Classification of enterprises in terms of barriers and risks resulting from the implementation of cloud computing using ELECTRE TRI

Paula Bajdor
Warsaw University of Technology
Warsaw, Poland *paula.bajdor@gmail.com*

Łukasz Lemieszewski
The Jacob of Paradies University
Gorzów Wielkopolski, Poland *llemieszewski@ajp.edu.pl*

Damian Dziembek
Czestochowa University of Technology
Czestochowa, Poland *damian.dziembek@pcz.pl*

Jarosław Becker
The Jacob of Paradies University
Gorzów Wielkopolski, Poland *jbecker@ajp.edu.pl*

Abstract

The development of cloud computing has opened up new opportunities for enterprises in implementing information and communication technologies. Despite the numerous benefits associated with its use, certain barriers and risks also emerge, affecting organizational functioning. To assess their nature and scope, the authors conducted empirical research among companies using services based on the Cloud Computing model, applying the ELECTRE TRI method — a tool belonging to the group of Multi-Criteria Decision Analysis (MCDA) methods. The analysis of the results indicated that the most significant challenges are of an organizational nature. At the same time, most of the surveyed enterprises were classified into categories indicating a low or moderate level of perceived barriers and risks.

Keywords: Cloud Computing, barriers and risks of CC implementation, management, Electre TRI method.

1. Introduction

Currently, available information technologies can significantly improve the implementation of business processes, determine new possibilities in the scope of enterprise management, and become the foundation for developing new business models. In recent years, new opportunities have appeared in planning, organizing, implementing, maintaining, and developing enterprise IT resources - from traditional local solutions to IT technologies based on the service model (Cloud Computing). As a model enabling access to a common pool of configurable IT resources (e.g. servers, memory, applications) via the network, cloud computing is one of the key pillars of digital transformation in enterprises.

The development potential of cloud computing makes using IT solutions based on this service model in enterprises increasingly popular. Despite numerous advantages and development opportunities, the implementation and operation of cloud computing in enterprises are associated with many challenges and limitations that may affect the effectiveness and efficiency of its use. The article examines how enterprises perceive the barriers and risks associated with implementing cloud computing. For this purpose, the following research questions were asked:

RQ1 – Does the size of the enterprise affect the perception of barriers and risks associated with implementing IT solutions available in cloud computing?

RQ2 – Does the business profile of enterprises affect the perception of barriers and risks associated with implementing IT solutions available in cloud computing?

To achieve the assumed goal and obtain answers to the research questions, the authors conducted research on over 400 small and medium-sized enterprises in Poland. The study

of the perceived barriers and risks related to implementing cloud computing is essential for theory and practice. This study complements the previous findings with an analysis of the perception of barriers, significantly expanding the scope of research with new aspects of the perception of the Cloud Computing model.

2. Literature review

Dynamic market changes require the flexibility of enterprises and rapid adaptation of strategy, structure, processes, and technologies to new business conditions. As a result, the demand of modern enterprises for flexible, scalable, easily accessible, and paid for depending on actual use IT solutions (servers, storage, network devices, programming platforms, and specialized applications with a variety of related services) offered in the cloud computing, is growing. The ongoing computerization and automation of processes, the constantly increasing amount of data resources, and the growing demand for computing power also favor decisions on the use of the cloud computing model in the operations of enterprises and limit the role of the current, traditional model of maintaining and developing their IT infrastructure (on-premise). Additionally, through cloud computing, enterprises can access modern, technologically advanced IT solutions without purchasing, updating, and servicing them. Using IT solutions in cloud computing allows enterprises to focus on implementing their development strategy and generating innovative products and services, avoiding excessive involvement in managing ICT resources.

