PERFORMANCE EVALUATION AND IMPORTANCE–PERFORMANCE ANALYSIS OF UNIVERSITIES BASED ON THE BSC-AHP IN FUZZY ENVIRONMENT

AVALIAÇÃO DE DESEMPENHO E ANÁLISE IMPORTÂNCIA-DESEMPENHO DE UNIVERSIDADES BASEADA NO BSC-AHP EM AMBIENTE FUZZY

Sara Talebzadeh
ORCID 0009-0005-8761-0892

Department of Management, Kermanshah Branch, Islamic Azad University, Kermanshah, Iran
talebzadehsara.iau@gmail.com

Elmira Alvandi Behineh
ORCID 0009-0003-7428-3082

Department of Business Administration, University of the Cumberlands, Kentucky, USA.
ebehineh12044@ucumberlands.edu

Marjan Masoomifard
ORCID 0000-0002-1780-2064

Department of Educational Sciences, Payam Noor University (PNU), P.O.Box 19395-4697, Tehran, Iran
dr.masoomifard@pnu.ac.ir

Munes Taheri
ORCID 0009-0000-6250-4130

Department of Accounting, Faculty of Management and Accounting, Imam Khomeini Memorial Branch, Islamic Azad University, Iran.
taheri.munes@gmail.com

Shayegan Shakeri Nasab
ORCID 0009-0002-3222-9793

Lead Product Manager, Tailorbird Inc, Princeton, NJ; MBA Candidate, Saint Peter's University, Jersey City, NJ, MS in Civil Engineering, University of Illinois Urbana-Champaign, USA.
shakeri3@illinois.edu

Abstract. The Balanced Scorecard (BSC) framework, encompassing the Financial, Customer, Internal Process, and Learning and Growth perspectives, serves as a vital approach for evaluating strategic performance in educational institutions. However, research addressing uncertainties in decision-making within this context remains sparse. This study seeks to bridge this gap by integrating the fuzzy Analytical Hierarchy Process (AHP) with the BSC to effectively quantify the weights of various criteria and sub-criteria relevant to university performance assessment. Through a comprehensive literature review and consultations with experts, key performance indicators specific to higher education institutions were identified. The research further analyzes the relative significance of these indicators across the BSC perspectives and assesses the current performance standing of selected universities. Additionally, an importance-performance analysis and radar chart visualization are employed as business intelligence tools to illustrate the strengths and weaknesses of the institutions, highlighting opportunities for potential enhancements.

Keywords: Higher education; Performance evaluation; Fuzzy analytic hierarchy process; Balanced scorecard

Resumo. Cartão de Pontuação Balanceado (BSC), abrangendo as perspectivas Financeira, Cliente, Processos Internos e Aprendizado e Crescimento, é uma abordagem vital para a avaliação do desempenho estratégico em instituições educacionais. No entanto, a pesquisa que aborda incertezas na tomada de decisão nesse contexto permanece escassa. Este estudo busca preencher essa lacuna ao integrar o Processo Analítico Hierárquico Fuzzy (AHP) com o BSC para quantificar efetivamente os pesos de vários critérios e subcritérios relevantes à avaliação de desempenho universitário. Por meio de uma revisão abrangente da literatura e consultas com especialistas, foram identificados indicadores-chave de desempenho específicos para instituições de ensino superior. A pesquisa analisa ainda a relevância relativa desses indicadores nas perspectivas do BSC e avalia a situação atual de desempenho de universidades selecionadas. Além disso, uma análise de importância-desempenho e visualização por meio de gráfico radar são empregadas como ferramentas de inteligência de negócios para ilustrar os pontos fortes e fracos das instituições, destacando oportunidades para possíveis melhorias.

Palavras-chave: Educação Superior, Avaliação de Desempenho, Processo de Análise Hierárquica Fuzzy, Cartão de Pontuação Balanceado

1. INTRODUCTION

To thrive in the competitive business environment of today, companies must constantly enhance the quality of their products and services. During the last decades, the concept of a process-centered enterprise has attracted a great deal of attention in which performance measurement plays a vital role in the sustained growth of the company (Garrido-Moreno et al., 2024). Performance measurement, as the most useful tool in performance management, helps managers identify the current situation of the organization with regard to the specified goals (Alipour et al., 2022). It also provides a more comprehensive picture of the organization by identifying the processes that need to be improved or have the potential to enhance the performance of the organization.

The performance evaluation of a university is a continuing process that is necessary for the university to be competitive the future. This process requires continuous monitoring of all internal actions with respect to specific standards of evaluation. The Balanced scorecard (BSC) is a widely acknowledged method for assessing internal processes, using a combination of financial and non-financial metrics for performance evaluation. According to Banker and Datar (1989), the BSC offers a comprehensive view of both current and future performance drivers. Despite its reputation as an effective performance measurement tool, there is limited research on how universities implement BSC in their performance management, as noted by Nazari-Shirkouhi et al. (2020). Uncertainty in decision-making is not unique to education; for instance, Roshdieh (2024) demonstrated how monetary policy uncertainty significantly affects stock market volatility, underscoring the critical need for robust frameworks to manage uncertainty across sectors. Recent advancements in automated formative assessment, such as those by Karizaki et al. (2024), highlight the potential of AI-driven tools to evaluate idea articulation and reduce ambiguities in strategic decision-making, offering a complementary approach to frameworks like the BSC in educational contexts.

