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Nurbek Sissenov
Master, Senior Lecturer, Department of Information Security
nurbek0692@gmail.com, orcid.org/0000-0002-1270-8634
L.N. Gumilyov Eurasian National University, Kazakhstan

Gulden Ulyukova
Master, Senior Lecturer, Department of Information Security
u.g.b@bk.ru, orcid.org/0000-0002-2924-0767
L.N. Gumilyov Eurasian National University, Kazakhstan

Dina Satybaldina
Candidate of Physical and Mathematical Sciences, Associate Professor, Research Institute of Information Security and Cryptology
dinasaty@gmail.com, orcid.org/0000-0003-0291-4685
L.N. Gumilyov Eurasian National University, Kazakhstan

Nikolaj Goranin
Professor, Head of Department of Information Systems
nikolaj.goranin@vilniustech.lt, orcid.org/0000-0002-2263-3947
Vilnius Gediminas Technical University, Lithuania

INTEGRATED APPLICATION OF MABAC, CODAS AND ARAS METHODS IN ASSESSING THE RELIABILITY OF INFORMATION SYSTEMS

Abstract: In the modern digital world, the reliability of information systems has become one of the most important factors that determine the stability and efficiency of organizations. Even short-term system failures can cause serious financial losses, data breaches, and reputational damage. Therefore, assessing and improving the reliability of information systems is an essential part of ensuring their overall quality and resilience. To achieve an objective and comprehensive evaluation, this study applies multi-criteria decision-making (MCDM) methods that take into account both technical and organizational factors. The main focus is on the ARAS (Additive Ratio Assessment) method, which not only ranks the studied systems but also expresses the reliability level in percentage form. This makes the results clear, comparable, and easy to interpret in practice. For additional verification and comparison, the MABAC and CODAS methods were used. They help confirm the stability of rankings and support the validity of the conclusions drawn from the ARAS method. The selection of assessment criteria was based on the international standard ISO/IEC 25010:2023, which defines the quality model for software and information systems. Expert evaluations were carried out across ten characteristics — functionality, performance, compatibility, usability, reliability, security, maintainability, portability, recoverability, and adaptability. Using this data, all three MCDM methods were applied to calculate and compare the reliability of selected systems. The results show that ARAS provides a clear quantitative measure of reliability, while MABAC and CODAS strengthen the analysis by verifying ranking consistency. The combination of these approaches offers a practical and reliable framework for evaluating the quality and dependability of modern information systems.

Keywords: information systems; reliability; multicriteria analysis; MABAC method; CODAS method; ARAS method; comparative analysis.

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Introduction

The reliability of information systems is a key factor determining the sustainability and operational effectiveness of modern organizations. In the context of digitalization, global competition, and increasing cybersecurity requirements, a failure or malfunction of an information system can lead to significant financial losses, data leakage, and decreased user confidence. Therefore, the task of comprehensively and objectively assessing the reliability of information systems is particularly urgent.

Classic multicriteria analysis methods, such as AHP, TOPSIS, and VIKOR, formed the basis for systematically comparing alternatives and selecting the optimal solution [1], [2]. The AHP method, proposed by Saaty in 1980, is widely used for hierarchical problem decomposition and determining criterion weights, while TOPSIS and VIKOR are focused on finding solutions that are as close as possible to the ideal or reflect a compromise option.

Since then, improved methods have been developed based on these approaches, including ARAS [3], SWARA, and WASPAS [4], as well as their various hybrid and fuzzy modifications [5], [6]. Their distinguishing features include more flexible processing of initial information and the ability to take into account the uncertainty of expert judgments. For example, the use of ARAS and its variations has yielded positive results in solving problems in the fields of sustainable development and transport logistics [7], [8]. Additionally, the emergence of FUCOM-type models [9] has expanded the possibilities for objectively determining weights, while the integration of methods (e.g., SWARA and ARAS) has demonstrated effectiveness in collective bargaining and the analysis of complex systems [8].

Modern research emphasizes the application of MCDM to risk management and improving the reliability of complex systems. The development of hybrid models for FMEA [10], [11] and success factor analysis in emergency situations [12] demonstrate that combining MCDM with intelligent and fuzzy approaches allows for more accurate prioritization of problems. At the same time, the use of entropy methods [13] has enhanced the objectivity of analysis. Thus, the evolution of MCDM reflects a movement from basic concepts to integrated and hybrid models, which have high practical value in a wide range of fields.

This paper focuses on the ARAS method [14], which, unlike many other approaches, allows not only to rank alternatives but also to express the level of reliability as a percentage, providing a more visual and interpretable assessment. To compare the results, the MABAC and CODAS methods [15], [16] were additionally used. The MABAC method is based on comparing alternatives with a "border region," while the CODAS method is based on calculating the combined distance to the negative ideal solution (Euclidean and Manhattan), which allows for a more detailed differentiation of alternatives with similar characteristics.

This approach ensures comprehensive analysis: ARAS makes the results quantitatively interpretable, while MABAC and CODAS serve as tools for validating the findings. The use of a combination of MCDM methods opens up new possibilities for objectively assessing the reliability of information systems based on international quality standards.

Literature review

Assessing the reliability of information systems (IS) is a key area of research in the field of information technology. In the context of digitalization and increasing demands on the quality and security of IS operation, failures and malfunctions can lead to significant financial and reputational losses. Therefore, in recent years, researchers have focused on developing integrated approaches that take into account multiple quality indicators defined by international standards, particularly ISO/IEC 25010:2023 [17].

