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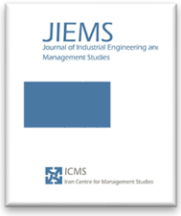

Evaluating and Ranking of Software Companies in Adapting to IT Outsourcing Risks

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Abstract

In recent decades, the effective use of information technology (IT) systems has become an integral part of industries. On the other hand, due to the benefits of these systems (cost reduction, access to the latest technology versions, monitoring and control, risk reduction, improvement of plans for future progress, and ultimately improvement of productivity), the use of IT outsourcing systems has been a special focus of these industries. However, the use of this system has always faced risks and challenges. This research aims to evaluate the key risks effective in IT outsourcing and to rank selected software companies in successful adaptation to IT outsourcing. For this purpose, the opinions of 75 experts were used to evaluate the risks and rank the companies. A binomial test (BT) approach was used to identify the final risks. The result showed that 6 risks are effective in IT outsourcing. Also, the risk assessment with a weighted average (WA) showed that technical risks are in the first importance and communicational risks are in the last importance. Ranking of companies based on the weight of risks with the Simple Additive Weighting (SAW) technique showed that the first software company was ranked first and the third company was ranked seventh. Based on the evaluations, practical suggestions were provided to companies. The proposed model of this research provides a suitable perspective for company managers in facing the risks of IT outsourcing.

Keywords: Outsourcing, IT Outsourcing, Information Technology, Risks, SAW.

Paper Type: Original Research

1. Introduction

One of the strategic and practical solutions in today's knowledge age is information technology (IT) outsourcing (Samantra et al., 2014). But this approach faces many potential risks that may have undesirable effects such as project delays and cost overruns ((Chandar and Zeleznikow, 2014). Many organizations have been tempted to use outsourcing strategies due to the pressures that competitive forces place on the organization. (IT) outsourcing can have countless benefits for organizations, but if outsourcing decisions are not carefully and thoughtfully made, it can cause irreparable damage to the organization (Hamidi et al., 2016). IT outsourcing uses external service providers to efficiently deliver services such as IT-based business processes and application solutions to businesses. In addition, the risks of IT outsourcing are of great importance. Therefore, it is worth paying much more attention to their effective and efficient management and control (Ebrahimnejad et al., 2017). IT outsourcing is one of the most popular strategies today for companies and organizations seeking to reduce IT operational costs and enhance their competitive advantage. IT outsourcing is a creative tool for IT management in both the private and public sectors, but choosing the type and method of outsourcing itself is an important and challenging issue. Outsourcing saves time, money, improves quality, and frees up organizational resources. Currently, outsourcing in the field of IT services in local companies and organizations is not only an option but also a strategic necessity (Song et al., 2022). In short, IT outsourcing will have various advantages, including controlling and reducing costs, accessing the latest and most recent versions of technology, reducing risk, monitoring the IT environment, strategic consulting and setting a plan for the future path of IT progress, focusing on business, increasing productivity levels, etc. In today's competitive and growing market, risk management in IT outsourcing projects has become a challenging issue (Samadi et al., 2024). Hence, assessing key risks is essential to ensuring a successful IT outsourcing process (Song et al., 2022). In this article, we have used the risks identified in the study by Ajalli and Arjomand (2023). Therefore, the main objective of this study is to assess the key risks affecting IT outsourcing and to rank a set of software companies active in IT outsourcing using a combined Weighted Average (WA) and Simple Additive

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Weighting (SAW) approach. The WA method involves assigning a weight to each indicator based on its importance, with more weight being given to indicators with higher importance. After calculating the weighted value of each indicator and dividing it by the sum of the weighted values of the indicators, the final weight of each indicator is determined. The SAW technique is one of the first techniques proposed by scientists in multi-criteria decision making, which has been widely used due to its simple understanding and ease of calculations and implementation steps. The continuation of this paper is organized as follows: Section 2 gives a literature review; Section 3 presents the research methods (WA & SAW), Findings of research and data analysis is done in Section 4, and finally in Section 5 the conclusion and recommendations of this paper is presented.

