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THE ASSESSMENT OF BLOCKCHAIN READINESS FOR ACADEMIC DOCUMENT VERIFICATION

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Abstract. This article presents a methodology for comprehensively assessing a blockchain platform's readiness to verify academic documents in a pilot production environment. The system under study is developed on the Ethereum Virtual Machine (EVM)-compatible blockchain network and utilizes smart contracts, document hashing, role-based access control, event registration, and transaction monitoring via BlockScout. Blockchain is viewed as an additional layer of trust and verification that integrates with the existing digital infrastructure of higher education. The study proposes an integrated readiness index for evaluation, considering six criteria: functional completeness, security, performance, reliability, integration, and regulatory readiness. Each criterion is assessed on

a five-point scale using weighting coefficients. The pilot test analyzed 294,698 transactions with a 15-second block generation interval. Average throughput was 8.26 transactions per second, node availability was 99%, and average cost was approximately 226,000 gas units per transaction. The integrated readiness index was 75.3%, which corresponds to conditional readiness for pilot production. Functional completeness, safety, and reliability received the highest scores. At the same time, the key areas for further improvement were regulatory readiness, scalability, and integration with the Learning Management System and the Unified Higher Education Platform.

Keywords: blockchain, academic credentials, smart contract, pilot operation, cybersecurity, verification, higher education

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БІЛІМ БЕРУ ҚҰЖАТТАРЫНЫҢ ТҮПНҮСҚАЛЫҒЫН ТЕКСЕРУГЕ БЛОКЧЕЙН ТЕХНОЛОГИЯСЫНЫҢ ДАЙЫНДЫҒЫН БАҒАЛАУ

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Аннотация. Мақалада академиялық құжаттардың түпнұсқалығын тексеруге арналған блокчейн-платформаның тәжірибелік-өнеркәсіптік пайдалануға дайындығын кешенді бағалау әдістемесі ұсынылады. Зерттелетін жүйе Ethereum Virtual Machine (EVM)-мен үйлесімді блокчейн желісінде әзірленген және смарт-келісімшарттарды, құжаттарды хэштеуді, рөлдерге негізделген қол жеткізуді басқаруды, оқиғаларды тіркеуді және BlockScout арқылы транзакцияларды мониторингтеуді пайдаланады. Блокчейн жоғары білім берудің қолданыстағы цифрлық инфрақұрылымымен интеграцияланатын қосымша сенім және верификация деңгейі ретінде қарастырылады. Бағалау үшін алты критерийді қамтитын интегралдық дайындық индексі ұсынылған: функционалдық толықтық, қауіпсіздік, өнімділік, сенімділік, интеграция және реттеушілік дайындық. Әрбір критерий салмақтық коэффициенттерді қолдана отырып, бес балдық шкала бойынша бағаланады. Пилоттық сынақ барысында блок қалыптастыру аралығы 15 секунд болған жағдайда 294 698 транзакция талданды. Орташа өткізу қабілеті секундына 8,26 транзакцияны, түйіндердің қолжетімділігі 99%-ды, ал бір транзакцияның орташа құны шамамен 226 000 gas бірлігін құрады. Интегралдық дайындық индексі 75,3% болды, бұл жүйенің тәжірибелік-өнеркәсіптік пайдалануға шартты түрде дайын екенін көрсетеді. Ең жоғары бағалар функционалдық толықтық, қауіпсіздік және сенімділік критерийлері бойынша алынды. Одан әрі жетілдіруді қажет ететін негізгі бағыттар ретінде реттеушілік дайындық, масштабталу, Learning Management System жүйесімен және Бірыңғай жоғары білім беру платформасымен интеграция анықталды. Ұсынылған бағалау әдістемесін академиялық құжаттарды блокчейн негізінде верификациялау жүйелерінің кең ауқымда енгізілуіне дейінгі технологиялық және ұйымдастырушылық жетілу деңгейін анықтау үшін пайдалануға болады.

