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DIGITAL TRANSFORMATION OF PROJECT TEAM COMPETENCIES: MODEL FOR ASSESSING PROJECT MANAGER TRAINING EFFECTIVENESS

Abstract

In the context of digital transformation, one of the urgent problems is the research of modern approaches to assessing the competencies of project managers necessary for the effective work of project teams. In this regard, the goal of the scientific article is to identify key competencies of project managers based on methods of content analysis of educational programs of higher education institutions in the Republic of Kazakhstan and the Fuzzy Analytic Hierarchy Process (FAHP) method to substantiate their weight coefficients. The results of the content analysis showed that current educational programs for training project managers lack professional, digital, communicative, and personal competencies critical for teamwork during project implementation. The absence of these competencies leads to a decrease in the efficiency of project activities and limits the readiness of graduates for the practical implementation of projects, as educational programs are often oriented predominantly towards theoretical preparation with an insufficient level of practical focus. The proposed FAHP model evaluates project manager competence according to indicators such as skill development, teamwork ability, formation of communicative and leadership qualities, as well as the ability to integrate digital innovations into the educational process. This model will allow universities to adjust educational programs taking into account practical requests in the field of training highly qualified project management specialists. Furthermore, domestic universities should transition to a competency-based training model and bring academic practice into compliance with international quality assurance standards. As a result, an effective structure of project management manager competencies will be formed, playing a key role in the employment of graduates and their adaptation in a professional project environment.

Keywords: project management, project manager, project team, professional competencies, digital competencies, educational programs, higher education institutions.

Introduction

Rapid digital transformation has significantly increased the demand for highly qualified human capital and developed competency profiles among project team members. As Kerzner (2023) notes,

organizations in various economic sectors, including IT, finance, the public sector, and education, face a common problem: project outcomes are largely determined by the level of project team competencies. Decision-making under uncertainty and the effective use of digital tools are becoming key factors in project performance. International studies (OECD, 2022; PMI, 2021) emphasize that forming a complex competency profile for project managers is a necessary condition for increasing project efficiency. However, traditional approaches to assessing future specialists' competencies, including expert opinions, current grades, and final training results, are often subject to subjectivity and do not fully reflect the real readiness of graduates for effective work in project teams.

At the same time, an analysis of university educational programs in Kazakhstan shows that, despite significant attention to project management issues, the curricula lack a discipline focused on managing project teams and assessing their competencies. This indicates a methodological gap between the requirements of practical project implementation and the current personnel training system in higher education. In conditions of accelerated digital transformation and the growing prevalence of project-oriented teams, there is an objective need to develop scientifically grounded, systemic, and objective approaches to competency assessment. In this context, the goal of this study is to develop a competency assessment model within higher education programs, oriented towards forming a sustainable readiness of students for effective participation in project teams under conditions of uncertainty.

In accordance with this goal, the main tasks of the study are: (i) identifying the structure and level of development of professional, managerial, communicative, and digital competencies; (ii) diagnosing competency deficits in the formation and functioning of project teams; (iii) scientifically justifying the introduction of a specialized discipline aimed at developing the competency potential of future project leaders and team members; (iv) developing recommendations for improving the quality of training at doctoral and master's levels in accordance with the requirements of real project activity. The transition from fragmentary and predominantly qualitative assessment methods to integrated models combining quantitative and qualitative analytical tools acquires particular importance.

The object of the study is project team competencies. The main research methods are content analysis and the Fuzzy Analytic Hierarchy Process (FAHP), which were used to assess the effectiveness of the formation and functioning of project teams, allowing for the determination of the level of professional, behavioral, and digital competencies of project managers.

The contribution of this study to higher education in Kazakhstan has practical significance. From an academic perspective, the study presents an innovative approach to assessing the competencies of students majoring in "Project Management," based on the application of the FAHP model. This approach increases the objectivity and transparency of competency assessment, supporting the accreditation requirements of national and international agencies. Structured weighting of competency indicators allows universities to substantiate assessment criteria and link assessment results with professional development planning.

Materials and methods

When forming project teams, it is necessary to rethink both the structure of competency assessment indicators and their content. Analysis of educational programs in the specialty "Project Management" in universities of Kazakhstan revealed significant gaps in defining the key competencies of future specialists, specifically their theoretical aspect and the low share of practical profiles necessary for effective project activity. This observation aligns with the results of international studies demonstrating that higher education curricula often lag behind labor market requirements regarding competency-oriented training [1].