IT solutions in cloud computing provide many benefits, including cost saving, scalability, mobile storage, anytime anywhere access, better security, easy scalability [10]. In addition, cloud computing enables businesses to grow rapidly, scale, and adapt, accelerating innovation, increasing company agility, streamlining operations, cutting costs, and enhancing long-term growth [3]. Despite its numerous advantages, adopting cloud computing in enterprises is also associated with serious challenges. There are several challenges in cloud computing, such as privacy and data security, availability, data jurisdiction, technical challenges, cultural resistance, data ownership, and data/service reliability [2]. Barriers and problems related to implementing cloud computing can also be classified as security and privacy of sensitive enterprise data, availability/reliability, little control over services, legal compliance, the absence of appropriate SLA, integration with current infrastructure, and unclear payment system [21]. In another approach, we can distinguish among the threats and risks related to cloud computing: lack of control capability, the need for IT specialists, the importance of internet connection needs, security&risk, government regulation, challenge of migration issues, and continuing change [17]. It should be emphasized that the barriers and risks associated with implementing cloud computing can be classified differently depending on the service or type of cloud computing used. It may also result from the specificity of a given enterprise.

Enterprises may perceive the barriers and risks of cloud computing (CC) adoption differently depending on their size. While some studies report no direct correlation between company size and CC-related challenges [12], others suggest that small enterprises face more severe obstacles—such as limited budgets, concerns over data security, lack of cloud knowledge, and shortage of IT specialists. In contrast, medium-sized enterprises, with greater financial and human resources, tend to view implementation costs and security risks as moderate due to the presence of internal IT teams and structured data protection procedures [7],[14],[8],[11],[13]. This indicates a potential link between enterprise size and perception of CC adoption challenges. However, the literature lacks detailed analysis that differentiates barriers by company size, which justifies the use of multi-criteria methods for further investigation.

Similarly, industry profile influences how SMEs perceive CC-related barriers. While concerns such as cost and security are universal, their importance varies by sector. In some studies, the business profile is considered secondary due to the increasing universality and flexibility of cloud-based solutions [4]. A review of the literature shows, for example, that in the finance, healthcare, and public administration, regulatory compliance and data security are primary barriers. Manufacturing firms emphasize system compatibility and production continuity, while retail and service enterprises often face risks related to operational disruptions, limited solution flexibility, and insufficient IT knowledge [5],[16],[6],[9]. There is a lack of research on CC adoption barriers and risks across SME industry sectors, highlighting the need for a multi-criteria approach to assess their importance and relevance.

3. The Methodology

The ELECTRE (ELimination Et Choix Traduisant la REalia) method is one of the methods classified as MCDA (Multi-Criteria Decision Analysis), a multi-criteria algorithm used in the decision support process, enabling the selection of the best alternative from many possible options. ELECTRE TRI is a multi-criteria decision support method used to assign alternatives to ordered categories based on outranking relations. The main assumptions of this method consist of comparing the evaluations of alternatives against reference thresholds, which allows for the classification of options into specific decision categories [1]. The ELECTRE method generally defines a set of decision criteria and their weights. A decision matrix is created in which each row corresponds to an alternative, and each column corresponds to one of the criteria. On the other hand, ELECTRE TRI enables the classification of decision variants into predefined, ordered categories described by profiles. Assignment of a variant to a given category is performed using a pessimistic or optimistic procedure. Based on the results obtained, a ranking of alternatives is established, and the one that achieved the highest position in the ranking is selected.

The research was conducted, in October 2023, among small and medium-sized enterprises operating in Poland that use solutions offered by CC in their operations. The main criterion for sample selection was the fact that enterprises used cloud computing (CC). This was the first question included in the survey, which served as the primary research tool. If the answer was negative, the given enterprise was excluded from further study. A total of 409 companies participated in the research, of which 56% were small enterprises and 44% were medium-sized. Considering that approximately 55 thousand such entities operate in Poland, a formula was used to determine the minimum sample size, allowing its size to be determined while maintaining representativeness. The calculations showed that with the assumed confidence level of $1-\alpha = 0.95$ and the maximum estimation error $e = 5\%$, the minimum sample size should be 384 surveys. Therefore, because the research included 409 enterprises, it can be assumed that the condition of representativeness was met.