Түйін сөздер: блокчейн; академиялық құжаттар; смарт-келісімшарт; тәжірибелік-өнеркәсіптік пайдалану; киберқауіпсіздік; верификация; жоғары білім

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ОЦЕНКА ГОТОВНОСТИ ТЕХНОЛОГИИ БЛОКЧЕЙН К ПРОВЕРКЕ ПОДЛИННОСТИ ДОКУМЕНТОВ ОБ ОБРАЗОВАНИИ

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Аннотация. В статье представлена методика комплексной оценки готовности блокчейн-платформы для верификации академических документов к опытно-промышленной эксплуатации. Исследуемая система разработана на базе блокчейн-сети, совместимой с Ethereum Virtual Machine (EVM), и использует смарт-контракты, хэширование документов, ролевое управление доступом, регистрацию событий и мониторинг транзакций посредством BlockScout. Блокчейн рассматривается как дополнительный уровень доверия и верификации, интегрируемый с существующей цифровой инфраструктурой высшего образования. Для оценки предложен интегральный индекс готовности, учитывающий шесть критериев: функциональную полноту, безопасность, производительность, надежность, интеграцию и регуляторную готовность. Каждый критерий оценивается по пятибалльной шкале с использованием весовых коэффициентов. В ходе пилотного тестирования были проанализированы 294 698 транзакций при интервале формирования блока 15 секунд. Средняя пропускная способность

составила 8,26 транзакции в секунду, доступность узлов — 99%, а средние затраты — около 226 000 единиц газа на одну транзакцию. Интегральный индекс готовности составил 75,3%, что соответствует условной готовности системы к опытно-промышленной эксплуатации. Наиболее высокие оценки получили функциональная полнота, безопасность и надежность. Ключевыми направлениями дальнейшего совершенствования являются регуляторная готовность, масштабируемость и интеграция с Learning Management System и Единой платформой высшего образования. Предложенная методика может использоваться для оценки технологической и организационной зрелости блокчейн-систем верификации академических документов перед их масштабным внедрением.

Ключевые слова: блокчейн; академические документы; смарт-контракт; опытно-промышленная эксплуатация; кибербезопасность; верификация; высшее образование

Introduction. Currently, the volume of documents such as transcripts and diplomas is increasing significantly. The traditional database management model relies primarily on storing data in local database systems (DBMS), where everything is stored centrally. However, this model carries significant risks of unauthorized access and modification by unauthorized persons. This is especially undesirable for such confidential documents. For universities, organizations, and employers, data authenticity and immutability are crucial.

One important solution is blockchain technology, which is not a complete replacement for university DBMSs but an additional data security solution. Early blockchain systems mostly used hash-based certificates to verify records. Newer systems support more complex educational tasks, such as access control, searching records on a distributed ledger, and connections with university or government databases. In these systems, the blockchain stores important events. Smart contracts define the rules for registration and verification. A hybrid on-chain and off-chain approach can also keep personal data separate from cryptographic records. However, building such a system requires more effort. Developers need to consider system performance, data privacy, and integration with existing learning management systems (LMS).

Kazakhstan already has a strong digital infrastructure for higher education. Universities commonly use LMS and online services to manage transcripts, diplomas, and other academic records. At the national level, these systems are connected to the Unified Higher Education Platform (UHEP). It collects and aggregates data from universities across the whole country. The UHEP provides a useful basis for introducing blockchain technologies in higher education. It brings together academic data from more than 100 universities and supports information exchange between universities and the Ministry of Science and Higher Education (MSHE). Because this infrastructure already exists, Kazakhstan will not need to

build an entirely new national system. Instead, this platform could be improved with smart contracts and hybrid models in which some data is stored on the blockchain, and some is kept outside it.

Following these principles, researchers developed a new blockchain platform to store and verify academic documents (Kistaubayev et al., 2025). On this platform, the BlockScout explorer verifies blockchain transactions and events. Unlike many implementations developed in Europe and the United States of America, which focus on direct interaction between students and universities and sometimes rely on Bitcoin-based transaction models, this system differs significantly by presenting the UHEP as a centralized national platform (Ussatova et al., 2026). In this approach, blockchain is added as an extra layer for verification and trust. However, a working system and successful transactions are not enough to show that the platform is ready for a pilot implementation. Readiness should be evaluated from operational and regulatory perspectives. For this reason, clear criteria are needed to connect technical performance with practical implementation requirements. Therefore, this study aims to develop a method for evaluating the readiness of a blockchain platform for academic document verification.