2. Literature Review

Risk has been considered as one of the most important phenomena in recent decades in various fields. Different quantitative and qualitative methods have been created and developed to assess the risks in various fields. One of the most important methods used to evaluate the risks is the hierarchical analysis process. Many researches have been conducted using the hierarchical analysis process method, either individually or with fuzzy logic, in relation to risk assessment in various scientific fields. Gonzalez et al. (2010) identified the most important risks of outsourcing information technology such as lack of compliance with the IT service provider's contract, the loss of technical knowledge, the inability of the provider to adapt to new technologies, security issues and hidden costs. Rusu and Hudosi (2011) have devised a tool based on cost exchange theory to assess the severity of the outsourcing of IT. They stated that the tool provided to assess the severity of the outsourcing of information technology (IT) is a useful and effective tool for decision makers in supporting outsourcing IT decisions and indicates that if outsourcing decision is made. Aminbakhsh et al. (2013) have used the hierarchical analysis process method to evaluate safety risks during planning and budgeting of construction projects. Werner, Brenton, Kichenham, Trenz, and Niazi (2014) also examined various sources of risk and developed a risk reduction strategy. Werner et al. could identify 85 risks and provided 75 actions to reduce identified risks using literature review. Mangla et al. (2015) analyzed the risks associated with the adoption and effective implementation of green supply chain measures from an industrial point of view. In the first step, the related risks were identified and in the second step by using the Fuzzy AHP method, the identified risks were analyzed. Ebrahimnezhad et al. (2017) proposed a new analytical approach with Incomplete Interval-valued Information for risk assessment in IT outsourcing. The analyses show that the proposed group decision-making model acts as an appropriate method for evaluation. Ebadi Torkayesh & Ebadi Torkayesh (2021) used an integrated MCDM approach for evaluation of information and communication technology development in G7 countries. This paper attempts to evaluate the ICT development based on social and economic indicators using an integrated MCDM approach. Nasri et al., (2022) used hybrid MCDM methods in Iran for performance evaluation of ICT companies. Based on the results, in-company management factors, technological and marketing factors, financial costs, government policies, and native features were the most important critical factors. As significant factors that influence the success of ICT companies, employee involvement, teamwork, customer focus, the state of the economy, and conflict of interest between governmental and private sectors were selected. Song et al., (2022) used an integrated approach considering risk interactions and hierarchies for risk assessment of IT outsourcing project. To prove the proposed model, the authors used an ITO case study in a mining company. Li et al., (2025) applies an extended MCDM-Based Approach for Risk Assessment of Smart Energy Information Security. The researchers' proposed model provides an innovative approach to scientifically assess information security risks in smart energy systems and establishes a solid theoretical foundation for broader regional applications and the expansion of assessment criteria. Zandi et al., (2025) proposed an extended simple additive weighting decision support system in the food industry. The results show that the market indicators and competitors directly impact the product portfolio’s priority. Some of the contributions of this research can be considered as a method for ranking alternatives based on the expanded information from sub-alternatives. As a management tool, the proposed model can be used in other fields and with different techniques to manage the portfolio of alternatives and sub-alternatives. Many researchers have shown that the most common outsourcing risks are loss of knowledge and critical competencies as well as the risk of dependency (Quinn & Hilmer, 1995). In the study, six categories of strategic, managerial, communicative, technical, operational and financial risks were considered as the most important categories. Table (1) shows the categories of risks and specific risks to each category. Strategic risks include tactical mistakes made by the purchasing organization in the outsourcing of information technology. For example, one of the most significant tactical errors occurs when the supplier begins to leak vital information from the buyer's organization to the next rival organization. Outsourcing of data components and supplier selection are tactical decisions that can lead to significant potential losses. Management risks also include potential losses due to the lack of expertise and experience and the involvement of senior executives of the buyer's organization and are considered as internal risks. Operational risks include unproductive output resulting from the operation of information technology in the organization. Communicational risks are the result of a relationship

between the buyer and supplier of information technology services, and the supplier's opportunistic behavior, which has the advantage of a long-term ambiguous contract. A significant part of operational risks is due to outsourced IT activities to the supplier, while the risk of communication with the buyer remains. Unlike operational risks, communication risks are bilateral. The risks that are in this category will be transferred from the buyer to the supplier by signing the outsourcing contract. One of the important categories of IT outsourcing risks is the financial risk category. The occurrence of losses due to planning and poor experience is the most important reason for the loss of this type of risk when outsourcing information technology (Ajalli & Arjomand, 2023).