Table. 1. CC implementation barriers and risks – classification by key aspects

Aspects	Threats
Economical	High costs of broadband Internet connections
	Lack of tax incentives or EU funding
	Risk of incurring additional/unexpected costs (due to adjustment activities, integration, higher level of services), which means that the costs of implementing and using cloud computing solutions will be higher than expected
Safety	Problems related to the security of collected and processed data
	Dependence on the quality of the Internet connection (Internet network failures preventing the use of IT resources)
	Market immaturity generates the risk of cooperation with an unprofessional supplier.
	Lack of local technical support
	Risk of losing IT knowledge
Technological	Lack of or limited control over the supplier's activities
	Difficulties in adapting IT resources to the customer's needs (limited functionality of solutions offered in the cloud)
	Problems related to data migration
	Limited possibilities of integrating own/local IT resources with IT resources available in the cloud
	Technological immaturity of solutions offered in the cloud
	Lack of an appropriate language version
	Risk that clouds solutions will not meet expectations (e.g., of employees, management, customers)
Organizational	Legal problems (different regulations in different countries, unfavorable or ambiguous contract
	Partial or complete dependence on the supplier
	Lack of qualified staff and necessary competencies to implement and develop CC solutions
	Technological complexity of IT solutions available in cloud computing hinders effective management.
	Uncertainty and reluctance to change existing local solutions (management reserve towards CC, resistance

In total, 20 threats (criteria) were identified and grouped into four groups.

As mentioned earlier, the article aims to determine to what extent enterprises, depending on their size and business profile, perceive barriers and risks related to implementing cloud computing (CC). For the purpose of structured analysis, the identified barriers and risks were classified according to four key aspects: Economical, Safety, Technological, and Organizational (Table 1).

4. The research results

This section presents the results of the analyses that were conducted. In our case, the ELECTRE Tri method's input data were the vectors of criteria values for the examined enterprises (objects), criteria weights, class profiles, and thresholds: indistinguishability, preferences, and veto. In the first stage, each group of barriers and risks (assessment criteria) was assigned equal weights of 1 (Scenario 1), and differentiated weights were determined based on the authors' expertise (Scenario 2). The adopted weights of scenario 2 reflect the relative importance of individual aspects for the effective implementation of cloud computing. Their values were determined based on the experience and knowledge of the authors and the analysis of available literature and market practice:

• Safety (1.0) – given the highest weight because data protection and cybersecurity are key challenges in implementing cloud computing. Enterprises are concerned about the risk of unauthorized access, cyberattacks, and loss of control over data stored with external suppliers. The high weight of this criterion also results from applicable legal regulations, such as GDPR, NIS2, and DORA, which require a rigorous approach to information protection.

• Organizational (0.8) – the second important factor is organizational readiness to implement the cloud. Many companies encounter employee resistance and the need to transform the IT management structure. The high weight of this criterion results from the fact that adapting new technologies requires a change in mentality, staff training, and adjustment of operational processes, which directly affects the success of the implementation.

• Technological (0.6) – technological fit is a necessary but less critical aspect. Although the cloud offers a wide range of solutions, companies must consider the compatibility of existing IT infrastructure, system performance, and ease of cloud integration with local IT resources. Migration, performance, and flexibility issues can make implementation difficult but are usually solvable through appropriate vendor selection and IT architecture adjustments.

• Economical (0.4) – the lowest weight was assigned to the economic aspect because the costs of implementing cloud computing, although significant, are not a major barrier for most companies. Many organizations treat the cloud as a way to optimize operational and investment costs, and flexible subscription models allow for the gradual implementation of solutions. However, unforeseen expenses, such as those related to system integration or training, can affect the overall profitability of the investment.

The adopted weights reflect the hierarchy of key challenges facing companies implementing cloud computing. Data security and organizational preparation were considered the most critical factors determining the success of the implementation. Technological and economic aspects, although also important, are supporting and can be managed through appropriate planning and implementation strategy.

Then, a classification was carried out, distinguishing three main classes (1, 2, and 3) and two intermediate classes (1/2 and 2/3), also called virtual, intended for objects whose assignment to neighboring basic classes was ambiguous: Class 1 – very low level of barriers and risks, Class 1/2 – low level of barriers and risks, Class 2 – medium/average level of barriers and risks, Class 2/3 – high level of barriers and risks, Class 3 – very high level of barriers and risks. In the next step, after determining the number of main classes, their boundaries, or separating profiles, were determined. Then, for each profile and criterion, the threshold values were determined: indistinguishability (Q), preference (P), and veto (V) (table 2).