According to data from the Project Management Institute [2], project success is largely determined by behavioral, leadership, and digital competencies, which cannot be formed exclusively within the framework of theoretical learning. Similar gaps are noted in national education systems [3].

Additional complexity in forming and assessing these competencies is created by the difference in conceptual approaches embedded in international project management standards. Specifically, the PMBOK Guide Seventh Edition [4] reflects a transition from a process-oriented model to a principle- and value-oriented approach, centered on adaptability, leadership, systems thinking, and value creation. At the same time, the PRINCE2 methodology [5] retains an emphasis on a formalized

project management structure, including clear role distribution, decision-making control points, and project life cycle manageability. This divergence underscores that competency requirements for project management specialists are formed in different logics: PMBOK 7 is oriented towards a behavioral-value competency model, while PRINCE2 is oriented towards a managerial-process model. This complicates their integration into educational programs and reinforces the need for systemic approaches to their assessment [2].

Comparing educational and production contexts reveals significant conceptual parallels in the structure of competencies. The professional subject knowledge of project management managers is comparable to the professional skills of enterprise employees. Thus, in IT companies, professional competence includes proficiency in programming languages, algorithms, and modern development methodologies, whereas in higher education, it manifests in deep subject matter expertise and the ability to effectively transfer knowledge to students [4]. Similarly, the managerial mastery of a project manager, understood as the ability to structure managerial analysis, clearly articulate content, and organize joint learning, corresponds in the corporate environment to the ability of employees to effectively perform tasks and interact in interdisciplinary teams [5]. These parallels justify the applicability of competency assessment models developed for the corporate sector to the educational context, especially when assessing readiness to participate in project teams.

To develop a competency assessment model in an educational environment, the Fuzzy Analytic Hierarchy Process (FAHP) method was chosen. This choice is based on a comparative analysis of FAHP with alternative fuzzy modeling approaches, including intuitionistic fuzzy sets. The degree of membership, non-membership, and hesitation (uncertainty) makes them suitable for situations with a high degree of ambiguity. However, when assessing project team member competencies, criteria are usually sufficiently clearly defined, and the main difficulty lies in establishing their relative importance rather than confirming their presence. FAHP, based on structured pairwise comparisons, effectively solves this task [5, 6]. At the same time, previous research results show that such complexity does not always lead to a proportional increase in interpretability and practical applicability when solving competency assessment tasks [7]. In contrast, the classic 1–9 scale used in FAHP is intuitive and sufficient for reflecting the relative importance of criteria in project-oriented educational environments.

Thus, FAHP acts as a stable and practically applicable methodological tool for developing competency assessment models in higher education. Based on this method, a set of key competencies can be systematically identified and hierarchically structured, including professional knowledge, managerial skills, communication, problem-solving ability, teamwork, leadership, and digital competencies [8, 9]. Through expert surveys and pairwise comparisons, matrices of relative importance are formed, allowing for the calculation of weight coefficients for competencies and the development of an objective assessment model [10, 11].

In the Kazakhstani context, expert commissions are often formed predominantly from senior lecturers and professors with similar educational backgrounds and long institutional experience [12]. Although such expertise is undoubtedly valuable, it may inadvertently prioritize traditional teaching approaches to the detriment of student-centered, digital, and project-oriented methods promoted within current national reforms [13]. Research in AI ethics in education indicates that the diversity of the expert composition is a key factor in reducing algorithmic bias and increasing assessment fairness [14]. In this regard, the FAHP-oriented model should rely on heterogeneous expert groups representing various regions, types of educational organizations, pedagogical approaches, and levels of digital literacy.

Similar FAHP-oriented models have proven their effectiveness in personnel selection, performance assessment, and training needs analysis tasks [6]. In an educational environment, the proposed model can be used when selecting managers, forming project teams, making promotion decisions, as well as developing targeted professional development programs. Beyond education and human resource management, the FAHP approach is applicable in AI-based decision-making processes, particularly in image recognition and natural language processing tasks. Determining the relative importance of these features represents a multi-criteria task, for the solution of which FAHP is a methodologically grounded tool [15].