MCDM methods are widely used to aggregate diverse IS characteristics (functionality, performance, compatibility, reliability, security, usability, etc.) into a single final assessment. Among the most well-known are hierarchical process analysis (AHP) for determining criterion weights, methods based on ideal and anti-ideal solutions such as TOPSIS and VIKOR, and additive and comparative models such as ARAS, MABAC, and CODAS. Comparative reviews emphasize that each method has its own advantages and limitations: TOPSIS is sensitive to normalization and weighting factors, VIKOR is focused on trade-offs but requires fine-tuning of parameters, and additive methods provide simpler interpretation but are less robust to extreme values.

The Combinative Distance-based Assessment (CODAS) method, proposed by Mahmut Baidas and colleagues, belongs to the family of distance-based methods [18]. Unlike TOPSIS, it combines Euclidean and Manhattan distances to the negative ideal solution, allowing for more reliable discrimination between alternatives with similar characteristics. CODAS has been successfully applied in supplier selection, technology sustainability assessment, logistics, energy, and industry [19]. Its strengths include robustness to the scale of metrics and high sensitivity to small differences, which is important in conditions where systems exhibit similar reliability levels.

The Multi-Attributive Border Approximation Area Comparison (MABAC) method is based on comparing normalized and weighted values with a so-called "border area" (the average level for the criterion) [20]. Positive deviations indicate exceeding the average level, while negative deviations indicate falling short. This scheme ensures simple calculations and clear interpretation: it is easy to understand by which criteria the system is "better or worse than average". MABAC was initially applied in transportation and logistics, and later in construction and equipment selection. Its main advantages are simplicity, transparency, and interpretive clarity.

CODAS and MABAC occupy an important place in the MCDM ecosystem as methods that provide robust and explainable rankings of alternatives. However, their main drawback is that results are expressed as ranks, without a quantitative assessment of the level of reliability. ARAS allows results to be presented in relative terms (as a percentage of the optimal level), which significantly increases the practical value of the analysis [21]. A number of studies recommend using a combination of methods: ARAS for quantitative interpretation and MABAC/CODAS for ranking validation. This approach reduces the influence of methodological bias and ensures more reliable and reproducible conclusions.

Methods and Materials

The study used the international standard ISO/IEC 25010:2023, which defines a quality model for software and information systems, as the basis for selecting criteria for assessing the reliability of information systems. Based on an analysis of the standard's provisions, key characteristics directly related to reliability were identified.

Let there be many alternatives

$$A = \{A_1, A_2, \dots, A_m\} \tag{1}$$

and many criteria

$$C = \{C_1, C_2, \dots, C_n\} \tag{2}$$

Each alternative is evaluated according to criteria, forming a decision matrix:

$$X = \left(x_{ij}\right)_{m*n}, \qquad i = 1, \dots, m; \;\; j = 1, \dots, n, \tag{3}$$

where x_{ij} is the value of the i-th alternative according to the j-th criterion.

Application of the ARAS (Additive Ratio Assessment) method

The ARAS method is a modern MCDM method. It was proposed by E.K. Zavadskas and Z. Turskas and is widely used to select the best alternative under multiple criteria. The basic idea

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behind the method is that the optimal alternative should be as close as possible to the "ideal" solution, which is formed based on the best values for each criterion.

A hypothetical alternative A_0 is formed, which includes the best values for each criterion:

$$x_{0j} = \max_i x_{ij}, \text{для критериев } max$$
$$x_{0j} = \min_i x_{ij}, \text{для критериев } min \quad (4)$$

Each element is normalized relative to the sum of the values according to the criterion:

$$r_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}} \quad (5)$$

Taking into account the weights of the criteria w_i, a weighted normalized matrix is calculated:

$$v_{ij} = w_j \cdot r_{ij}, \qquad \sum_{j=1}^{n} w_j = 1 \quad (6)$$

For each alternative, the total priority is determined:

$$S_i = \sum_{j=1}^{n} v_{ij} \quad (7)$$

The utility of each alternative is calculated as the ratio of its total value to the value of the optimal alternative:

$$K_i = \frac{S_i}{S_0} \quad (8)$$

where S_0 is the value for the ideal alternative.

The alternatives are ordered in descending order of K_i. The best alternative has the highest utility value.

Advantages of the ARAS method:

- Simplicity of calculations and interpretation of results;
- Possibility to take into account both benefit criteria and cost criteria;
- Obtaining a visual assessment of the degree of usefulness of each alternative compared to the optimal one;
- Widely used in economics, management, engineering and evaluation of information systems.

The ARAS method is an effective tool for multi-criteria analysis, allowing for informed decision-making based on a comprehensive assessment of alternatives.

Application of the CODAS (Combinative Distance-based Assessment) method

The CODAS method belongs to the class of MCDM methods and is used to rank alternatives based on their distances to the negative-ideal solution. The basic idea is that the best alternative should be the farthest from the "worst" (negative-ideal) solution, which is achieved through a combination of Euclidean and Taxis metrics.