Table. 2. Weight values, thresholds, and profiles for each evaluation criterion

Aspects	Scenario 1: $W_{1;1}$	Scenario 2: $W_{2;1}$	P_1*	Q_1	P_1	V_1 (veto)
Economical	1	0,4	7,00	0,21	1,05	2,1
Safety	1	1	11,67	0,35	1,75	3,5
Technological	1	0,6	16,33	0,49	2,45	4,9
Organizational	1	0,8	11,67	0,35	1,75	3,5
	$W_{2;1}$	$W_{2;2}$	P_2*	Q_2	P_2	V_2 (veto)
Economical	1	0,4	11,00	0,33	1,65	3,3
Safety	1	1	18,33	0,55	2,75	5,5
Technological	1	0,6	25,67	0,77	3,85	7,7
Organizational	1	0,8	18,33	0,55	2,75	5,5

* W –vector of weighting factors; **P_1, P_2 – class separation profiles

The cut-off threshold λ should be in the range (0.5-1.0), following the generally recommended practice. The value of 0.75 was adopted for the research purposes. For all criteria indicating threats resulting from the use of CC, the "cost" type was established, meaning ("the more, the worse" - the decision maker prefers objects from lower classes over objects from higher classes).

Figures 1, 2, and 3 present a summary of the assignment of objects to individual classes using the optimistic procedurę, the pessimistic procedure, and together with the use of virtual classes for weights equal to 1 (scenario 1).

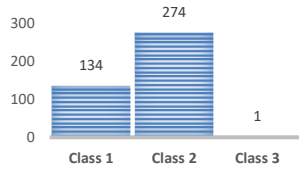


Fig. 1. Class Membership - Optimistic Procedure

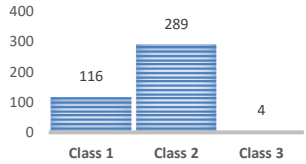


Fig. 2. Class Membership - Pessimistic Procedure

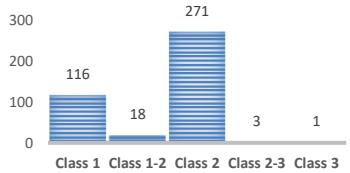


Fig. 3. Class Membership – General (with virtual classes)

As a result of using the optimistic procedure (fig. 1), the companies were classified into three designated classes. The majority of them (67%) were classified into class 2, meaning that the companies indicated a moderate level of barriers and risks resulting from using CC. Only 0.2% of the companies that identified a very high level of this type of threat were classified into class 3. In this procedure, only one medium-sized company operating in the transport & warehouse industry rated this aspect very highly.

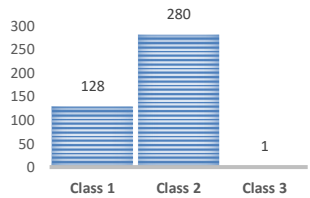
As a result of using the pessimistic procedure (fig. 2), more than half of the companies (70.7%) assessed the barriers and risks as moderate, almost 1/3 of the companies (28.4%) as very low, and only four of them, less than 1%, as very high. These four companies include three medium-sized companies operating in the industrial and transport & warehouse sectors and one small company operating in the trade sector.

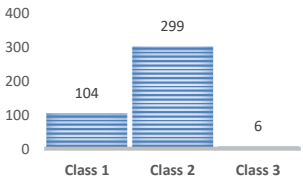
Comparing the obtained results, which are the effect of applying two different procedures, it can be stated that the structure of the individual classes is very similar because, in both cases, the most significant number were those enterprises that showed low and moderate levels of barriers and risks resulting from the use of CC. In the case of belonging to class 3, some ambiguity was noticed in the assignment to classes. In the optimistic procedure, one enterprise was classified as it, while in the pessimistic procedure, this number increased to four.

