprehensive data analysis and aimed at ensuring the long-term economic efficiency of cloud technology use.

Conclusions. It has been established that the growth in the use of cloud technologies in enterprises' activities is accompanied by an increase in their financial instability, due to the volatility of resource consumption, limited cost transparency, and dependence on global providers. The main factors of such instability are uncontrolled resource scaling, inefficient capacity reservation, fragmentation of financial accounting, and the influence of the human factor, which form a multidimensional system of financial risks at the operational, tactical, and strategic levels of management. The feasibility of applying an integrated approach to minimizing financial risks through the implementation of an automated cloud cost control system that combines monitoring, analytics, budget regulation, and forecasting tools is substantiated. The proposed approach provides a continuous resource management cycle, focused on timely detection of deviations, adaptation of infrastructure and optimization of financial flows.

The practical significance of the developed model lies in transforming cloud cost management from a reactive to a proactive approach, which contributes to reducing overspends and developing a long-term digital efficiency strategy for enterprises. Further research should focus on empirical testing of the model and on assessing its impact on the financial stability of business entities.



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