The rapid development of digital educational environments has strengthened the need for reliable and data-driven competency assessment systems in higher education. Competency-based learning is

recognized as a key mechanism for aligning learning outcomes with labor market and project activity requirements [15, 16]. In this context, remote assessment platforms create new opportunities for systemic and scalable competency diagnostics [17]. The platform's business logic layer implements standardized assessment procedures based on multi-criteria decision-making theory. Such approaches are widely used in educational assessment to manage complex decision structures involving multiple qualitative and quantitative indicators. The platform is designed with the capability to integrate with existing academic information systems, such as learning management systems and student information systems. Such integration is a necessary condition for reducing administrative burden and ensuring the consistency of educational processes [9].

Overall, the proposed platform represents a theoretically grounded and methodologically stable solution for assessing competencies in higher education. The integration of FAHP analytics with the principles of assessment theory, information systems design, and learning analytics supports evidence-based academic decision-making and contributes to improving the quality of project-oriented education.

The general research design is based on the theory of competency-based education and decision science and aims to build an objective and systemic model for assessing manager competencies. The main research methods are content analysis and the Fuzzy Analytic Hierarchy Process (FAHP).

Content analysis was used to assess the effectiveness and quality of educational programs for training master's and doctoral students in the specialty "Project Management" in higher education institutions of the Republic of Kazakhstan. Content analysis was conducted based on educational programs hosted in the EPVO.kz system, which is the official registry of educational programs of the Republic of Kazakhstan. The analysis included 18 master's educational programs implemented in 13 universities of Kazakhstan under the training direction M072 – Management, profile "Project Management" [12]. Of these:

- 7 specialized programs have a duration of 1 year (60 ECTS);
- 2 combined (hybrid) programs – 1.5 years (90 ECTS);
- 9 scientific-pedagogical programs – 2 years (120 ECTS).

Within the direction D072 – Management, 27 doctoral programs were analyzed, of which 5 programs relate directly to the "Project Management" profile. Identical basic parameters were established for all programs: study duration – 3 years; volume – 180 ECTS credits.

Regarding competency assessment, the study examines how manager competencies can be decomposed into a structured system of evaluation criteria and how the FAHP method can be used to determine their relative importance. FAHP uses fuzzy logic tools, allowing experts to express preferences using linguistic variables rather than strict numerical values. This combination of methods allows for considering both the complexity of the competency structure and the uncertainty inherent in human judgments. The FAHP method was chosen as the key analytical tool due to its ability to account for uncertainty, subjectivity, and the qualitative nature of expert assessments, which is a characteristic feature of competency assessment.

The final competency scores obtained based on FAHP represent a quantitative and interpretable characteristic of competencies. Methodologically, these results are used to solve three key tasks:

- identifying the strengths and weaknesses of individual project management managers' competencies;
- supporting evidence-based planning of professional development and training;
- informing decisions in the field of designing educational programs and educational policy.

Thus, the combination of content analysis, hierarchical modeling, and fuzzy multi-criteria analysis forms a sustainable model for assessing competencies in higher education.

Results and discussion

As noted earlier, the content analysis was based on the study of educational programs in the specialty "Project Management" in 13 higher educational institutions of Kazakhstan. Table 1 presents the structure and orientation of competency training within master's and doctoral studies, which allows for identifying the priorities of educational programs, the degree of their applied or research orientation, as well as the specifics of training specialists for the digital economy and the innovative sphere of project management [12].

Table 1 – Comparative analysis of educational programs in the specialty "Project Management" in higher educational institutions of Kazakhstan