Analyzing the affiliation to the classes in general (fig. 3), i.e., aggregating the different results of the optimistic and pessimistic assignment to two virtual classes, it is visible that the largest group (66.3%) was in class 2, which indicates a moderate level of barriers and risks related to the use of CC. A significant percentage (28.4%) was assigned to class 1, where they were assessed as very low, while only 0.2% of enterprises were classified in class 3, identifying a very high level of these threats. One enterprise was classified as a medium-sized entity operating in the transport & warehouse industry. Virtual classes supplemented the classification - 4.4% of companies were on the border between classes 1 and 2, indicating low barriers and risks, and 0.7% in class 2/3, where they were assessed as high.

In the next step, analogous analyses were carried out, but for different weight values: the safety aspect was assigned weights equal to 1, the organizational aspect weights equal to 0.8, the technological aspect weights equal to 0.6, and the economic aspect weights equal to 0.4.

Figures 4, 5, and 6 present a summary of the assignment of objects to individual classes in the optimistic procedure, pessimistic procedure, and in general for individual weight values.





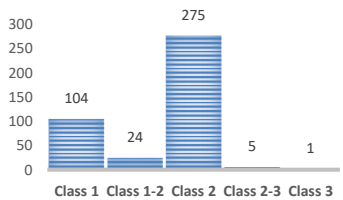


Fig. 4. Class Membership - Optimistic Procedure **Fig. 5. Class Membership - Pessimistic Procedure** **Fig. 6. Class Membership – General (with virtual classes)**

In the optimistic procedure (fig. 4), enterprises were classified into the first, second, and third classes. Most of them (68.5%) were classified into class 2, meaning enterprises indicated a moderate level of barriers and risks resulting from using CC. One of the same enterprises (i.e., 0.2%) was also classified into the third class, as in scenario 1. In the pessimistic procedure (fig. 5), almost ¾ of enterprises (73.1%) indicated a moderate level of barriers and risks resulting from the use of CC, ¼ of enterprises (25.4%) rated it very low, and only six of them (1.5%) rated it very high. These six enterprises include four medium-sized enterprises operating in the industrial and transport & warehouse sectors and two small enterprises operating in the trade, information, and communication sectors.

Comparing the results obtained using two different procedures considering different weights, it can be seen that the structure of the individual classes remains very similar. In both cases, the dominant group were companies that assessed the level of barriers and risks related to using CC as low or moderate. Also, in the case of belonging to class 3 - in the optimistic procedure, only one company belongs to this class, and in the pessimistic procedure - six.

Analyzing the affiliation to the classes in general (fig. 6), i.e., aggregating the different results of the optimistic and pessimistic assignment to two virtual classes, it is visible that the largest group (67.2%) was in class 2, which indicates a moderate level of barriers and risks related to the use of CC. A significant percentage (25.4%) was assigned to class 1, where they were assessed as very low, while only 0.2% of enterprises were classified to class 3, identifying a very high level of these threats. One enterprise was classified into the latter group, as in scenario 1. Virtual classes supplemented the classification - 5.9% of companies were on the border between classes 1 and 2, indicating low barriers and risks, and 1.2% in class 2/3, where they were assessed as high.

Table 3 presents the affiliation to individual classes depending on the size and industry of the enterprises in the case of weights equal to 1.

Table. 3. Affiliation to individual classes depending on the size and industry of the enterprises (Weights equal to 1)

	Class 1	Class 1-2	Class 2	Class 2-3	Class 3	Total
All categories	**116**	**18**	**271**	**3**	**1**	**409**
Administration and operations	15	1	14	0	0	30
Construction	1	1	8	0	0	10
Professional, scientific, and technical activities	0	0	9	0	0	9
Education	6	0	3	0	0	9
Trade	27	6	59	1	0	93
Information and Communication	7	0	17	0	0	24
Culture, entertainment, and recreation	8	0	10	0	0	18
Other service activities	7	0	19	0	0	26
Industry	4	0	4	1	0	9
Transport and storage	39	9	125	1	1	175
Accommodation and catering	2	1	3	0	0	6
Size of the enterprise	**Class 1**	**Class 1-2**	**Class 2**	**Class 2-3**	**Class 3**	**Total**
Medium	52	6	117	2	1	178
Small	64	12	154	1	0	231

Analysis of the structure of enterprises in terms of their size reveals an apparent convergence in the assessment of the level of barriers and risks related to the use of CC. The most significant percentage in both groups were enterprises, indicating a moderate level of these barriers - 37.7% among small and 28.6% among medium-sized enterprises. Similar proportions were observed in classes 1 and 1-2, where 15.6% of small and 12.7% of medium-sized enterprises assessed the barriers and risks as very low, while 2.9% of small and 1.5% of medium-sized enterprises classified them as low.