Literature review. Research on blockchain in education has explored several key areas: using distributed ledgers to store diplomas and academic transcripts; systems to improve privacy, access control, cooperation between institutions, and independent verification of academic credentials.

One important systematic study is (Caldarelli and Ellul, 2021), which examines the energy consumption of trusted academic transcripts. The authors analyze random changes in terms of technological organization, decentralization level, and the orientation of trust formation. Particular attention is paid to the lack of full standardization in proposed solutions and the “oracle” problem, in which the stability of already recorded information is consistently ensured. However, the data’s accuracy is not guaranteed upon initial entry. The authenticity of the transcript still depends on the university or organization that issues it. Blockchain can protect the record from change, but it cannot guarantee the original information was correct.

Another important area of focus has been enhancing confidentiality and organizing controlled inter-university exchange of educational data. In An and Chen 2021, the ElearnChain blockchain system for electronic educational records was proposed. This work focused on the security issues of digital diplomas and the complexity of electronic educational resources. Unlike fully public blockchain networks, the consortium model limits participation in registry maintenance to a select group of organizations. This implementation creates a dedicated environment for circulating electronic educational records. This approach shows that a managed network of organizations with administrative and legal relationships is better suited to the education sector.

The paper (Castro and Au-Yong-Oliveira, 2021) examined blockchain

primarily from the perspective of diploma issuance and verification. The authors paid attention to immutability and traceability in document verification. They viewed blockchain as a mechanism to combat diploma forgery and reduce the time spent on qualification verification. An analysis of the publications demonstrated the novelty of this approach and the prevalence of conceptual models and early prototypes. Thus, even at an early stage of research, the focus shifted from simply storing a diploma digitally to creating an infrastructure that allows a third party to independently confirm a document's origin and immutability without lengthy access to the issuing university.

The paper (Alsobhi et al., 2023) analyzed blockchain-based microcredential management systems and formulated the requirements for platforms that use them. It paid particular attention to giving learners access to their achievements and supporting interaction among participants in the educational ecosystem. The authors found that most systems issued, stored, and verified microcredentials. More advanced functions were less common. Therefore, the main challenge was not only protecting digital documents. It was also about making educational achievements easier to share and reuse across different information systems.

A broader review of blockchain use in education was presented in (El Koshiry et al. 2023). The study showed that blockchain can verify records and improve transaction transparency. At the same time, it identified challenges such as selecting a suitable blockchain platform and adapting the technology to existing institutional processes. Thus, the question of blockchain application is gradually shifting from proving the technology's general usefulness to choosing an architecture that suits a specific educational and organizational context.

EduASAC blockchain-based access control system was discussed in (Hu et al., 2023). The authors combined Discretionary Access Control (DAC) and Mandatory Access Control (MAC). Smart contracts provided access policy registration, permission checking, system parameter management, and control of participant interactions. The experiments showed that the system could provide detailed access control with high transaction speed and low delays. However, this requires a more complex architecture with additional authorization methods and cryptographic tools.

In the study (Dias et al., 2024), the authors analyzed the application of Hyperledger Fabric in universities and considered transforming the proposed Ethereum-based model into a Hyperledger Fabric architecture. A main advantage of this approach is that it creates a controlled network with known participants. Different organizations share responsibilities without using an open cryptocurrency system. This model suits education because universities and government agencies operate within defined roles and responsibilities.

In Berrios Moya et al. (2025), the authors introduced ZKBAR-V, a system for validating academic records with zero-knowledge proofs. This system combines smart contracts, decentralized identifiers (DIDs), and decentralized document

storage. Its main benefit is that it can verify specific information from an academic record without showing the entire document. An employer can confirm a person's qualification without receiving a full transcript or other personal details. The authors also tested the system and evaluated the cost of processing requests and running smart contracts.