Chinta et al. (2016) propose a comprehensive framework to facilitate performance evaluation in higher education institutions. Their research identifies nine distinct perspectives for application within this model, offering practical metrics and benchmarks developed through an extensive review of literature and real-world examples from a large university in the United States, aimed at enhancing institutional assessment and fostering continuous improvement. Petrudi et al. (2022) introduced an innovative multiple-criteria decision-making framework that combines the Fuzzy Delphi Method and the Best-Worst Method to effectively measure performance in higher education institutions. Their findings highlight that "education" and "human capital" are the top criteria influencing performance, with key indicators including the number of patents, faculty-to-student ratio, and student satisfaction with teaching quality. Nazari-Shirkouhi et al. (2020) emphasized the significance of performance evaluation in higher education institutions through an integrated fuzzy approach, utilizing a BSC methodology to assess the importance of university services and activities. Their research revealed that educational income is a critical performance indicator, and they propose actionable guidelines for universities to enhance their performance and policymaking processes by prioritizing key factors and the growth of student enrollment. De Jesus Alvares Mendes Junior and Alves (2023) conducted a systematic literature review on the application of the BSC in the education sector, identifying key topics of discourse and highlighting both the dominance of qualitative research and the presence of quantitative studies, thereby revealing significant research gaps for future exploration. Makki et al. (2023) introduced a multi-criteria decision-making framework to qualitatively assess and rank university colleges based on educational quality, aligning with both international ranking standards and institutional strategic objectives, thereby facilitating informed decision-making to enhance performance and resource allocation in higher education.

Sharaf-Addin and Fazel (2021) developed a BSC framework to enhance performance management at the University of Bisha, Saudi Arabia, aiming to align the institution's strategic plan with its vision for 'Educational and Research Excellence' through qualitative research, documentation analysis, and executive interviews. Palaniappan et al. (2021) developed a comprehensive balanced scorecard framework for performance assessment in higher education management institutions in India, identifying 16 objectives, 46 measures, and 54 metrics to facilitate continuous evaluation and sustainable growth. Alharafsheh et al. (2021) investigated the influence of entrepreneurial characteristics of leaders in private Jordanian universities on strategic performance, revealing that these characteristics significantly enhance performance through the mediating role of strategic planning, thereby emphasizing the need for improved entrepreneurial attributes and strategic planning in educational institutions. Enachee et al. (2021) explored the implementation of the Balanced Scorecard methodology in Romanian educational institutions, analyzing fifteen key performance indicators across institutional capacity, educational efficiency, and quality management, ultimately suggesting that their findings can significantly influence educational decision-makers and institutional managers by emphasizing the importance of performance metrics in enhancing service delivery.

Determining performance measure indicators is an important step in performance management of universities. The indicators must be established in a way that maintain the university operating standards, encourage university to work on deficiencies, and promote university competitiveness. Integration of appropriately determined performance measure indicators with the BSC helps university managers build the performance of each department and organization (Chen et al., 2009). Wu and Li (2009) have proposed an integrated model based on data reduction factor and data envelopment analysis methods while the performance measure indicators are determined using the BSC method. The results show that the proposed model is capable of evaluating the performance of higher education institutions scientifically and reasonably. Wu et al. (2011) have developed a model for performance evaluation in extension education centers based on the BSC and multiple criteria decision making. In the proposed model, the relative weights between performance measure indicators are determined by analytic network process (ANP) and the causality between the BSC perspectives are established using the decision making trial and evaluation laboratory (DEMATEL).

The BSC has attracted a great deal of attention in performance evaluation of the educational institutions because of its capability for dealing with non-financial measures as well as financial ones. However, the performance measures, determined based on the BSC framework, need to be unified and therefore, analytic hierarchy process (AHP) is an appropriate method to be integrated with the BSC. On the other hand, performance measure indicators are highly affected by uncertainty and imprecision and a reliable decision making model needs to handle this imprecision (Nazari-Shirkouhi et al., 2023; Tavana et al., 2021; Yazdi et al., 2018). This study addresses the uncertainty inherent in the data on which the BSC framework is based in performance measurement of the universities and higher education institutions. A fuzzy AHP is incorporated with the BSC to determine the weights of each criteria and sub-criteria since it is capable of identifying various criteria weights in a hierarchical structure.

1.1. Balanced Scorecard

The BSC is a framework for performance management that assists organizations in translating their overall strategic goals into effective operational tactics. It serves as more than

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just a tool for measuring performance, but also as a strategic management system and a means of communication (Niven, 2002; Chen et al., 2009). The BSC's effectiveness lies in its ability to address various aspects such as customer focus, internal processes, innovation, and financial indicators within the organization's performance management. By utilizing a range of performance indicators, the BSC allows managers to assess the organization's accomplishments comprehensively. The customer perspective, which prioritizes stakeholder engagement, aligns with emerging models of participatory decision-making, such as Saremi et al. (2024), who demonstrate how knowledge management systems can enhance customer-centric metrics by systematically integrating stakeholder feedback into performance frameworks. The financial perspective, for instance, aligns with findings from Izadian et al. (2024), who demonstrated that asset revaluation and capital increases significantly influence market perceptions and organizational credibility in pharmaceutical sectors, highlighting the cross-industry relevance of robust financial metrics in strategic performance frameworks. The learning and growth perspective emphasizes the development of organizational human capital, including faculty competencies and their ability to transfer knowledge effectively—a factor underscored by research on preservice teacher education and categorical reasoning (Azimi Asmaroud, 2022). This aligns with Agarwal et al. (2022), who stress the importance of evaluating teaching development programs to ensure they yield measurable improvements in instructional quality and student outcomes, a critical consideration for institutions aiming to align faculty growth with strategic performance goals.