For max type criteria the formula used is:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (9)$$

for criteria of type min:

$$r_{ij} = \frac{1/x_{ij}}{\sqrt{\sum_{i=1}^{m}\left(1/x_{ij}\right)^2}} \tag{10}$$

After normalization, the values are multiplied by the criteria weights:

$$v_{ij} = w_j \cdot r_{ij}, \qquad \sum_{j=1}^{n} w_j = 1 \tag{11}$$

where w_j is the weight of criterion C_j.

A vector of negative-ideal alternative is formed:

$$\overline{s_j} = \min_i v_{ij}\,, j = 1, \dots, n \tag{12}$$

For each alternative, two distances are calculated:

Euclidean:

$$E_i = \sqrt{\sum_{j=1}^{n}\left(v_{ij} - \overline{s_j}\right)^2} \tag{13}$$

Manhattan:

$$T_i = \sum_{j=1}^{n}\left|v_{ij} - \overline{s_j}\right| \tag{14}$$

To calculate the integral value, the function is used:

$$H_i = E_i + \tau T_i \tag{15}$$

The alternatives are sorted in descending order of H_i values. The alternative with the highest value is considered the best.

Advantages of the CODAS method:

- The ability to take into account both Euclidean and Manhattan distances, which increases the reliability of distinguishing alternatives that are similar in quality;
- Simplicity of calculations and transparency of the procedure;
- Universality of application in management, engineering, economics and information systems evaluation tasks.

The CODAS method allows for obtaining objective results in multi-criteria comparison of alternatives, ensuring stable ranking even with close criterion values.

Application of the MABAC (Multi-Attributive Border Approximation Area Comparison) method

The MABAC method is an MCDM method. It was proposed to improve the objectivity of optimal alternative selection in the presence of multiple criteria with varying weights. The basic idea of the method is to define a border approximation area (BAA), which is used as a benchmark for comparing alternatives.

For max type criteria the formula used is:

$$r_{ij} = \frac{x_{ij} - \min\,(x_j)}{\max(x_j) - \min\,(x_j)} \tag{16}$$

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for criteria of type min:

$$r_{ij} = \frac{\max(x_j) - x_{ij}}{\max(x_j) - \min(x_j)} \tag{17}$$

Considering the weights of the criteria w_i, we obtain a weighted normalized matrix:

$$v_{ij} = w_j \cdot (r_{ij} + 1) \tag{18}$$

For each criterion, the value of the approximation boundary is calculated:

$$g_j = \prod_{i=1}^{m} v_{ij}^{1/m} \tag{19}$$

that is, the geometric mean of all alternatives for each criterion is used.

For each alternative, its deviation from the boundary region is determined:

$$q_{ij} = v_{ij} - g_j \tag{20}$$

If $q_{ij} > 0$, then the alternative is better than the boundary region according to the given criterion. If $q_{ij} < 0$, then the alternative is worse than the boundary.

For each alternative, the sum of deviations is calculated:

$$Q_i = \sum_{j=1}^{n} q_{ij} \tag{21}$$

Alternatives are sorted in descending order of Q_i values. The alternative with the highest Q_i value is considered the best.

Advantages of the MABAC method:

- The method allows us to clearly separate alternatives into those above and below the boundary region;
- Using the geometric means makes the model more robust to outliers in the data;
- Simplicity of calculations with a fairly high ranking accuracy;
- Widely used in engineering, economics, management and in the evaluation of information systems.

The MABAC method provides a balanced and objective comparison of alternatives, forming a stable system of preferences based on deviations from the boundary region of approximation.

Results and Discussion

In this paper, three open-source reference applications were chosen as the experimental basis for conducting a study of the reliability and performance of information systems: Online Boutique [22], Sock Shop [23], and eShop [24]. All three projects are implemented using microservice architecture principles and represent simplified models of e-commerce systems, making them suitable for scientific experiments related to the analysis of internal subsystems, assessment of fault tolerance, and scalability.

Online Boutique was developed by Google Cloud as a demonstration project and replicates the core functionality of an online store: browsing the product catalog, adding to cart, placing an order, payment, and delivery. The architecture includes a set of microservices (catalog, cart, checkout, payment, shipping, recommendation, email/ads, frontend), each isolated and communicating with others via network interfaces (Figure 1). This approach allows for independent scaling of components, failure modeling, and system degradation analysis under increased load. The implementation is accompanied by ready-made deployment scripts on Docker Compose and Kubernetes, simplifying the reproducibility of the experiment.