Materials and methods. To evaluate whether the blockchain platform is ready for trial use, it is important to describe the main technologies used. The platform is built on an Ethereum Virtual Machine (EVM) blockchain network (Cardenas-Quispe and Pacheco, 2025) and uses smart contracts to manage transactions and other operations. The blockchain acts as a trusted layer for registering documents, keeping transaction records, and preventing changes to stored information. However, not all educational data is stored on the blockchain. The full data remains in a database, while a master hash is stored on the cloud-based blockchain for verification. This blockchain component (Chinnasamy et al., 2025) supports operations where provability and the impossibility of undetectable modification of recorded information are particularly important.

The developed experimental environment uses EVM mechanisms to execute smart contracts (Fekete and Kiss, 2023), process transactions, and generate events. Each academic document is registered through a blockchain transaction. Once the transaction is completed, it is added to a block and receives a unique hash. This creates a verifiable record for every operation. The record includes details such as the sender, smart contract address, execution time, transaction status, and the computing resources used.

All transactions are monitored in the BlockScout browser, the primary tool for monitoring transaction execution. BlockScout's interface allows monitoring generated blocks and transactions, searching by address, transaction hash, or block number, and analyzing network status and transaction activity. The main BlockScout browser window is shown in Figure 1.

The BlockScout main window provides summary data on the blockchain network (Tran et al., 2023). The system shows a list of recent transactions with details such as the transaction type, hash, confirmation time, sender and receiver addresses, transferred value, and gas used. A "Success" status means the transaction completed correctly and was added to the blockchain (Gottlieb et al., 2024). In an academic document verification system, this matters because it proves the operation was successfully recorded on the distributed ledger (Wei et al., 2024).

Each transaction displayed in the window contains the following information:

- The type of the executed transaction: a regular transaction or a smart contract transaction;
- The transaction hash (e.g. 0 xdf 6652 a ... bd 2), which is a unique identifier of the transaction;
- Transaction execution time, which shows the time passed during the transaction execution;

- Sender and recipient addresses (e.g. 0 xb 9... D 150 → 0 x 69...38 E 2), which indicate the direction of the transaction being performed;
- A commission, which is a fee for executing a transaction.

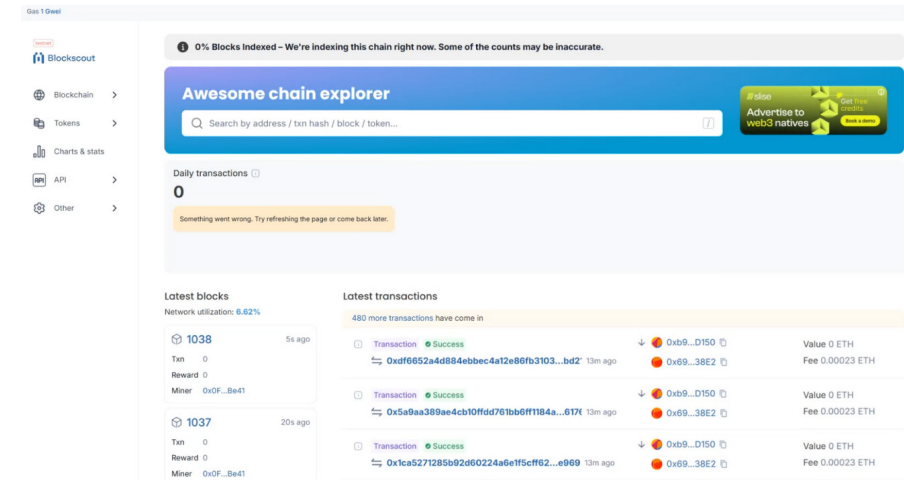


Figure 1 – BlockScout browser window.