1.2. Fuzzy Analytic Hierarchy Process

Saaty (1980) first developed the Analytic Hierarchy Process (AHP), a technique for multi-criteria decision-making that uses network structures to illustrate a decision problem and rank alternatives based on the decision maker's preferences. AHP has found extensive applications in various areas like forecasting, business process improvement, allocation of resources, and quality management.

According to the ambiguity and vagueness inherent in many decision-making problems, handling vagueness and uncertainty is indispensable in a proper decision-making model. In conventional AHP, the qualitative preferences are transformed to point estimates. However, the decision makers' judgments do not often provide precise values and therefore, it is preferable to consider the ambiguity in some or all pairwise comparison values in AHP. Fuzzy set approach is capable of handling optimistic or pessimistic nature of decision maker's attitude and hence, it can be used for representing linguistic values whose membership functions are fuzzy numbers. Performance ratings are better represented by linguistic values than conventional numerical values (Keramati et al. 2013; Rezaie et al., 2014).

2. RESEARCH METHODOLOGY

In this research, a list of preliminary performance measure indicators is determined based on the BSC framework and previous research available in the literature. Then, the final performance measures are identified by modifying the list through interviews with the experts in the universities. The selected performance indicators are used to design a questionnaire based on the typical AHP questionnaire format. The experts, in the second run, are asked to give their answers to the questions and then, fuzzy AHP is utilized to analyze the feedbacks. The relative importance of the performance measure indicators, the relative importance of the four perspectives of the BSC framework, and the current situation of the organization in terms of the selected performance measures are determined.

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2.1. Performance Measure Indicators

A preliminary list of 126 performance indicators was derived from a literature review of BSC-based studies in higher education (Chen et al., 2000; Nazari-Shirkouhi et al., 2020; Petrudi et al. 2022; De Jesus Alvares Mendes Junior and Alves, 2023; Makki et al., 2023; Sharaf-Addin and Fazel, 2021; Palaniappan et al., 2021; Alharafsheh et al., 2021; Enache et al., 2021; Lin and Lo, 2023; Bugrov et al., 2021; Rošulj and Petrović, 2020; Kirir, 2022; Oliveira et al., 2021; Camilleri, 2021; Pietrzak, 2021; Sauri et al., 2023; Wu and Li, 2024; Al-Filali et al., 2024). Through structured interviews with 10 experts, the list was refined to 19 key indicators (Table 1), ensuring alignment with operational standards and strategic priorities of universities.

Table 1. The selected BSC performance indicators

Perspective	Indicator	Description
Financial (C1)	Turnover volume (C11) Net income (C12) Annual income growth (C13) Cost control (C14)	How should the organization appear to the shareholders and beneficiaries?
Customers (C2)	Students satisfaction (C21) Service quality (Students complaint rate) (C22) Customer relationship (C23) Increasing of new students (C24) Faculty to student ratio (C25)	How should the organization appear to the students?
Internal Process (C3)	Service cycle processing time (C31) Information Technology (C32) Scholarly publications (C33) Facilities productivity (C34) Teaching quality evaluation (C35)	How should the business processes of the organization be performed?
Learning and Growth (C4)	Faculty/ staff capabilities (C41) Faculty/ staff satisfaction (C42) Innovative teaching (C43) Encouraging methods (C44) Stability of the employees (C45)	How should the organization develop, enhance and maintain the capability of value creation?

2.2.Data Collection

A hybrid questionnaire (19 Likert-scale questions and 42 AHP-style pairwise comparisons based on Azadeh et al. (2010); Rezaei et al. (2013); Azadeh et al. (2011) was distributed to 15 experts. Responses were analyzed using fuzzy AHP to quantify weights (Section 2.3) and assess institutional performance

2.3. Fuzzy AHP Method Implementation

Following the fuzzy AHP methodology outlined in Section 1.2, experts provided pairwise comparisons using the linguistic scale in Table 2. To address uncertainties in expert judgments, triangular fuzzy numbers were employed. Additionally, the consistency ratio (C.R.) was rigorously evaluated to ensure the reliability of pairwise comparisons. While traditional statistical tests (e.g., significance levels) were not applied due to the qualitative nature of expert-driven fuzzy AHP, the consistency checks (C.R.<0.1) and aggregation of fuzzy

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judgments inherently account for variability and ensure robustness. This approach aligns with advancements in multi-criteria decision-making methodologies, such as the integration of WEAP and TOPSIS proposed by Fathi et al. (2025), which similarly emphasizes the importance of systematic criteria weighting under uncertainty to derive contextually optimal solutions. Future studies may complement this approach with quantitative data and statistical validation to further reinforce reliability. Triangular fuzzy numbers aggregated responses (Equations 1–3), and Liou and Wang's (1992) defuzzification method derived crisp weights (Tables 9–13). Consistency ratios (Table 8) confirmed reliable judgments (C.R.<0.1).