Table1. Extracted risks for IT Outsourcing

Classification of Information Technology Outsourcing Risks	Researcher & Year
Strategic Risks	Samantra et al., (2014); Ajalli & Arjomand (2023);
1. Loss of organizational competencies (S1)	
2. inherent uncertainty (S2)	
3. Integrations and takeovers and participations with poor management (S3)	
4. Outdated technical skills (S4)	
5. Lack of information flow in support of outsourcing strategy (S5)	
Managerial Risks	Samantra et al., (2014); Song et al., (2022); Ajalli & Arjomand (2023); Li et al., (2025).
1. Lack of senior management involvement (M1)	
2. Lack of contingency plans (M2)	
3. Non-transparent decision process (M3)	
4. lack of Understanding of individual powers and responsibilities (M4)	
5. Lack of expertise and experience in the field of Information Technology (M5)	
Communicational Risks	Sloniec et al., (2016); Ajalli & Arjomand (2023);
1. Inappropriate terms and ambiguous contract with supplier (C1)	
2. Ineffective bidding mechanisms (C2)jman	
3.Quality of the supplier in the provision of services (C3)	
Technical Risks	Sloniec et al., (2016); Song et al., (2022); Nasri et al., (2022); Ajalli & Arjomand (2023); Li et al., (2025).
1. Non-use of new technologies (T1)	
2. the complexity of technology and new emerging communicational lines (T2)	
3. Loss of innovation capacity (T3)	
4. Lack of knowledge and technical training (T4)	
5. Task Complexity (T5)	
Operational Risks	Ajalli & Arjomand (2023); Li et al., (2025).
1. Problem in measuring (O1)	
2. Lack of expertise and customer experience in contract management (O2)	
3. Poor management feasibilities(O3)	
4. The lack of organizational learning (O4)	
Financial Risks	Ajalli & Arjomand (2023);
1. The hidden costs (F1)	
2. Ineffective investment in infrastructures (F2)	
3. Increase in the cost of providing services (F3)	
4. Lack of planning and the existence of incorrect budgeting (F4)	

3. Research methodology

The present study, in terms of its purpose, data collection method and analysis method, is an of applied-descriptive-survey-quantitative type. In order to collect data in a targeted manner, the opinions of 75 experts familiar with IT outsourcing were used. To identify the effective risks in IT outsourcing in software companies, a binomial test with a test number of 3 was used. Also, the weighted average (WA) method was used to evaluate the risks and calculate their weight and importance. Finally, the SAW decision-making technique was used to rank 7 software companies active in IT outsourcing.
In this research, we have used from 75 experts as table 2:

Table 2. Information of experts

Group	Classification	Number
Education Level	Bachelor	0
	Master	56
	Doctoral	19
Sexuality	Male	64
	Female	11

The following describes each of the implementation methods.

3.1. Binominal Test (BT) approach

BT is a non-parametric test that evaluates success and failure based on a value or characteristic. The meaning of success and failure is the presence or absence of a variable in the studied society. One of the most widely used non-parametric tests is the binomial test or the success ratio test. This test is the non-parametric equivalent of the one-sample t-test. Although the one-sample sign test can also be referred to as a non-parametric equivalent of the one-sample t-test, in SPSS it is only possible to use the binomial test.

3.2. The WA method

In the WA method, each indicator is placed in a row of the questionnaire and a five-point scale (with scores of very low: 1; low: 2; medium: 3; high: 4; and very high: 5) is placed in the column. Each expert or decision maker completes a copy of the questionnaire by marking the degree of importance corresponding to each indicator.

3.3. The SAW technique

This approach uses two important inputs (decision matrix and indicator weight vector) to analyze and rank options and includes the following computational steps:

Step 1: Normalize (dimensionless) the decision matrix using a linear method (r_{ij});

Step 2: Extracting the weighted dimensionless decision matrix (t_{ij}); by multiplying the weight of each indicator in the column corresponding to that indicator in the dimensionless decision matrix as follows;

$$t_{ij} = r_{ij} \times W_i \quad (1)$$

Step 3: Calculate the sum of the rows of the weighted dimensionless matrix (U_i) using the following equation:

$$U_i = \sum_{j=1}^{n} t_{ij} \quad (2)$$

Step 4: Ranking the alternatives in descending order of score (row sum).