Registration of an academic document is performed through the appropriate smart contract functions. This sequence begins with transferring academic transcript data and verifying the input parameters. An external Interoperable Role-Based Access Control (IRBAC) module is used to restrict access. It checks whether the user has the Issuer role to register academic records. If the user does not have such rights, the operation is rejected. After successful role verification, the system generates an operation to save the data to the blockchain (Silaghi and Popescu, 2025). The hash works like a digital fingerprint of the academic document. During verification, the system compares the current document with the hash to check whether the content has changed. It is very useful for diplomas, transcripts, and similar records because even a small change to the original file produces a different hash (Li et al., 2026). The list of transactions is shown in Figure 2. The smart contract function implementation results in a blockchain transaction. When the transaction is completed, the system creates a unique transaction hash that serves as a permanent identifier (Chen et al., 2026). This hash can be used in BlockScout to find the transaction and view its details. The developed algorithm also introduces a TranscriptSaved event that contains the transcript identifier and data to establish the registration initiator. Thus, along with changes to the smart contract's state, the system generates an event log that external information systems can use to track transactions.

Blockchain >Tokens >Charts & stats >API >Other >

Search by address / txn hash / block / token...

Transactions

MinedPending

Advanced filter

Txn hash	Type	Method	Block	From/To	Value ETH	Fee ETH
scanning new transactions...						
☐ 0xea774a39f0...8ece	Transaction		991	☐ 0xb9...d150 ☐ 0xb9...38e2	0	0.00023339
12m ago Success						
☐ 0x4096428b6a...cfcf	Transaction		991	☐ 0xb9...d150 ☐ 0xb9...38e2	0	0.00023339
12m ago Success						
☐ 0x5e150de576...0e81	Transaction		991	☐ 0xb9...d150 ☐ 0xb9...38e2	0	0.00023339
12m ago Success						
☐ 0x7d77c59083...c9cd	Transaction		991	☐ 0xb9...d150 ☐ 0xb9...38e2	0	0.00023339
12m ago Success						
☐ 0x3880d9758...3d68	Transaction		991	☐ 0xb9...d150 ☐ 0xb9...38e2	0	0.00023339
12m ago Success						
☐ 0x2dffb799da...375e	Transaction		991	☐ 0xb9...d150 ☐ 0xb9...38e2	0	0.00023339
12m ago Success						

Figure 2 – List of transactions

Figure 3 shows a more detailed view of each transaction page in BlackScout. It includes the transaction hash, status, smart contract method, block number, timestamp, sender and recipient addresses, and gas usage. The number of confirmations shows how many blocks have been added since the block containing the transaction. The timestamp shows when the transaction was processed and added to the blockchain. The “From” and “To” fields show the sender’s address and the smart contract address. Since these transactions only call smart contract functions and do not transfer cryptocurrency, the transaction value is zero. The transaction itself is a complete blockchain operation because it initiates program execution and changes the contract state.

Blockchain >Tokens >Charts & stats >API >Other >

Search by address / txn hash / block / token...

Transaction details

0xea774a39f0e4bdcf18539d501191e6510a99a9c8af431e6b60416f53a78ece

DetailsToken transfersInternal txnsLogsStateRaw trace

This is a testnet transaction only

Transaction hash0xea774a39f0e4bdcf18539d501191e6510a99a9c8af431e6b60416f53a78ece

Status and methodSuccess

Block991 | 49 Block confirmations

Timestamp12m ago | Jan 29 2026 18:08:00 PM (+05:00 UTC) | Confirmed within 0 secs

Sponsored

YOUR USERS ARE ONCHAIN. WE KNOW WHERE

Target wallets that convert

Get new proposal

From0xb90Ebd28c5760cAc82581fdC4f936e6E6cD150

To0x6983B77198e9C3d6c41fB8BAdc7C476cD0838E2

Value0 ETH

Transaction fee0.00023338906768281 ETH

Gas price0.00000001000000029 ETH (1.00000029 Gwei)

Gas usage & limit by txn233,389 | 236,409 98.72%

Figure 3 – Data of the executed transaction

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When analyzing a transaction system, evaluating the blockchain system, and determining its readiness for pilot production, these steps play a crucial role. This indicator, called the integrated readiness index, is determined not by a single parameter but by the interrelationships among multiple characteristics (Daraghmi et al., 2019). A combination of interrelated characteristics, such as functional correctness, security, performance, and operational reliability, determines the need for an integrated indicator. The criteria vary in importance when deciding whether the system is ready to move from a prototype to real use in education. Each criterion is rated from 0 to 5. A score of 0 means that the requirement is not met, middle scores show partial compliance, and 5 means that the requirement is fully met. This method evaluates not only what the platform can do, but also whether clear, repeatable technical evidence shows it works as expected.