Table 2. Fuzzy scale used for making pairwise comparisons

Fuzzy Scale	**Definition**
(1,1,1)	Equal importance
(2,3,4)	Weak importance
(4,5,6)	Essential or strong importance
(6,7,8)	Demonstrated importance
(8,9,9)	Extreme importance
(x -1, x, x +1)	Intermediate values between two adjacent judgments
(1/(x+1), x,1(x -1)	Inverse values

$$I_{ij}^{l} = \min\{O_{ijk}^{l}\} \qquad (1)$$

$$I_{ij}^{m} = \sqrt[n]{\prod_{1}^{n} O_{ijk}^{m}} \qquad (2)$$

3. $$I_{ij}^{u} = \max\{O_{ijk}^{u}\} \qquad (3)$$

Where, O_{ijk}^{l}, O_{ijk}^{m}, and O_{ijk}^{u} are the first, second, and third parameter of the relative importance of criteria C_i and C_j given by kth expert.

3. RESULTS

Aggregated matrices of the experts' judgments for the BSC perspectives and the performance measure indicators are shown in Tables 3 to 7.

Table 3. Aggregated matrix of the experts' judgments for the BSC perspectives

	C1			C2			C3			C4		
C1	1.000	1.000	1.000	0.318	0.378	0.467	0.397	0.444	0.515	0.446	0.503	0.591
C2				1.000	1.000	1.000	1.560	0.823	2.072	0.908	1.145	1.376
C3							1.000	0.000	1.000	0.763	0.877	1.000
C4										1.000	1.000	1.000

Table 4. Aggregated matrix of the experts' judgments for the indicators of financial perspective

	C11			C12			C13			C14		
C11	1.000	1.000	1.000	0.555	0.648	0.780	0.330	0.371	0.435	0.896	0.992	1.116
C12				1.000	1.000	1.000	0.456	0.517	0.616	1.195	1.431	1.641
C13							1.000	0.000	1.000	1.389	1.580	1.738
C14										1.000	1.000	1.000

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Table 5. Aggregated matrix of the experts' judgments for the indicators of customer perspective

	C21			C22			C23			C24			C25		
C21	1.000	1.000	1.000	0.390	0.437	0.508	1.267	1.621	2.024	1.320	1.546	1.823	0.443	0.520	0.609
C22				1.000	1.000	1.000	1.694	2.102	2.495	1.130	1.301	1.497	0.691	0.822	0.987
C23							1.000	1.000	1.000	0.660	0.788	0.948	0.960	1.144	1.390
C24										1.000	1.000	1.000	1.157	1.390	1.632
C25													1.000	1.000	1.000

Table 6. Aggregated matrix of the experts' judgments for the indicators of internal process perspective

	C31			C32			C33			C34			C35		
C31	1.000	1.000	1.000	0.626	0.678	0.736	0.247	0.303	0.377	0.699	0.823	0.960	0.383	0.454	0.558
C32				1.000	1.000	1.000	1.135	1.344	1.552	1.244	1.416	1.595	0.593	0.679	0.798
C33							1.000	1.000	1.000	0.928	1.121	1.390	0.320	0.367	0.448
C34										1.000	1.000	1.000	0.743	0.867	1.056
C35													1.000	1.000	1.000

Table 7. Aggregated matrix of the experts' judgments for the indicators of learning and growth perspective

	C41			C42			C43			C44			C45		
C41	1.000	1.000	1.000	1.267	1.561	1.823	0.554	0.656	0.767	0.480	0.568	0.660	2.198	2.491	2.752
C42				1.000	1.000	1.000	0.652	0.732	0.855	0.780	0.803	0.836	2.297	2.667	2.930
C43							1.000	1.000	1.000	1.625	1.967	2.285	1.048	1.388	1.741
C44										1.000	1.000	1.000	1.405	1.707	2.055
C45													1.000	1.000	1.000

Different methods exist for converting experts' opinions into a clear format, with many requiring a standard or triangular membership function. However, these approaches often overlook the uncertainty inherent in the expert's opinion (Nazari-Shirkouhi et al., 2011; Nazari-Shirkouhi et al., 2017). To address this issue, Liou and Wang (1992) developed a unique difuzzification method that considers this uncertainty. This method involves converting a fuzzy pairwise comparison matrix $\tilde{F}$ into a crisp pairwise comparison matrix, as shown in equation 5 when the fuzzy pairwise comparison matrix $\tilde{F}$ is represented by equation 4.

$$\tilde{F} = [\tilde{f}_{ij}] = \begin{array}{c} \\ C_1 \\ C_2 \\ \vdots \\ C_n \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \dots & C_n \end{array} \\ \begin{bmatrix} 1 & \tilde{f}_{12} & \cdots & \tilde{f}_{1n} \\ 1/\tilde{f}_{12} & 1 & \cdots & \tilde{f}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/\tilde{f}_{1n} & 1/\tilde{f}_{2n} & \cdots & 1 \end{bmatrix} \end{array} \qquad (4)$$

$$P = [p_{ij}] = \begin{cases} \beta((f_{ij}^{m} - f_{ij}^{l})\alpha + f_{ij}^{l}) + (1-\beta)(f_{ij}^{u} - (f_{ij}^{u} - f_{ij}^{m})\alpha) \quad ; 0 \le \alpha, \beta \le 1 & i \le j \\ 1/p_{ij}, \quad 0 \le \alpha, \beta \le 1 & i > j \end{cases} \qquad (5)$$