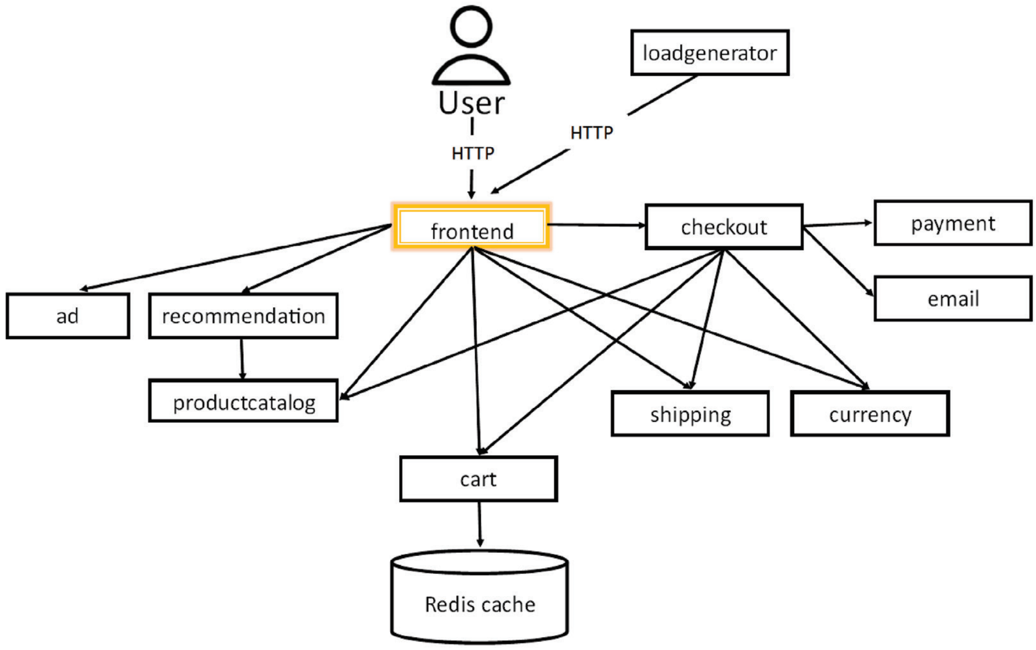

Figure 1. Online Boutique architecture diagram illustrating microservices and their interactions [22].

Sock Shop is another benchmark online store focused on demonstrating distributed systems. Its key feature is the use of event-driven architecture and various database types for different services, simulating "polyglot data storage." The architecture includes a frontend, an API gateway, shopping cart, payment, and shipping services, as well as a message broker for event processing (Figure 2). This allows for studying the system's behavior during broker failures, queue delays, and database overloads. Docker and Kubernetes manifests are provided for launch, enabling the reproduction of failure scenarios and the measurement of resilience metrics (error rate, MTTR, processing latency).

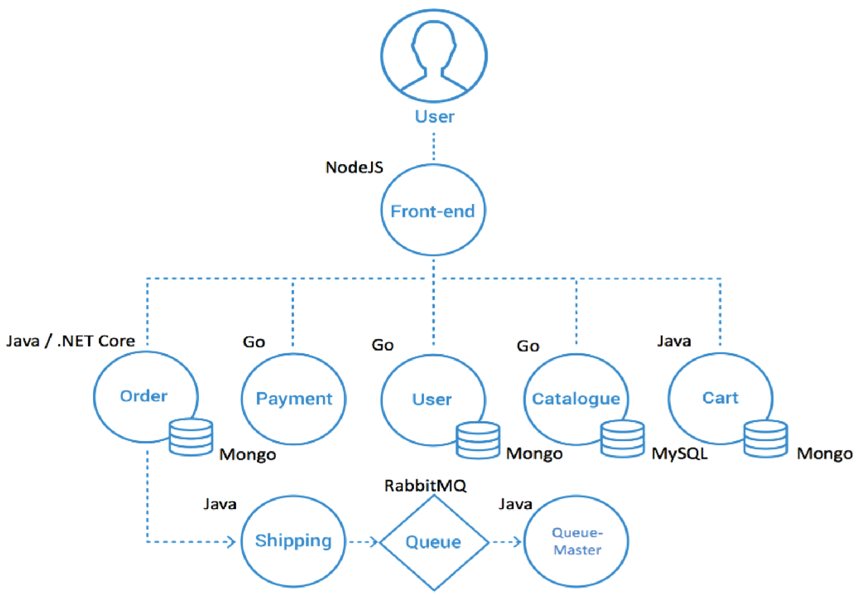

Figure 2. Diagram of interaction of Sock Shop services via message broker and database [23].

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eShop is a reference application developed on the .NET platform and demonstrates domain-driven design (DDD) principles, the use of API gateways, and service containerization. The architecture highlights key domain contexts (Catalog, Basket, Ordering, Identity), interacting through a single gateway (Figure 3). eShop emphasizes proper domain separation and the use of enterprise patterns (CQRS, distributed transactions), making it particularly valuable for analyzing data consistency and assessing the impact of .NET platform features on system performance.