Analyzing the obtained results in terms of the sector of enterprise activity, there is also some convergence. The largest group consists of enterprises that showed a moderate level of barriers and risks resulting from using CC, with 66% representing all sectors of activity. In second place was the group of enterprises (33%) that assessed this threat as very low and low. However, only four companies (one commercial, one industrial, and two from transport

and warehousing) rated the barriers and risks of using CC as high and very high (less than 1%).

Table 4 presents the assignment to individual classes depending on the enterprises' size and sector of activity in the case of specific weights. In this case, too, there is a certain convergence among the analyzed enterprises regarding their size. In both groups, the highest percentage were enterprises with moderate barriers and risks related to using CC - 37% among small and 30% among medium-sized enterprises. Similar proportions were observed in classes 1 and 1-2, where 14% of small and 11% of medium-sized enterprises indicated a very low level of barriers and risks, and 5% of small and 1% of medium-sized enterprises assessed them as low.

Table 4. Affiliation to individual classes depending on the size and industry of the enterprises (specific weights)

	Class 1	Class 1-2	Class 2	Class 2-3	Class 3	Total
All categories	104	24	275	5	1	409
Administration and operations	13	2	15	0	0	30
Construction	1	1	8	0	0	10
Professional, scientific, and technical activities	0	0	9	0	0	9
Education	6	2	1	0	0	9
Trade	24	5	63	1	0	93
Information and Communication	6	1	16	1	0	24
Culture, entertainment, and recreation	7	1	10	0	0	18
Other service activities	6	1	19	0	0	26
Industry	4	0	4	1	0	9
Transport and storage	36	9	127	2	1	175
Accommodation and catering	1	2	3	0	0	6
Size of the enterprise	**Class 1**	**Class 1-2**	**Class 2**	**Class 2-3**	**Class 3**	**Total**
Medium	45	5	124	3	1	178
Small	59	19	151	2	0	231

When analyzing the results in the context of the industry of activity, certain similarities can also be seen. The largest group (67%) comprises enterprises representing all sectors that indicated moderate barriers and risks. In second place were entities (31%) that assessed these factors as very low or low. On the other hand, only six enterprises - one commercial, one from the information and communication industry, one industrial, and three from the transport and storage sector - indicated a high or very high level of barriers and risks, which is less than 1.5%.

5. Conclusions

The increasing adoption of cloud computing (CC) stems from its key benefits, including cost efficiency, process flexibility, and enhanced competitiveness. However, its implementation is not free from barriers and risks that may influence enterprise operations. This study assessed these factors using the ELECTRE TRI method, analyzing 20 criteria across four dimensions: Economical, Safety, Technological, and Organizational. The impact was evaluated across enterprises of different sizes and business profiles. Results indicate that most enterprises perceive CC-related risks and barriers as low or moderate, regardless of the weighting scenario applied. Both equal weighting (scenario 1) and differentiated weighting (scenario 2) yielded similar class structures, with a dominant share of enterprises reporting low to moderate perceived risks. When segmented by company size, both small and medium enterprises showed convergence in their assessments, with the majority indicating moderate levels of risk. In both weighting scenarios, most enterprises (66–67%) assessed cloud computing barriers and risks as moderate, while around 31–33% rated them as low or very low. Only a small fraction (less than 1.5%) indicated high or very high-risk levels. The similarity of results confirms the robustness of the classification regardless of weighting assumptions. These findings suggest growing awareness among enterprises of CC-related risks, yet they do not perceive these challenges as significant enough to discourage adoption. Despite its contributions, the study has limitations. Future research could benefit from including CC users at the operational level to broaden the perspective. Applying additional MCDM methods could also enrich the analysis. The results offer practical guidance for cloud service providers and policymakers, and support further academic exploration of risk dynamics in CC adoption.