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Where α represents the preference of the decision maker and β represents their risk tolerance. The final crisp pairwise comparison matrix can be represented by equation 6.

$$P = [p_{ij}] = \begin{matrix} & C_1 & C_2 & \cdots & C_n \\ C_1 \\ C_2 \\ \vdots \\ C_n \end{matrix} \begin{bmatrix} 1 & p_{12} & \cdots & p_{1n} \\ 1/p_{12} & 1 & \cdots & p_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/p_{1n} & 1/p_{2n} & \cdots & 1 \end{bmatrix} \quad (6)$$

The eigenvalue $\lambda_{\max}$ of the matrix used for pairwise comparisons P can be determined through a specific set of equations.

$$P.W = \lambda_{\max}.W \quad (7)$$

$$[P - \lambda_{\max}].W = 0 \quad (8)$$

Eigenvector W is derived from the matrices P and $0 \leq \alpha, \beta \leq 1$. The Consistency index (C.I.) and Consistency ratio (C.R.) are calculated in the following manner:

$$C.I. = \frac{\lambda_{\max} - n}{n-1} \quad (9)$$

$$C.R. = \frac{C.I.}{R.I.} \quad (10)$$

Table 8 shows C.R. for all pairwise comparisons, which are well below the threshold of 0.1, confirming high consistency in expert judgments. This validates the reliability of the aggregated weights despite the absence of traditional statistical tests.

Table 8. Consistency ratio of pairwise comparisons

	First level	Second level			
		C1	C2	C3	C4
CR	0.009	0.0143	0.0642	0.0525	0.0576

The results of consistency test show that C.R. never exceeds the upper threshold value 0.1 and hence, the judgments in the pairwise comparisons are consistent. The weights of the BSC perspectives and the performance measure indicators are calculated using the defuzzified pairwise comparison matrices according to equation (8). Tables 9 to 13 illustrate the final defuzzified pairwise comparison matrices and the related weights.

Table 9. Final pairwise comparison matrix for the BSC perspectives

	C1	C2	C3	C4	**Weight**
C1	1	0.3851	0.4497	0.5105	**0.1276**
C2	2.5965	1	1.8194	1.1432	**0.3575**
C3	2.2237	0.5496	1	0.8793	**0.239**
C4	1.9589	0.8747	1.1372	1	**0.2759**

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Table 10. Final pairwise comparison matrix for the financial perspective

	C11	C12	C13	C14	Weight
C11	1	0.6575	0.3766	0.9992	**0.1657**
C12	1.5208	1	0.5264	1.4245	**0.2429**
C13	2.6552	1.8995	1	1.572	**0.3973**
C14	1.0008	0.702	0.6362	1	**0.194**

Table 11. Final pairwise comparison matrix for the customer perspective

	C21	C22	C23	C24	C25	Weight
C21	1	0.4428	1.633	1.5584	0.523	**0.1793**
C22	2.2583	1	2.0985	1.3073	0.8301	**0.2668**
C23	0.6124	0.4765	1	0.7956	1.1595	**0.1489**
C24	0.6417	0.7649	1.2569	1	1.3925	**0.1885**
C25	1.9119	1.2047	0.8625	0.7181	1	**0.2165**

Table 12. Final pairwise comparison matrix for the internal process perspective

	C31	C32	C33	C34	C35	Weight
C31	1	0.6794	0.3075	0.8264	0.4623	**0.1151**
C32	1.4718	1	1.344	1.4177	0.687	**0.2104**
C33	3.2521	0.7441	1	1.14	0.3755	**0.199**
C34	1.2101	0.7054	0.8772	1	0.8833	**0.1726**
C35	2.1633	1.4555	2.663	1.1321	1	**0.3029**

Table 13. Final pairwise comparison matrix for the learning and growth perspective

	C41	C42	C43	C44	C45	Weight
C41	1	1.5528	0.6584	0.569	2.4828	**0.2066**
C42	0.644	1	0.7429	0.8054	2.6405	**0.1901**
C43	1.5187	1.346	1	1.9611	1.3911	**0.2718**
C44	1.7575	1.2417	0.5099	1	1.7185	**0.219**
C45	0.4028	0.3787	0.7189	0.5819	1	**0.1125**

In order to determine the significance of each performance measure indicator, its weight is multiplied by the weight of corresponding perspective. Table 14 shows the calculated weights of the performance measure indicators and the related perspectives in the BSC framework for Azad University in Iran (Engineering college- branch ***A*** and branch ***B)***.