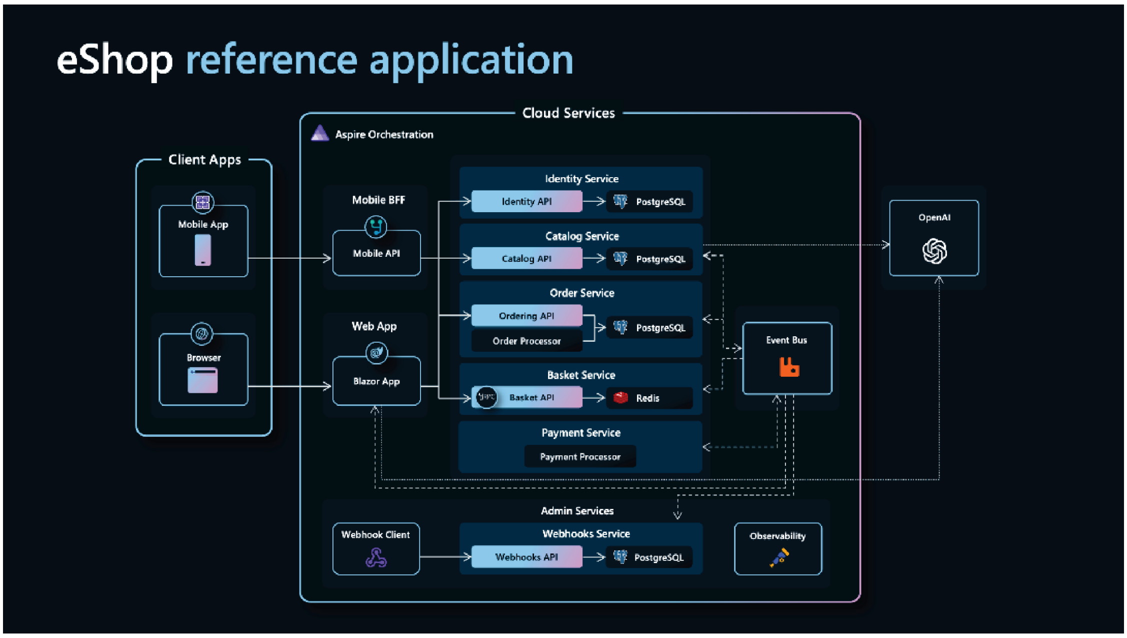

Figure 3. An eShop diagram showing domain services and their connections via the API gateway [24].

These systems were chosen due to their openness, ease of deployment, and widespread use in academic and industrial research. They provide clearly defined internal services that can be considered as separate subsystems for analysis according to the criteria of the ISO/IEC 25010:2023 standard. Using such reference applications eliminates legal and ethical risks associated with access to industrial data while ensuring the reproducibility of experiments, as any researcher can deploy a similar environment. Online Boutique, Sock Shop, and eShop represent a suitable basis for an empirical study aimed at assessing the reliability and efficiency of information systems in a microservices architecture (Table 1).

Table 1. The studied systems and their common architectural layers

Architectural layer	Online Boutique	Sock Shop	eShop
Frontend/UI Layer	Frontend (monolithic UI)	front-end	Mobile API, Web App, Blazor App
Core Business Services	Product Catalog, Cart, Checkout, Payment and others	Catalog, Cart, Orders, Payment, and others	Catalog, Ordering, Basket, Identity, and others
Data Persistence	Each service has its own database (for example, Redis for caching)	Each service has its own database (user-db, catalog-db)	PostgreSQL, Redis, Event Bus. Each service has its own database.
Communication Layer	gRPC (synchronous)	RESTful HTTP (synchronous)	HTTP (via API Gateway) and RabbitMQ/Event Bus (asynchronous)

In this study, the AHP method was used to objectively assess the quality of the selected information systems. This method allows for a formal determination of the relative importance of criteria. The ISO/IEC 25010 quality model, which includes the following characteristics, was used as a basis: Functionality, Performance, Compatibility, Usability, Reliability, Security, Maintainability, Portability, Recoverability, and Adaptability.

The AHP procedure involved sequentially performing paired comparisons of the specified criteria by experts using the Saaty nine-point scale. For each pair, the degree of preference of one criterion over the other was determined, after which a paired comparison matrix was constructed. Based on this matrix, normalized priority vectors were calculated, as well as a consistency ratio, which allows for confirmation of the accuracy of the expert assessments.

The analysis resulted in calculated weighting coefficients for each criterion, reflecting their relative importance in the overall system quality assessment model (Table 2). The AHP method allowed us to move from subjective expert judgments to quantitative weightings suitable for further use in comparative system assessments using multicriteria methods (Figure 4).

Table 2. Comparison of criteria weights

№	Criterion	E1	E2	E3	E4	E5	w
X1	Functionality	0.16	0.15	0.17	0.16	0.18	0.164
X2	Performance	0.14	0.16	0.13	0.15	0.15	0.146
X3	Compatibility	0.07	0.08	0.06	0.07	0.06	0.068
X4	Usability	0.10	0.11	0.10	0.12	0.11	0.108
X5	Reliability	0.14	0.13	0.15	0.14	0.14	0.140
X6	Security	0.14	0.16	0.16	0.14	0.15	0.150
X7	Supportability	0.08	0.07	0.07	0.07	0.06	0.070
X8	Portability	0.05	0.04	0.05	0.05	0.05	0.048
X9	Recoverability	0.06	0.05	0.06	0.05	0.05	0.054
X10	Adaptability	0.06	0.05	0.05	0.05	0.05	0.052
Total							1.000