References

1. Dias, L., Clímaco, J.: ELECTRE TRI for groups with imprecise information on parameter values. Group Decision and Negotiation, 9, 355-377 (2000).
2. Gupta S, Meissonier R, Drave V.A., Roubaud D.: Examining the impact of cloud ERP on sustainable performance: A dynamic capability view. International Journal of Information Management, 51 (2020).
3. Islam, R., Patamsetti, V.V., Gadhi, A., Gondu, R.M., Bandaru, C.M., Kesani, S.C. Abiona, O.: The Future of Cloud Computing: Benefits and Challenges. International Journal of Communications, Network and System Sciences, 16 (2023).
4. Khan, N., Al-Yasiri, A.: Framework for cloud computing adoption: A road map for SMEs to cloud migrationInternational Journal on Cloud Computing: Services and Architecture (IJCCSA) Vol. 5, No. 5/6, (2016)
5. Mehrtak, M., SeyedAlinaghi, S., MohsseniPour, M., Noori, T., Karimi, A., Shamsabadi, A., Heydari, M., Barzegary, A., Mirzapour, P., Soleymanzadeh, M., Vahedi, F., Mehraeen, E., Dadras, O.: Security challenges and solutions using healthcare cloud computing, J Med Life, Jul-Aug, 14(4) (2021)
6. Mohammad, A., Abbas, Y.: Key Challenges of Cloud Computing Resource Allocation in Small and Medium Enterprises. Digital, 4(2) (2024).
7. Nagahawatta, R., Lokuge, S., Warren, M., Salzman, S.: Cybersecurity Issues and Practices in a Cloud Context: A Comparison Amongst Micro, Small and Medium Enterprises. In Proceedings of the 32nd Australasian Conference on Information Systems (ACIS) (2021)
8. Ognjanović, I., Šendelj, R., Daković-Tadić, M., & Kožuh, I.: Longitudinal Study on the Adoption of Cloud Computing in Micro, Small, and Medium Enterprises in Montenegro. Applied Sciences, 14(14), 6387 (2024).
9. Phaphoom, N., Wang, X., Samuel, S., Helmer, S., & Abrahamsson, P. (2017). A survey study on major technical barriers affecting the decision to adopt cloud services. Journal of Systems and Software, Volume 103, (2015)
10. Sayginer C., Ercan T.: Benefits and Challenges of Cloud Computing in Production and Service Sector in Izmir. The City of Turkey, Humanities & Social Sciences Reviews, 8(3), (2020).
11. Senarathna, I., Yeoh, W., Warren, M., & Salzman, S.: Security and Privacy Concerns for Australian SMEs Cloud Adoption: Empirical Study. Australasian J. of Infor. Sys., 20, (2016).
12. Sithole, S.S, Ruhode, E.: Cloud Computing Adoption: Challenges and Opportunities for SMMEs in South Africa, Proceedings of the 1st Virtual Conference on Implications of Information and Digital Technologies for Development (2021).
13. Trigueros-Preciado, S., Pérez-González, D., Solana-González, P.: Cloud computing in industrial SMEs: Identification of the barriers to its adoption and effects of its application. Electronic Markets, 23(4), (2013)
14. Ugbebor, F. O.: Intelligent Cloud Solutions Bridging Technology Gaps for Small and Medium-Sized Enterprises. Deleted Journal, 7(01) (2025)
15. Vasiljevaa, T., Shaikhulinaa, S., Kreslinsb, K.: Cloud Computing: Business Perspectives, Benefits and Challenges for Small and Medium Enterprises (Case of Latvia). Procedia Engineering, 178 (2017).
16. Wang, X, Wang, L. Gördes, R.: Interoperability in Cloud Manufacturing: A Case Study on Private Cloud Structure for SMEs. International Journal of Computer Integrated Manufacturing, 31, (2018).
17. Widyastuti D., Irwansyah I.: Benefits And Challenges Of Cloud Computing Technology Adoption In Small And Medium Enterprises (SMEs). Advances in Economics, Business and Management Research (AEBMR), 41 (2017).