To determine the importance of the criteria, weighting coefficients (w_i) are used. The sum of all coefficient weights is equal to one. Higher weights are assigned to characteristics that influence the platform's safe and sustainable operation, while auxiliary parameters contribute less to the final result. The integral readiness index itself is calculated using formula (1):

$$R = 100 \times \sum (w_i \times s_i / 5) \quad (1)$$

where R is the final readiness in percent; w_i is the weight of the criteria, the sum of which equals 1; and s_i is the expert-analytical assessment of the criterion from 0 to 5. A score of 0 means no confirmation, 3 means partial completion with limitations, and 5 means confirmation by tests. A value below 50% corresponds to a laboratory prototype; 50%–69% means the need for significant revision; 70%–84% means conditional readiness for pilot industrial operation; 85% and higher means high readiness with positive official tests. The system readiness is assessed according to the following criteria, specified in Table 1.

Table 1 – Criteria for readiness of the pilot industrial operation system

Criterion	Weight	Contents of the assessment	Confirmed materials
Functional completeness	0.20	Registration, receipt, verification, and audit of documents	Functional test protocols, demo scenarios
Safety	0.20	Access control, key protection, vulnerability analysis, and integrity	Threat model, scanning reports, information security testing
Performance	0.15	Confirmation time, load, storage growth	Load testing and resource forecasting
Reliability	0.15	Node availability, monitoring, recovery, logging	BlockScout and a continuity plan
Integration	0.15	REST API, data formats, interaction with LMS and EHEA	API specifications and integration tests
Regulatory readiness	0.15	Personal data, roles of the parties, node management, maintenance	Regulations, agreements, orders, appointment of responsible persons

The general scheme of the algorithm for assessing readiness for pilot industrial operation is shown in Figure 4.

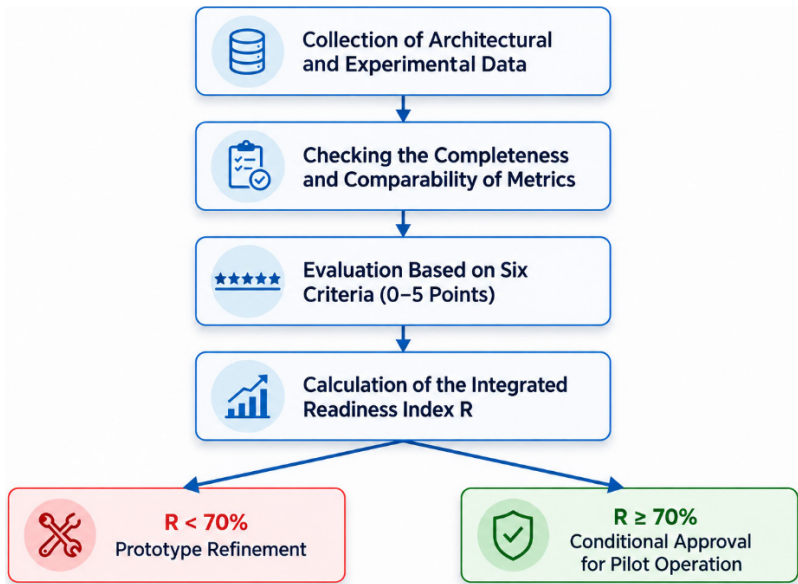


Figure 4 – Algorithm for assessing the system’s readiness for pilot industrial operation

Results. The experiments included 294,698 transactions. Blocks were created every 15 seconds, and the system processed an average of 8.26 transactions per second. Node availability reached 99%, and the team fully monitored the system during testing. These results show that the platform performed well under the test load. Average gas usage was about 226,000 units per transaction. The strongest aspects are the functional implementation of key smart contracts, the presence of a role model, and transaction observability. Organizational readiness is a weak criterion, as the system does not provide complete rules for consistent personal data processing, validator management models, or error correction. Table 2 presents an assessment of the system’s readiness criteria for pilot production based on the monitoring results. Figure 5 shows the system’s operational readiness profile.