Table 14. Weights of the performance measure indicators

Perspective	Weight	Indicator	Weight		Rank	
			Local	Final	Local	Final
C1	0.1276	C11	0.1657	0.02114	4	19
		C12	0.2429	0.03099	2	16
		C13	0.3973	0.0507	1	11
		C14	0.194	0.02475	3	18

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C2	0.3575	C21	0.1793	0.0641	4	6
		C22	0.2668	0.09538	1	1
		C23	0.1489	0.05323	5	9
		C24	0.1885	0.06739	3	5
		C25	0.2165	0.0774	2	2
C3	0.2390	C31	0.1151	0.02751	5	17
		C32	0.2104	0.05029	2	12
		C33	0.199	0.04756	3	13
		C34	0.1726	0.04125	4	14
		C35	0.3029	0.07239	1	4
C4	0.2759	C41	0.2066	0.0570	3	8
		C42	0.1901	0.05245	4	10
		C43	0.2718	0.07499	1	3
		C44	0.219	0.06042	2	7
		C45	0.1125	0.03104	5	15

In order to assess the performance level of each higher education institution, the current situation in terms of the performance measure indicators is determined based on the decision makers' judgments. Performance level of Engineering College- branch A and branch B are 71.08% and 53.50% respectively. Table 15 illustrates the performance level of the two branches in each performance measure.

Table 15. Performance Level Of Each Higher Education Institution

Perspective	Indicator	Performance level		Total performance level	
		Branch ***A***	Branch ***B***	Branch ***A***	Branch ***B***
Financial (C1)	Turnover volume (C11)	0.8	0.6	0.016	0.012
	Net income (C12)	0.7	0.6	0.021	0.018
	Annual income growth (C13)	0.6	0.5	0.030	0.025
	Cost control (C14)	0.75	0.7	0.018	0.017
Customers (C2)	Students satisfaction (C21)	0.7	0.75	0.045	0.048
	Students complaint rate (C22)	0.7	0.75	0.067	0.072
	Customer relationship (C23)	0.7	0.6	0.037	0.032
	Increasing of new students (C24)	0.6	0.45	0.041	0.031
	Faculty to student ratio (C25)	0.55	0.25	0.043	0.020
Internal Process (C3)	Service cycle processing time (C31)	0.65	0.6	0.018	0.016
	Information Technology (C32)	0.7	0.45	0.035	0.023
	Scholarly publications (C33)	0.65	0.35	0.031	0.017
	Facilities productivity (C34)	0.65	0.55	0.027	0.023
	Teaching quality evaluation (C35)	0.8	0.5	0.059	0.037
Learning and Growth (C4)	Faculty/ staff capabilities (C41)	0.9	0.7	0.051	0.040
	Faculty/ staff satisfaction (C42)	0.8	0.45	0.042	0.024
	Innovative teaching (C43)	0.75	0.6	0.057	0.045

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	Encouraging methods (C44)	0.8	0.35	0.048	0.021
	Stability of the employees (C45)	0.8	0.5	0.025	0.016

4. DISCUSSION

One of the most important steps in the performance management of an organization is to compare the current performance level to the ideal level and determine the gap between the current situation and the organization's goals. This helps managers to identify the strengths and weaknesses of the organization and determine the processes that require revisions or improvements. A radar graph provides a clear visual indication of the performance level of the organization and is very useful for identifying the strengths and weaknesses. Figures 1 and 2 illustrate the radar graphs of performance scores of Engineering College, branch A and branch B respectively.