4. Results

4.1. BT (extracting the risks effective in IT outsourcing)

In order to determine the effectiveness of these risks in IT outsourcing in the companies, the opinions of 75 experts and the statistical analysis of binominal test were used. According to the extraction of key risks from the literature review (six dimensions), a five-scale Likert questionnaire was designed to investigate the effectiveness of these factors in the companies. After completing the questionnaire by experts, using SPSS software and binomial distribution test, a significance level of 0.02 was considered for effective factors. According to the results of the experts' questionnaire and the output table of SPSS with desired value equal to 3, all the factors were confirmed by the experts (Table 3):

Table 3. Selected risks

No.	Factors affecting performance	Degree of Free (DF)	Two-way significance (Sig)	Cronbach α	Accepted / Rejected
1	Strategic Risks	74	0.001	0.827	**A**
2	Managerial Risks	74	0.019	0.861	**A**
3	Communicational Risks	74	0.015	0.805	**A**
4	Technical Risks	74	0.008	0.723	**A**
5	Operational Risks	74	0.017	0.846	**A**
6	Financial Risks	74	0.004	0.784	**A**

As can be seen from the table above, the SIG values for all factors are less than 0.02, and as a result, the effectiveness of all 6 risks is accepted.

4.2. Weighing and ranking the risks with WA

After distributing the questionnaire among the experts, their supplementary responses were collected and summarized in Table 4:

Table 4. Additional answers from experts

Factor	Description of Factor	Very low	Low	Medium	High	Very high	Sum	Weighted value	Factor weight	Rank
		1	2	3	4	5				
R1	Strategic Risks	18	20	25	7	5	75	186	0.15410	4
R2	Managerial Risks	10	14	21	22	8	75	229	0.18973	2
R3	Communicational Risks	21	23	27	3	1	75	165	0.13670	6
R4	Technical Risks	7	11	18	29	10	75	249	0.20630	1
R5	Operational Risks	16	17	23	12	7	75	202	0.16736	3
R6	Financial Risks	19	22	26	5	3	75	176	0.14582	5

As can be seen in the table above, the fourth factor (technical risks) with the highest weight is ranked first in terms

of importance. Also, the second factor (managerial risks) and the fifth (operational risks) were ranked next. The third factor (communicational risks) was ranked last.

4.3. Ranking the companies with SAW

In this section, the final evaluation and ranking of the alternatives (companies) is discussed using the steps of the SAW technique. For this purpose, the extracted weights of the risks (factors) from the previous section are entered as inputs into the initial matrix of the SAW technique. In Table 5, the decision matrix of the experts' opinions regarding each company based on each risk is given. These opinions have been presented by experts in very low to very high qualitative terms. As can be seen, the weights of the risks are included in the last row of this matrix:

Table 5. Initial matrix of expert opinions about companies in adapting to risks

Risks / Companies	Strategic Risks	Managerial Risks	Communicational Risks	Technical Risks	Operational Risks	Financial Risks
1	High	Very low	Low	Very high	Medium	Low
2	Very low	High	Very high	Low	High	Very high
3	Medium	Low	High	Medium	Low	Very low
4	Low	Medium	Low	High	Very low	High
5	Very high	Low	Medium	Very low	High	Low
6	Low	Very high	High	Low	Medium	Medium
7	Medium	High	Very low	High	Very high	Very low

Before executing the steps, it is first necessary to convert the above qualitative matrix into a quantitative matrix. Therefore, the qualitative terms are converted into quantitative values using values 1 to 5. The output of these conversions is presented in Table 6:

Table 6. Quantitative matrix of expert opinions

Risks / Companies	Strategic Risks	Managerial Risks	Communicational Risks	Technical Risks	Operational Risks	Financial Risks
1	4	5	2	5	3	2
2	1	4	5	2	4	5
3	3	2	4	3	2	1
4	2	3	2	4	1	4
5	5	2	3	1	4	2
6	2	5	4	2	3	3
7	3	4	1	4	5	1

In the first step, we dimensionless the quantitative decision matrix using the linear method. For this purpose, dimensionless values are obtained by dividing the values of each column by the maximum values of that column. The output of this step is given in Table 7:

Table 7. Dimensionless decision matrix

Risks / Companies	Strategic Risks	Managerial Risks	Communicational Risks	Technical Risks	Operational Risks	Financial Risks
1	0.8	1	0.4	1	0.6	0.4
2	0.2	0.8	1	0.4	0.8	1
3	0.6	0.4	0.8	0.6	0.4	0.2
4	0.4	0.6	0.4	0.8	0.2	0.8
5	1	0.4	0.6	0.2	0.8	0.4
6	0.4	1	0.8	0.4	0.6	0.6
7	0.6	0.8	0.2	0.8	1	0.2

In the second step, we multiply the weight of each factor by its corresponding column in the dimensionless decision matrix to obtain a weighted dimensionless decision. Therefore, the dimensionless weight matrix is obtained as Table 8:

Table 8. Dimensionless weight matrix

Risks / Companies	Strategic Risks	Managerial Risks	Communicational Risks	Technical Risks	Operational Risks	Financial Risks
1	0.123280862	0.1897266	0.054681	0.2062966	0.1004143	0.0583264
2	0.030820215	0.1517813	0.1367026	0.0825186	0.1338857	0.1458161
3	0.092460646	0.0758906	0.1093621	0.123778	0.0669428	0.0291632
4	0.061640431	0.113836	0.054681	0.1650373	0.0334714	0.1166529
5	0.154101077	0.0758906	0.0820215	0.0412593	0.1338857	0.0583264
6	0.061640431	0.1897266	0.1093621	0.0825186	0.1004143	0.0874896
7	0.092460646	0.1517813	0.0273405	0.1650373	0.1673571	0.0291632

In the third step, the row sum of the weighted dimensionless matrix will be equal to the score of each company (U_i). These scores are presented in Table 9:

Table 9. The score of each company

Companies	U_i
1	0.7327
2	0.6815
3	0.4976
4	0.5453
5	0.5455
6	0.6312
7	0.6331

In the fourth step, by sorting the companies' scores in descending order, their final ranking is obtained. Therefore, the company with the highest score is recognized as the top company. Table 10 shows the company rankings:

Table 10. The company rankings

Companies	Sum of scores	Rank
Company 1	0.7327	1
Company 2	0.6815	2
Company 3	0.4976	7
Company 4	0.5453	6
Company 5	0.5455	5
Company 6	0.6312	4
Company 7	0.6331	3

According to Table 11, it is clear that the first, second, and seventh companies are ranked first to third. The third company is also ranked seventh.

5. Conclusion and recommendations

This paper used a hybrid approach to assess the risks affecting IT outsourcing and ranking companies in adapting to these risks. The results of the risk assessment showed that technical risks ranked first and communicational risks ranked sixth in terms of importance. Using expert opinions, seven software companies active in the field of IT outsourcing were evaluated for their successful adaptation to these risks. The final result shows that company number 1 is ranked first and company number 3 is ranked seventh. Considering the analysis and ranking of risks, the following suggestions are made: Technical risks are a combination of risks resulting from the use of technology. Possible losses in this area could derive from interconnectivity problems and as more open systems are developed, key technical risks arise from security issues. Strengthening the organization's agility and using up-to-date and advanced Industry 4.0 technologies can be effective in improving the technical status of outsourcing and reducing related risks. Managerial risks arise from poor management tasks. One important problem is that all of these categories may have strategic, financial and technical effect on organizations which considered IT outsourcing. In this context, senior management commitment and support for essential outsourcing and building trust and strong relationships with key suppliers can be effective. Operational risks concern the day-to-day issues that the organization is confronted with as it strives to deliver its strategic objectives. These risks will actually impact your ability to achieve the current strategy that you've got these risks associated with the execution of a company's business functions. involves undesirable consequences deriving from the operations of IT in the organization. A significant portion of the operational risk is passed on to the supplier as the IT function is outsourced while the relationship risk remains with the buyer. Strategic risks concern the long-term strategic objectives of the organization. If they occur, can force a change in strategic direction of the organization. These risks come from errors in direction or tactical mistakes and have significant effects on organizations present and future situation. Understanding target markets and competitors and having the right perspective in this field will be helpful. Financial risks involve the hidden costs, ineffective investment in infrastructures, Increase in the cost of providing services and Lack of planning and the existence of incorrect budgeting. In this context, accurate cost forecasting and appropriate investment in outsourcing are effective. Communicational risks stem from the relationship between the buyer and supplier in the form of opportunistic behavior by the supplier who takes advantage of a long-term and ambiguous contract and are 'bi-directional'. In this instance, the risk exposure relating to the relationship can be passed back and forth depending on the situation and the 'bargaining power' of both the contracting parties at that time. The relationship risk shifts from buyer to supplier and vice versa. Financial risks defined losses occurring as a result of poor planning and experience are major contributors to losses in this category when outsourcing the IT function. One of the limitations of the research is the difficulty of finding relevant and responsive experts in the field of IT outsourcing. For this purpose, the researcher made a lot of effort in this field to select experts in a targeted manner. For future scientific research, it is suggested that the authors use multi-criteria decision-making techniques to calculate the weight of the factors. Researchers can also use other scoring and ranking techniques to rank the companies.