Table 2 – Assessment of the readiness of the pilot industrial operation system

Criterion	Points (0-5)	Weight	Justification
Functional completeness	4.4	0.20	Transcripts, diplomas, roles, data receipt, and verification are registered and implemented.
Safety	4.0	0.20	IRBAC, hashing, and auditing; no independent formal verification
Performance	3.2	0.15	Stability of periodic and high-load limitation
Reliability	4.1	0.15	100% monitoring, 5-10 min recovery, 99% node availability

Criterion	Points (0-5)	Weight	Justification
Integration	3.8	0.15	API and hybrid model available; LMS pilot with live data required
Regulatory readiness	2.8	0.15	Regulations on personal data, site management, and party responsibilities are required.
Total	-	1.00	Conditional readiness for pilot industrial operation

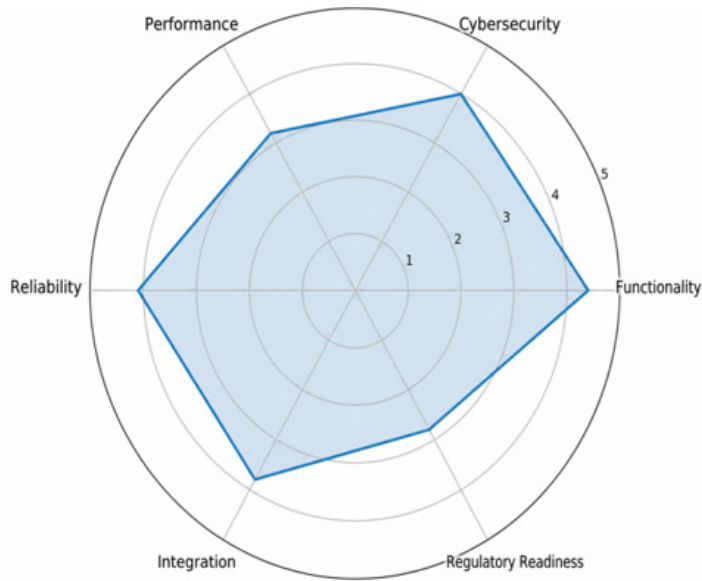


Figure 5 – System readiness profile for pilot industrial operation

Discussion. The proposed method helps connect a research prototype with a system that can be used in practice. It also considers organizational trust, document legal status, and distributed-system management. This matters in education because blockchain can show that a record has not been changed. However, it cannot prove the original information was correct unless the source and data-creation process are properly controlled.

The evaluation showed that the developed blockchain platform has generally reached a level that allows it to be considered for pilot production. The pilot study also analyzed 294,698 transactions with a block generation interval of 15 seconds. The average throughput was 8.26 transactions per second, node availability was 99%, and the system components were fully monitored. The indicators showed the developed solution performed stably under the simulated training load. The resource cost analysis used an average of approximately 226,000 gas units per transaction, enabling an additional assessment of the cost and computational complexity of smart contract operations.

The functional completeness criterion received the highest score, 4.4 out of 5, with a weight of 0.20. This score reflects the platform's core functions: registering

transcripts and diplomas, managing user roles, retrieving stored records, and verifying academic documents. The result shows that the basic functions required for document verification are already available. At this stage, the main challenges involve system integration, formal operating procedures, and testing data exchange with educational systems under real conditions.

The safety criterion received a score of 4.0 out of 5, with a weight of 0.20. The system uses role-based access control, hashing, and audit tools to protect important functions and track user actions. These mechanisms help control who can access the system and record activities related to document registration. The score was not higher because the security mechanisms have not yet been independently verified.