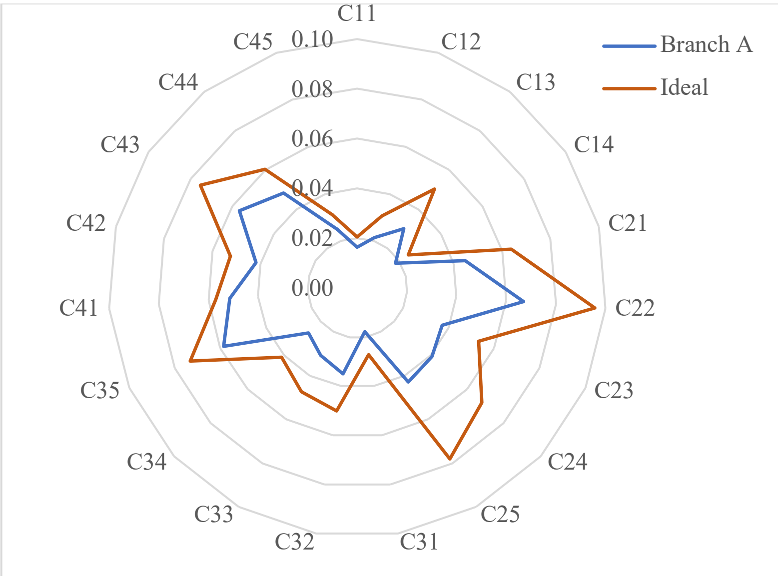

Figure 1. Comparison of the performance scores of branch A to the ideal scores

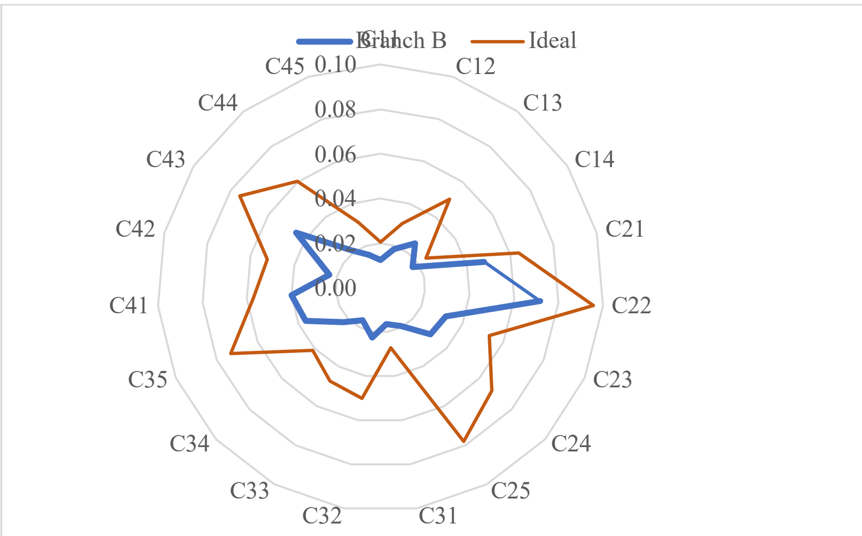

Figure 2. Comparison of the performance scores of branch B to the ideal scores

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As is shown in Figure 1, the performance level of branch A on indicators C21 to C25 has a remarkable distance to the ideal level. These indicators belong to the customer perspective which is the most important perspective based on the experts' judgments. Furthermore, the distance between the performance level of branch A on the indicators of the learning and growth perspective is also significant. As can be seen from Figure 2, the performance scores of branch B on indicators C23 to C25 from the customer perspective, C32, C33 and C35 from the internal process perspective, and C42 and C44 from the learning and growth perspective are remarkably lower than the ideal scores. In order to effectively improve the performance of the organization, the focus must be on the indicators on which the performance level is significantly lower than the ideal level.

4.1. Performance improvement

The importance-performance analysis is a useful technique for identifying those features of a service that are most in need of improvement and for determining the priority of different attributes of a service to be considered for possible improvement. One of the greatest advantages of the importance-performance sampling is that the results can be easily displayed on a two-dimensional grid (Martilla & James, 1977). Figure 3 depicts the relative positions of the performance measure indicators of Engineering College - branch A in matrix format. The matrix is represented by the priority weights on the horizontal axis and the performance scores on the vertical axis.

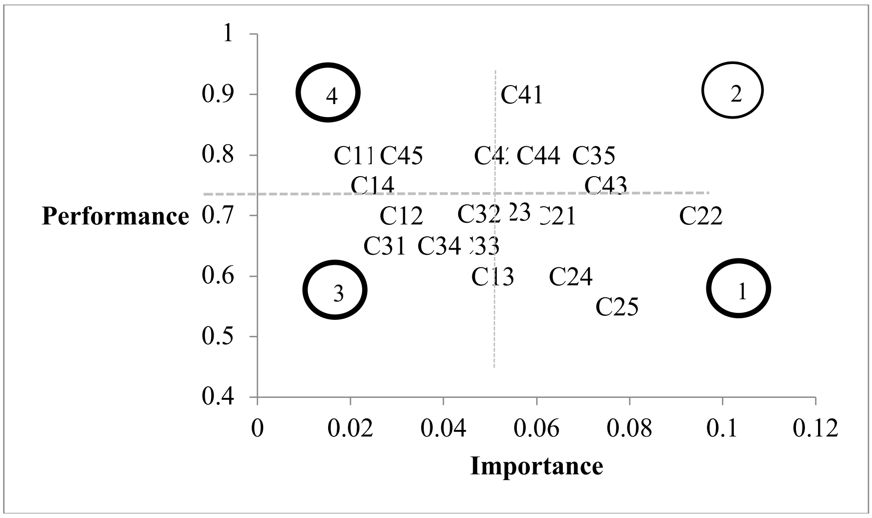

Figure 3. Importance-performance matrix of the performance measure indicators for branch ***A***

As shown in the graph, performance measure indicators are classified in quadrants. Quadrant 1 is reflective of the fact that the organization is not performing up to its potential on certain aspects and considerable improvements are required to enhance the performance level of the organization on these indicators. Students' satisfaction, service quality, customer relationship, increasing of new students and faculty to student ratio are the indicators on which the university must concentrate for improvement. Quadrant 2 is reflective of those performance measures that are highly important and the performance scores are also relatively high. It is vital for the organization to keep these performance scores up through effective monitoring and evaluation system. The indicators located in this area are faculty/staff capabilities, faculty/staff satisfaction, innovative teaching, encouraging methods, and teaching quality evaluation. Quadrant 3 comprises those performance measures that the university is not performing satisfactory but the experts do not perceive these aspects to be very important. The university should consider this area as the secondary improvement area for future plans. Six indicators

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including net income, annual income growth, Service cycle processing time, information technology, scholarly publications, and facilities productivity are located in this area. Quadrant 4 is the over-emphasized area. It is unlikely that any further improvement or investment in the aspects located in this area will lead to a higher total performance level. Importance-performance matrix of the performance measure indicators for branch B is shown by Figure 4.