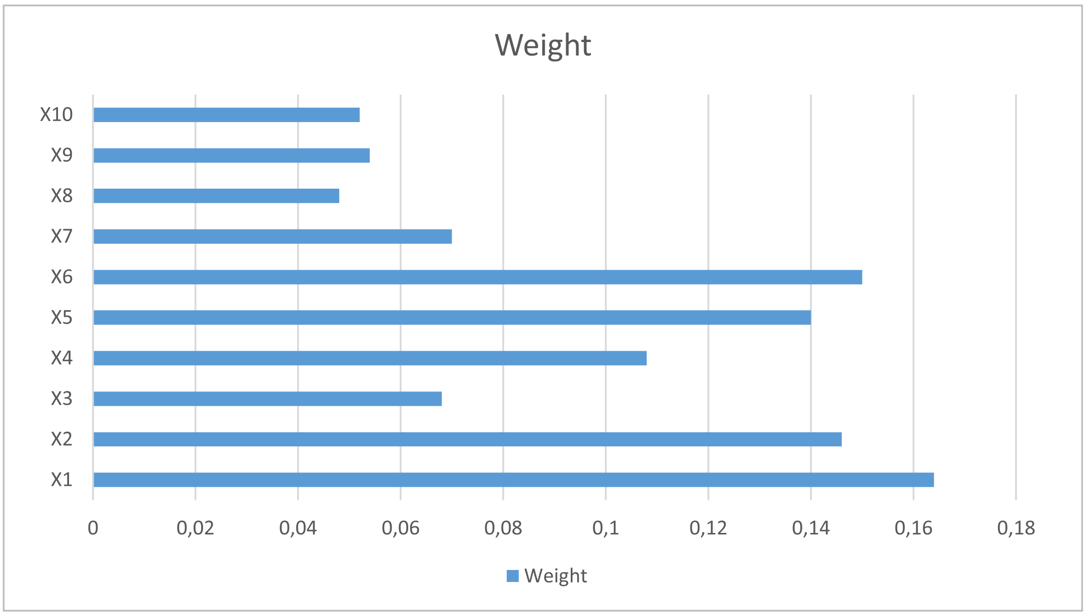

Figure 4. Average weight of criteria

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To evaluate software quality criteria within the ISO/IEC 25010 model, an interval scale from 0 to 100% is used, divided into five ranges. This scale is based on the generally accepted recommendations of the ISO/IEC 2502x series of standards, which define measurement metrics, as well as on SLA practices and research findings in the areas of usability and system reliability. The use of interval thresholds allows not only for the recording of quantitative values but also for their interpretation in qualitative categories ("very low," "low," "average," "good," and "very good") (Table 3).

Table 3. Assessment intervals and description of levels

Interval (%)	Functionality	Reliability (Uptime)	Adaptability
0–20% Very low level	only a small part of the requirements are met, the system is practically unusable	the system often fails, accessibility is practically non-existent	There is no possibility of control via configuration, adaptation is impossible
21–40% Low level	Only a small part of the key functions has been implemented, full functionality is impossible	the system is rarely available, stability is low	Only a limited number of parameters can be configured, and customization is extremely limited
41–60% Average level	about half of the requirements are met, the system can function, but does not cover all needs	the system is partially available, with frequent interruptions	Some functions can be changed through configuration, but flexibility is limited
61–80% Good level	Most of the requirements are met, only a few additional functions are missing	the system is generally stable, interruptions are rare	Most parameters are configurable, adaptation is relatively simple
81–100% Very high level	all basic and additional requirements are met, the system is fully ready for operation	The system is virtually fail-safe and meets international SLA requirements.	The vast majority of parameters are configurable, the system easily adapts to new conditions

The study collected values for ten quality criteria for three selected information systems. These indicators reflect how well the systems handle basic functional tasks, how they perform under load, how easy and reliable they are to use, and the extent to which they support security, portability, and adaptability. The resulting data allows not only to identify the strengths and weaknesses of each system but also to compare them against one another using a common framework (Table 4).

Table 4. The importance of information systems

IS components	**Criteria**									
	Functionality	**Performance**	**Compatibility**	**Usability**	**Reliability**	**Security**	**Supportability**	**Portability**	**Recoverability**	**Adaptability**
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
Units of measurement	%	ms	units (Number of integrations)	0-100	%	unit (Number of vulnerabilities)	0–100	unit (Number of supported OS/ environments)	minut (Average recovery time)	%
Direction of optimization	max	min	max	max	max	min	max	max	min	max
Weight of the criterion	0,164	0,146	0,068	0,108	0,140	0,150	0,070	0,048	0,054	0,052
Optimal value	100	200	5	82	99,9	1	84	4	25	80
Online Boutique	85	350	4	75	99,2	3	78	3	45	65
Sock Shop	78	480	3	68	98,5	6	70	2	60	55
eShop	92	220	5	82	99,8	2	84	4	25	80

For further comparison, the obtained expert assessments were normalized to a single scale. This procedure considers the heterogeneity of the initial data, expressed in different units of measurement, and converts them into a comparable form within the range from 0 to 1. Thanks to normalization, each system is assessed on the same basis, ensuring the accuracy of the multicriteria analysis and increasing the reliability of the final ranking of alternatives (Table 5).