The performance criterion received a more moderate score of 3.2 points with a weight of 0.15. These results confirm the system's stability under periodic loads, but reveal limitations when transitioning to high-intensity transaction modes. An average throughput of 8.26 transactions per second may suffice for experimental and limited pilot applications, as academic document registration operations typically do not require the same intensity as financial or high-frequency transaction systems. However, scaling the solution to a national level requires accounting for the simultaneous operation of many universities, the mass issuance of diplomas and transcripts, and peak document-processing periods.

The reliability criterion received a score of 4.1 out of 5, with a weight of 0.15. The system is fully monitored, node availability reaches 99%, and recovery takes about 5–10 minutes. These results show that the platform has basic monitoring and recovery mechanisms needed for pilot use. However, the 99% availability level may not be sufficient for national critical infrastructure. Further testing should examine how the system behaves when several validators fail, network problems occur, a node loses connection, or the system recovers after a long period of downtime. The integration criterion received 3.8 points, weighted at 0.15.

The platform supports API connections and a hybrid data model. However, its integration readiness still needs to be tested with an LMS or another educational information system using real or near-real data. This matters because the platform's value depends not only on its smart contracts, but also on how well it works with existing digital systems used in higher education. The regulatory readiness criterion received the lowest score, 2.8 out of 5, with a weight of 0.15.

The main issues are related to personal data rules, management of blockchain nodes, and the division of responsibilities between participants. This shows that the main challenges are not only technical, but also legal and organizational. Before the platform can be used in practice, the roles of network participants should be clearly defined. It is also necessary to decide who will manage validator nodes, how access rights will be granted or removed, and how to correct incorrect information recorded on the blockchain.

Thus, the results show that the published network performs well enough for scenarios related to the end of academic periods and batch registration of results. However, when scaling to a national level, modeling seasonal peaks is necessary, as

average performance may mask queues during periods of mass diploma issuance. The latency from message receipt in the API to final block confirmation, as well as recovery time after node failure and message reprocessing, should be assessed separately.

Conclusion. This study proposed a method for evaluating whether a blockchain-based platform for academic document verification is ready for pilot use. Unlike approaches that focus only on technical performance, the proposed method also considers functionality, reliability, integration, security, and regulatory requirements. This matters for educational systems because blockchain can protect registered data from tampering, but it cannot replace control over data sources, user permissions, and operating procedures.

The evaluation was carried out on an EVM-based platform designed to register and verify academic transcripts and diplomas. The platform uses smart contracts, document hashing, event logging, and transaction monitoring through BlockScout. Blockchain is not intended to replace existing university information systems. Instead, it adds a verification layer that records key operations and supports independent verification of academic records.

Platform readiness was assessed using six criteria: functional completeness, security, performance, reliability, integration, and regulatory readiness. Each criterion was scored from 0 to 5 and assigned a weight according to its importance. The study then combined these values into a single readiness index. This allowed evaluation of different aspects of the platform within a single framework. The experimental evaluation included 294,698 transactions with a block generation time of 15 seconds. The platform achieved an average throughput of 8.26 transactions per second, while node availability reached 99%. Average gas consumption was about 226,000 units per transaction. These results showed that the system operated stably under the simulated test load and that its transactions could be monitored effectively.

Functional completeness received the highest score of 4.4 points. Reliability scored 4.1 points, while security received 4.0 points. Integration received 3.8 points, and performance scored 3.2 points. These results show that the basic platform functions are already well developed, while further load testing and integration with real LMS and other educational systems are still needed. Regulatory readiness received the lowest score of 2.8 points. This was mainly related to unresolved issues in personal data processing, validator node management, and procedures for handling incorrectly registered information. The final readiness index was 75.3%. According to the adopted evaluation scale, this result indicates that the platform is conditionally ready for pilot use. The system has therefore moved beyond the initial prototype stage, but several issues should still be addressed before full-scale implementation.

Overall, the study shows that the developed blockchain platform is technically viable and that the proposed assessment method can evaluate its readiness for practical use. Future work should include an independent security audit, larger-

scale performance and fault-tolerance testing, practical integration with LMS platforms and the Unified Higher Education Platform, and the development of clear organizational and regulatory procedures. These steps can improve the platform's readiness for use within Kazakhstan's higher education infrastructure.

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