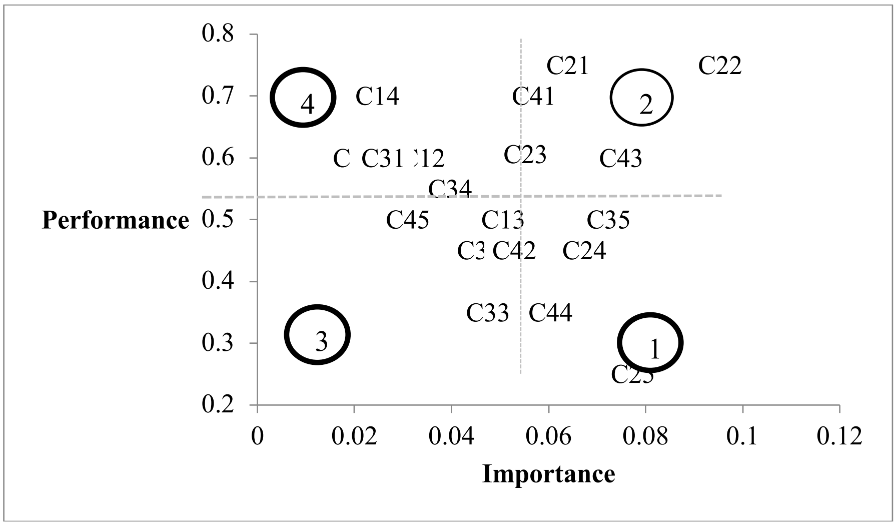

Figure 4. Importance-performance matrix of the performance measure indicators for branch ***B***

As can be seen in Figure 4, the Engineering College College- branch B must concentrate its improvement efforts on the aspects located in quadrant 1 including faculty to student ratio, increasing of new students, teaching quality evaluation, and encouraging methods. As mentioned before, it is necessary for the university to maintain the performance level of the aspects located in quadrant 2. The indicators located in quadrant 2 are students' satisfaction, service quality, customer relationship, faculty/staff capabilities and innovative teaching. Quadrant 3, the secondary improvement area, includes net income, annual income growth, service cycle processing time, information technology, scholarly publications, and facilities productivity.

4.2. Cross-Cultural Adaptability of the Framework

While the study was conducted in Iranian universities, the BSC-Fuzzy AHP framework is inherently adaptable to diverse educational contexts. The methodology's flexibility lies in its iterative process of indicator selection and weight calibration through expert engagement. For instance, in regions prioritizing research output (e.g., European institutions), the weight of scholarly publications (C33) could be elevated, while in student-centric systems (e.g., U.S. liberal arts colleges), student satisfaction (C21) might dominate. Comparative studies, such as Sharaf-Addin and Fazel's (2021) BSC implementation in Saudi Arabia and Palaniappan et al.'s (2021) work in India, demonstrate that core BSC perspectives remain consistent, but sub-criteria weights vary with institutional priorities. Furthermore, as highlighted by Eason et al. (2023) in their analysis of Black women's experiences in engineering education, performance frameworks must critically address systemic barriers to equity, ensuring metrics account for diverse stakeholder experiences and inclusive institutional practices. To adapt this model, stakeholders should:

- Localize Indicators: Replace context-specific metrics (e.g., annual income growth in Iran) with regionally relevant ones (e.g., government funding efficiency in public EU universities).

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- Recalibrate Weights: Use local expert panels to reprioritize criteria via fuzzy AHP, ensuring alignment with strategic goals.
- Align with Regulatory Standards: Integrate national accreditation requirements (e.g., teaching quality benchmarks in the UK's TEF) into the internal process perspective and cybersecurity protocols, as highlighted by Nasiri et al. (2024), into the internal process perspective to ensure comprehensive risk management and data integrity.

5. CONCLUSION

This study presented a new model for evaluating the performance of higher education institutions using a balanced scorecard approach combined with fuzzy analytic hierarchy process to address uncertainties in decision-making. Key performance indicators for higher education institutions were identified through a thorough review of literature and expert interviews, serving as a benchmark for performance management. The framework was applied to two universities in Iran, revealing that customer satisfaction is the most crucial aspect, followed by learning and growth, internal processes, and financial performance. Key performance indicators include service quality, faculty-student ratio, and innovative teaching methods. The study also assessed the performance levels of the institutions and conducted an importance-performance analysis to prioritize areas for improvement. However, several limitations should be noted. First, while the expert panel provided region-specific insights, its focus on Iranian institutions may limit the immediate applicability of findings to other cultural or regulatory contexts. Future studies could validate this framework in multinational settings to enhance cross-border relevance. Second, the reliance on expert judgments, though mitigated by fuzzy logic, could be further strengthened by incorporating quantitative benchmarks such as enrollment trends or financial audit outcomes. Finally, while the model demonstrates robustness in the studied cases, testing its scalability across a broader range of institutions would solidify its generalizability.

Despite these constraints, the study equips university administrators with actionable tools to align strategic goals with operational performance. The IPA-driven prioritization of weaknesses (e.g., customer perspective gaps in Branch A) offers a roadmap for targeted resource allocation. Future research directions could explore adaptive weight adjustments using machine learning or artificial intelligence (AI) algorithms—such as those proposed by Sadeghi and Niu (2024), who demonstrate AI's potential to enhance diversity and inclusivity in educational systems through data-driven recruitment strategies, and Darvishinia (2023), who outlines frameworks for addressing implementation challenges of AI in institutional decision-making. Additionally, longitudinal studies could track performance evolution to refine the model's precision and deepen its utility in dynamic educational ecosystems. This study's reliance on expert judgments, while validated through consistency checks, highlights the need for future research to incorporate statistical tests and quantitative metrics. Such advancements would strengthen the framework's applicability in diverse educational contexts.

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