References

Ajalli, M., Arjomand, O. (2023). Risk Analysis in Outsourcing of Information Technology Using Combination Approach of SWARA-FISM, the 13th International Conference on Modern Researches in Management, Economics, Accounting and Banking, (ICMEAB 2023), WWW. ICMEAB.ir; https://civilica.com/doc/1655141.

Aminbakhsh, S., Gunduz, M., & Sonmez, R. (2013). Safety risk assessment using analytic hierarchy process (AHP) during planning and budgeting of construction projects. Journal of Safety Reasearch, 46, 99-105.

Chandar, S., Zeleznikow, J., (2014). Risks to consider when negotiating IT outsourcing agreements. In: Dershowitz, N., Nissan, E. (Eds.), Language, Culture, Computation. Computing of the Humanities, Law, and Narratives. In: Lecture Notes in Computer Science, vol. 8002, Springer, Berlin, Heidelberg.

Ebadi Torkayesh, A., Ebadi Torkayesh, S. (2021). Evaluation of information and communication technology development in G7 countries: An integrated MCDM approach, Technology in Society, Volume 66, https://doi.org/10.1016/j.techsoc.2021.101670.

Ebrahimnezhad, S., Gitinavard, H. and Sohrabvandi, S. (2017). A New Extended Analytical Hierarchy Process Technique with Incomplete Interval-valued Information for Risk Assessment in IT Outsourcing. International Journal of Engineering, 30(5), 739-748.

Gonzalez, R., Gasco, J., & Llopis, J. (2010),"Information systems outsourcing reasons and risks: a new assessment", Industrial Management & Data Systems, Vol. 110(2), 284-303

Hamidi, H., Roghanian, E., Kamankesh, A., (2016). Decision-making model for IT outsourcing to improve IT support of organizations, Supply Chain Management, 18(51), 71-86.

Li, Z., Du, P., & Li, T. (2025). Comprehensive Risk Assessment of Smart Energy Information Security: An Enhanced MCDM-Based Approach. Sustainability, 17(8), 3417. https://doi.org/10.3390/su17083417.

Mangla, S. K., Kumar, P., & Barua, M. K. (2015). Risk analysis in green supply chain using fuzzy AHP approach: A case study. Journal of Resource, Conservation and Recycling, 104(2), 375-390.

Nasri, S.A., Safaie, N., Sarabi, A.H., Eghbali, A., and Barkhordari, G. (2022). Performance Evaluation of ICT Companies Using Hybrid MCDM Method in Iran, Hindawi Mathematical Problems in Engineering, Volume 2022, Article ID 5308343, 13 pages https://doi.org/10.1155/2022/5308343.

Quinn J. B., Hilmer G. (1995). Make versus buy, strategic outsourcing. The McKinsey quarterly, 1.

Rusu, L., & Hodosi, G. (2011). Assessing the risk exposure in IT outsourcing for large companies. International journal of information technology and management, 33(10), 24–44.

Samadi, H., Nazari-Shirkouhi, S., Keramati, A. (2014). Identifying and Analyzing Risks and Responses for Risk Management in Information Technology Outsourcing Projects Under Fuzzy Environment, International Journal of Information Technology & Decision Making,13:06, 1283-1323.

Samantra, C., Datta, S., & Mahapatra, S., S. (2014). Risks assessment in IT outsourcing using fuzzy decision-making approach: An Indian perspective. Expert systems with applications, 41, 4010–4022.

Słoniec J., Kaczorowska A., Motyka S. (2026). RISK ASSESSMENT OF IT OUTSOURCING IN ENTERPRISES DEPENDING ON THEIR BRANCH, ZESZYTY NAUKOWE POLITECHNIKI ŚLĄSKIEJ, Seria: ORGANIZACJA I ZARZĄDZANIE z. 99, Nr kol. 1968.

Song, W., Zhu, Y., Li, S., Wang, Li., Zhang, H. (2022). Risk evaluation of information technology outsourcing project: An integrated approach considering risk interactions and hierarchies, Engineering Applications of Artificial Intelligence, Volume 113, https://doi.org/10.1016/j.engappai.2022.104938.

Zandi, P., Ajalli, M., Soleiman Ekhtiyati, N. (2025). An extended simple additive weighting decision support system with application in the food industry, Decision Analytics Journal, Volume 14, https://doi.org/10.1016/j.dajour.2025.100553.