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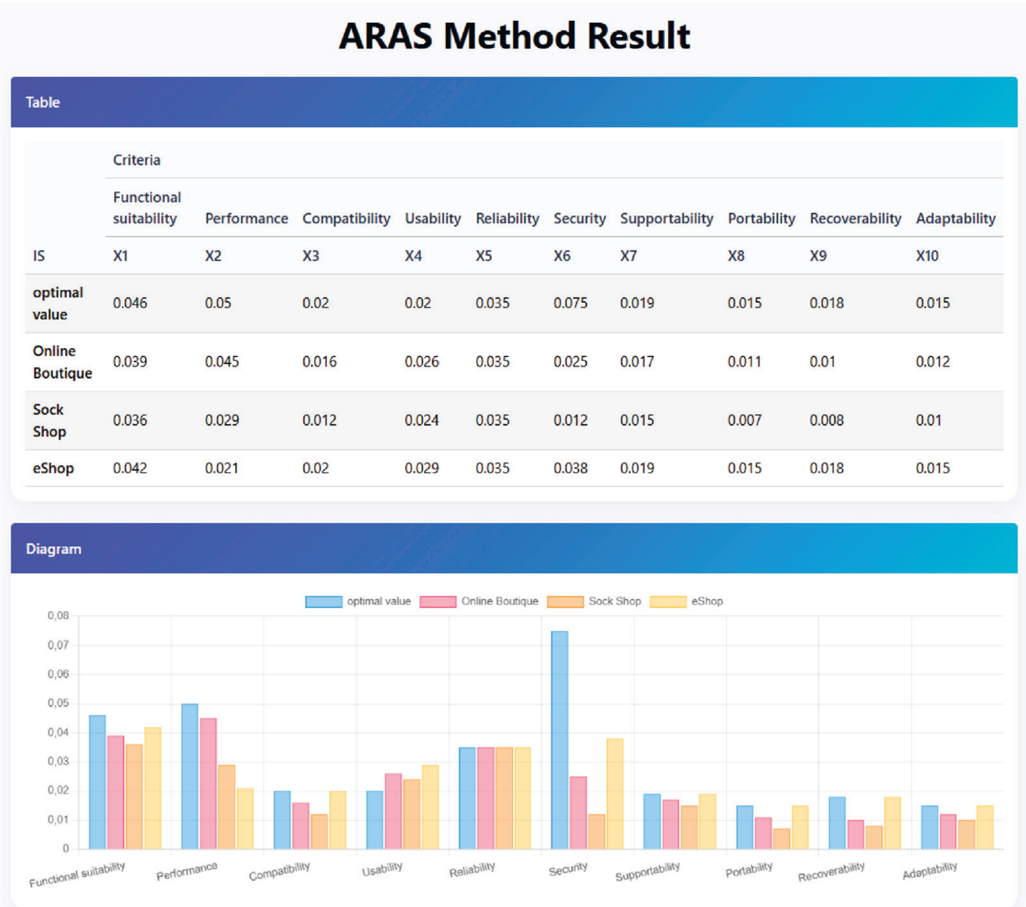
Table 5. Normalized measurement values in the IS for the ARAS method

IS components	**Criteria**									
	Functionality	Performance	Compatibility	Usability	Reliability	Security	Supportability	Portability	Recoverability	Adaptability
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
Weight of the criterion	0,164	0,146	0,068	0,108	0,140	0,150	0,070	0,048	0,054	0,052
Optimal value	0,282	0,345	0,294	0,267	0,251	0,5	0,266	0,308	0,336	0,286
Online Boutique	0,239	0,310	0,235	0,244	0,250	0,167	0,247	0,230	0,187	0,232
Sock Shop	0,220	0,200	0,177	0,222	0,248	0,083	0,221	0,154	0,140	0,196
eShop	0,259	0,145	0,294	0,267	0,251	0,25	0,266	0,308	0,336	0,286

After normalization and consideration of the criteria's weighting coefficients, a final matrix was obtained reflecting the actual impact of each indicator on the overall system reliability. This data presentation format enables comparison of alternatives not only with each other but also with the optimal value, revealing the strengths and weaknesses of each information system. The obtained results serve as the basis for further calculation of integrated indicators using the ARAS method and visual interpretation in the form of a diagram (Figure 5).



ARAS Method Result

Table

	Criteria									
	Functional suitability	Performance	Compatibility	Usability	Reliability	Security	Supportability	Portability	Recoverability	Adaptability
IS	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
optimal value	0.046	0.05	0.02	0.02	0.035	0.075	0.019	0.015	0.018	0.015
Online Boutique	0.039	0.045	0.016	0.026	0.035	0.025	0.017	0.011	0.01	0.012
Sock Shop	0.036	0.029	0.012	0.024	0.035	0.012	0.015	0.007	0.008	0.01
eShop	0.042	0.021	0.02	0.029	0.035	0.038	0.019	0.015	0.018	0.015

Figure 5. The result taking into account the weights of the criteria w was calculated weighted according to the ARAS methods

The results of the MABAC method are presented in a weighted normalized matrix, where the values of each system are correlated with a "boundary area". Positive values indicate exceeding the average level for the corresponding criterion, while negative values indicate underachievement. The diagram clearly shows that the eShop system exhibits predominantly positive deviations and is closer to optimal values, while Online Boutique and, especially, Sock Shop significantly underperform on several criteria. This analysis format allows for a clear classification of systems by reliability level and identification of areas requiring improvement (Figure 6).

MABAC Method Result

Table

	Criteria									
	Functional suitability	Performance	Compatibility	Usability	Reliability	Security	Supportability	Portability	Recoverability	Adaptability
IS	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
optimal value	0.092	0.067	0.03	0.047	0.063	0.068	0.029	0.021	0.025	0.024
Online Boutique	-0.02	-0.011	-0.004	-0.007	-0.007	0.008	-0.001	-0.003	-0.006	-0.007
Sock Shop	-0.072	-0.079	-0.038	-0.061	-0.077	-0.082	-0.041	-0.027	-0.029	-0.028
eShop	0.032	0.056	0.03	0.047	0.053	0.038	0.029	0.021	0.025	0.024