University	Project Management Courses in Master's Programs (Duration and Credits)	Project Management Courses in Doctoral Programs (Duration and Credits)	Competency-Based Learning and Assessment
Astana IT University (AITU)	7M04102 Project Management (2 years, 120 credits)	8D04101 Project Management (3 years, 180 credits)	Yes (Explicitly) Doctoral program descriptions emphasize required competencies and their compliance with international project management (PM) standards. The logic of the competency approach is clearly integrated into the program structure.
Satbayev University	Master's programs related to Project Management (1 year, 60 credits / 1.5 years, 90 credits)	8D04101 Project Management (3 years, 180 credits)	Partially A strong emphasis is placed on research methodology; however, competency assessment is not presented as an independent, clearly formulated model.
L.N. Gumilyov Eurasian National University (ENU)	Master's programs related to Project Management (1.5 years, 90 credits)	8D04119 Project Management (3 years, 180 credits)	Partially Program goals are oriented towards training highly qualified specialists, but explicit frameworks and competency assessment tools are not designated.
Kazakh-British Technical University (KBTU)	7M04106 Project Management (Practice-oriented track) (2 years, 120 credits)	8D04106 Project Management (3 years, 180 credits)	Yes (Master's level) Curricula include organizational behavior, management psychology, communication, and teamwork, indicating a distinct orientation towards competency development.
Almaty Management University (AlmaU)	7M04102 / 7M04112 Project Management (1 year, 60 credits / 2 years, 120 credits)	Available DBA/PhD tracks (3 years, 180 credits)	Yes (Master's level) Learning outcomes focus on professional skills, adaptability, and decision-making competencies.
Al-Farabi Kazakh National University (KazNU)	7M04115 Project Management (2 years, 120 credits)	Doctoral tracks related to Project Management (3 years, 180 credits)	Partially Competencies such as team building are mentioned, but systematic methods for their assessment are described insufficiently clearly.
Yessenov University	7M04110 Project Management (1 year, 60 credits)	Doctoral tracks in Project Management (3 years, 180 credits)	Partially Program descriptions emphasize knowledge, skills, and practical abilities, but formalized competency assessment models are not presented.
International IT University (IITU)	7M04110 Project Management (1 year, 60 credits / 2 years, 120 credits)	Doctoral tracks in Project Management (3 years, 180 credits)	Yes (Explicitly) Program descriptions directly mention leadership, the PMI Talent Triangle model, and professional competencies.
Note: Compiled by the authors from the source epvo.kz [12].			

In order to identify similarities and differences in the content and direction of specialist training in the field of project management, a comparative analysis of the educational programs of Astana IT University and Satbayev University was conducted. The analysis is oriented towards comparing the hard skills (professional competencies) and soft skills (transversal competencies) formed in graduates, taking into account the levels of higher and postgraduate education.

Following this issue, project management programs across universities in Kazakhstan demonstrate significant differences in the implementation of competency-based learning and assessment. In

particular, Astana IT University (AITU) and International IT University (IITU) show the most explicit and systematic integration of competency frameworks aligned with international PM standards, particularly at the doctoral level. In contrast, most other universities emphasize knowledge and research training, while competency assessment remains fragmented or insufficiently formalized.

To sum up, the need for a unified, methodologically grounded competency assessment model to ensure consistency and comparability of learning outcomes among posgraduate programs in project management.

Table 2 – Matrix of competencies of graduates of educational programs in project management (Astana IT University and Satbayev University)

Competency Group	Astana IT University (AITU) (Master / PhD)	Satbayev University (Master / PhD)
HARD SKILLS		
Project Management	Agile and hybrid methodologies (Agile, Scrum), IT and product project management, MVP	Classic project, program, and portfolio management (PMBOK, ISO, IPMA)
Digital Technologies	Data analytics, Big Data, BI tools (Power BI, Tableau), SQL, Python	Project management information systems, digitalization of management processes
Analytics and Research	Predictive, operational, and strategic analytics, R&D approach	Quantitative and qualitative research methods, business research
Financial-Economic Skills	Financial evaluation of IT and innovation projects	Financial analysis, investment evaluation of projects, KPI
Sustainable Development and ESG	Sustainable development in digital transformation conditions	ESG approaches, sustainable strategies, and innovation management
Working with Standards	PMBOK, Agile frameworks, hybrid models	PMBOK, ISO 21500, IPMA, PRiSM, P5 Standard
SOFT SKILLS		
Communications	Intercultural and digital communications, working in distributed teams	Stakeholder management, negotiations, business communications
Leadership	Leadership in agile teams, product-thinking	Strategic and organizational leadership
Critical Thinking	Problem-solving, research and innovative thinking	Systemic and strategic thinking
Change Management	Adaptation to digital and technological changes	Management of organizational and structural changes
Scientific-Academic Skills	Academic writing, applied research	Methodology of science, scientific-methodological and pedagogical activity
Emotional Intelligence	Empathy, teamwork, conflict management in IT environments	Management psychology, stress resistance, personnel motivation
Note: Compiled by the authors from the source epvo.kz [12].		

Based on the comparative analysis presented in table 2, the following results can be highlighted:
⬥ Broad representation of project management programs. Most leading universities in Kazakhstan implement educational programs in project management at the master's and/or doctoral levels.
⬥ Competency development is predominantly implicit. Although many programs mention skills, leadership, teamwork, and decision-making, formal competency assessment models are rarely presented as independent academic components.
⬥ Pronounced orientation towards IPMA competency logic. Universities such as AITU, KBTU, and IITU demonstrate a closer link to competency models oriented toward human capital.