Diagram

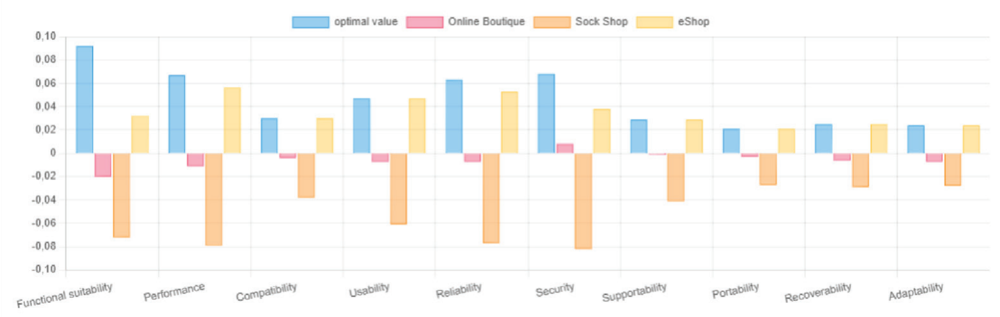


Figure 6. The result taking into account the weights of the criteria w was calculated weighted by MABAC methods

The results obtained using the CODAS method are presented as a normalized and weighted matrix, where each system is rated based on its distance to the negative ideal solution. Higher values for each criterion indicate a greater distance from the "worst-case" solution, and thus a higher level of reliability. According to the diagram, eShop demonstrates results closest to optimal across almost all indicators, while Online Boutique and Sock Shop perform worse, particularly in the areas of compatibility, supportability, and recoverability. The CODAS method allows for a more detailed differentiation of the systems under study and confirms the overall ranking obtained by other methods (Figure 7).

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CODAS Method Result

Table

	Criteria									
	Functional suitability	Performance	Compatibility	Usability	Reliability	Security	Supportability	Portability	Recoverability	Adaptability
IS	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
optimal value	0.092	0.096	0.039	0.058	0.07	0.127	0.037	0.029	0.034	0.029
Online Boutique	0.078	0.055	0.031	0.053	0.07	0.042	0.034	0.021	0.019	0.024
Sock Shop	0.072	0.04	0.024	0.048	0.069	0.021	0.031	0.014	0.014	0.02
eShop	0.085	0.087	0.039	0.058	0.07	0.064	0.037	0.029	0.034	0.029

Diagram

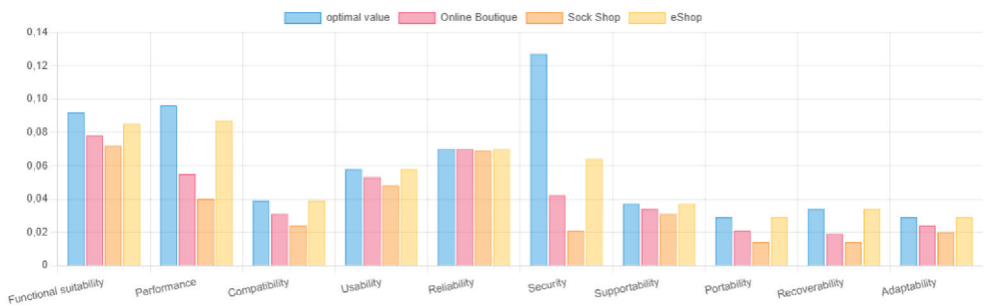

Figure 7. The result taking into account the weights of the criteria w was calculated weighted according to CODAS methods

Total Result

Table

	IS			
Method	Optimal value	Online Boutique	Sock Shop	eShop
ARAS	1	0.737	0.587	0.781
MABAC	0.464	-0.06	-0.536	0.354
CODAS	0	0.104	0.131	0.066

Diagram

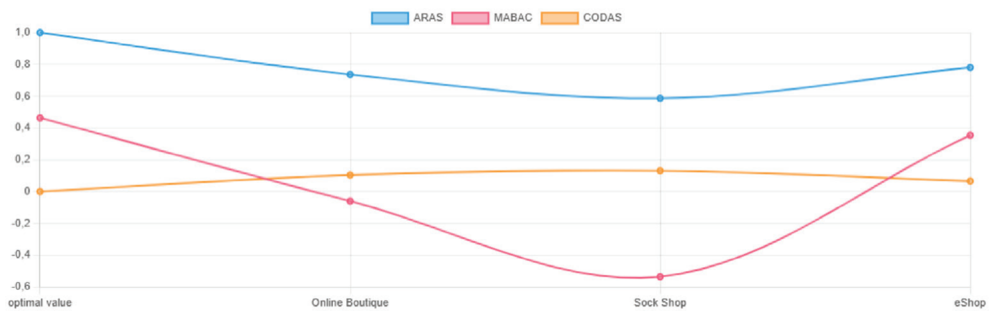

Figure 8. Comparative analysis of methods

Conclusion

The study demonstrated that the MABAC, CODAS, and ARAS methods enable a comprehensive assessment of the reliability of information systems based on the criteria of the ISO/IEC 25010:2023 standard. The MABAC and CODAS methods provide a stable ranking of alternatives and enable the identification of the most reliable systems. However, their key limitation is that they provide only ranking results, without a quantitative interpretation of the reliability level.

The ARAS method, in contrast, not only determines the order of preference of systems but also expresses their reliability as a percentage. This makes the results more visual, interpretable, and practical for decision making. Furthermore, the rank distributions obtained using MABAC and CODAS match the results of the ARAS method, confirming the validity and reliability of the analysis (Figure 8).

It can be concluded that the use of a combination of methods is justified: MABAC and CODAS serve as a check on the stability of the results, while ARAS provides a quantitative assessment of reliability, allowing one to clearly determine the extent to which each information system meets the specified criteria.

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