Based on analysis differentiation in competency at Astana IT University (AITU) emphasizes digital, agile, and data-driven competencies aligned with IT and product-oriented project environments, while Satbayev University applies mostly classical project management frameworks, financial analysis, and organizational leadership. This contrast highlights complementary educational models: AITU

is oriented toward digital transformation and innovation, whereas Satbayev University reinforces systemic, methodological, and managerial competencies, together reflecting diverse pathways for developing project management expertise at the postgraduate programs.

Nevertheless, most universities lack an independent discipline aimed at developing the "Soft skills" of project teams and assessing their competencies. This confirms the existence of a gap between educational training in project management and the competency requirements presented in real project activity.

At the master's level, competency development is generally integrated into separate disciplines (organizational behavior, communications, leadership). At the doctoral level, the main emphasis is on scientific research and methodology, while the modeling and assessment of competencies are rarely formalized as independent objects of research.

This forms a weighty justification for the introduction of a discipline oriented towards assessing the competencies of project managers and their teams within master's and doctoral programs in project management. This recommendation is substantiated by the fact that currently, universities in Kazakhstan operate under a competency assessment model involving surveys of students after graduation, but not throughout the entire study period. The criteria for the demand for specialists in the labor market is the employment percentage, and the criteria for the effectiveness of educational programs is the full completion of credits under the educational program. While these tools formally comply with national regulatory requirements and accreditation criteria, they insufficiently reflect the real formation of future project management specialists' competencies.

To assess the competencies of project managers and their teams, we propose using the FAHP model, which allows for structuring competencies in the form of a hierarchical model reflecting national educational priorities. At the top level of this hierarchy is the general goal – effective competency-based learning aligned with project-oriented forms of education. At the lower level, according to the analysis results, five dominant groups of competencies are distinguished in accordance with modern requirements for the professional skills of project managers:

- professional subject knowledge (traditionally a strong side of Kazakhstan's higher education);
- innovation and entrepreneurial competence;
- communication skills and interaction;
- digital competence;
- ability to support team and project-oriented activity.

The analysis of educational programs in the specialty "Project Management" showed that domestic universities prioritize the first two groups of competencies, while the latter three receive significantly less, often implicit, significance. The FAHP method allows making these priorities explicit and quantitatively comparable, revealing structural imbalances in competency development. The weighting mechanism provides transparent justification for revising assessment criteria in favor of insufficiently developed competencies.

FAHP results show that these competencies possess high significance yet an insufficient level of development. This imbalance explains why graduates often possess solid theoretical knowledge but demonstrate limited readiness to participate in real projects – a problem regularly raised by employers and reflected in national educational discussions.

From an analytical perspective, the results obtained using FAHP provide direct justification for the need to reform curricula. Universities can use weighted competency profiles to argue for the introduction of independent courses dedicated to project teamwork, digital tools, and applied communication skills.

At a systemic level, the application of this model reveals a discrepancy between national strategic priorities (digitalization, internationalization, graduate employability) and current assessment practices in higher educational institutions. FAHP provides a tool for translating the strategic goals of state policy into operationalized assessment criteria [12].

The most important conclusion is that the problems of Kazakhstan's higher education are conditioned not by a lack of standards or expert potential, but by a deficit of integrated, weighted, and evidence-based competency assessment mechanisms. The proposed methodology fills this gap and offers a scalable tool for increasing the quality of project readiness and graduate competitiveness.

Table 3 presents the key competencies of project teams, which, in our opinion, are most relevant in the context of digital transformation.

Table 3 – Hierarchical structure of project manager competencies in the higher education system of Kazakhstan

Level	Code	Competency Name	Description in the Context of Kazakhstan
Goal	G	Integral Pedagogical Competence	Readiness of faculty and project managers to implement competency-based and project-oriented learning in accordance with the SCES RK (State Standards).
Level 1 (Basic)	C1	Professional Knowledge	Possession of modern knowledge in the field of project management corresponding to national educational standards and typical curricula.
Level 2 (Basic)	C2	Innovation and Entrepreneurship	Ability to generate and evaluate innovative ideas, develop business models and startup projects.
Level 3 (In-depth)	C3	Communications and Interaction	Ability to build an effective feedback system, ensure productive interaction in offline and digital project environments.
Level 4 (In-depth)	C4	Digital and Multimedia Competence	Ability to effectively use digital learning platforms, project management systems, digital tools for organizing online work and analytics for planning and implementing projects.
Level 5 (Advanced)	C5	Facilitation	Ability to manage a project team, facilitate team members in making joint decisions, motivate, and achieve goals through facilitation and mentorship methods.
Note: Compiled by the authors from the source epvo.kz [12].			

As seen in table 4, the results of competency assessment based on the FAHP model showed that communication and interaction skills receive the highest weight, testifying to their key role in ensuring effective learning. However, institutional assessment systems in Kazakhstan traditionally prioritize professional subject knowledge, indicating a structural mismatch between the significance of competencies and the practices of their assessment.

The advanced competency hierarchy reflects a structured progression from basic professional knowledge to advanced facilitation skills, aligning with Kazakhstan's transition to competency-based and project-oriented education under national standards. Moreover, this hierarchy emphasizes the increasing importance of communication and digital competencies at in-depth levels, while positioning facilitation as a key advanced capability for effective project team leadership.

To sum up, the framework provides a coherent basis for assessing integral pedagogical competence in the context of Kazakhstan's educational and project management systems.

Table 4 – FAHP Pairwise Comparison Results (Defuzzified Weights)

Competency Dimension	Fuzzy Weight (L, M, U)	Defuzzified Weight	Rank
Professional Knowledge (C1)	(0.18, 0.22, 0.26)	0.22	3
Innovation and Entrepreneurship (C2)	(0.20, 0.25, 0.30)	0.25	2
Communications and Interaction (C3)	(0.23, 0.28, 0.33)	0.28	1
Digital and Multimedia Competence (C4)	(0.14, 0.17, 0.21)	0.17	4
Facilitation (C5)	(0.06, 0.08, 0.12)	0.08	5
Note: Compiled by the authors from the source epvo.kz [12].			

According to table 4, the FAHP results indicate that communications and interaction (C3) hold the highest priority, followed by innovation and entrepreneurship (C2) and professional knowledge (C1). In contrast, digital and multimedia competence (C4) and facilitation (C5) receive the lowest weights, reflecting their secondary emphasis within the evaluated framework.

To conclude this analysis, this ranking highlights the dominant role of interpersonal and innovative competencies in project-oriented contexts while revealing areas that require strategic reinforcement in competency development.

Furthermore, testing of the FAHP model demonstrated the formation of criteria weights, observed scores, and weighted indicators without using real expert assessments, i.e., illustrative data (table 5).

Table 5 – Performance indicators of Kazakhstan universities (illustrative data)

Competency Dimension	FAHP Weight	Observed Performance Score	Weighted Indicator
Professional Knowledge (C1)	0.22	0.78	0.172
Innovation and Entrepreneurship (C2)	0.25	0.70	0.175
Communications and Interaction (C3)	0.28	0.58	0.162
Digital and Multimedia Competence (C4)	0.17	0.45	0.077
Project and Teamwork Facilitation (C5)	0.08	0.40	0.032
Total Competency Level: 1.00 - 0.618	1.00	—	0.618
Note: Compiled by the authors from the source epvo.kz [12].			

As a result, the FAHP-weighted results indicate an overall competency level of 0.618, reflecting a moderate level of alignment between importance and performance. The strongest contributions come from professional knowledge and innovation and entrepreneurship, while the weakest weighted indicators are observed in digital and multimedia competence and project and teamwork facilitation. This imbalance confirms that educational outcomes remain theory-oriented and highlights the need to strengthen digital and collaborative competencies to improve the overall competency profile.

Despite the fact that communication and digital competencies have a high specific weight, indicators of their formation remain relatively low. This explains the limited readiness of graduates to work in conditions of project-oriented activity.

Based on the obtained results, a competency gap analysis was conducted using a "low-medium-high and very high" assessment scale, which is clearly presented in table 6.

As can be seen, the largest gaps are identified in the field of digital competencies and facilitation of project activity, confirming the need to reform curricula and develop the professional competencies of lecturers in Kazakhstan's universities.

The comparative analysis shows that the largest competency gaps are observed in digital and multimedia competence and communication skills, where high or very high importance contrasts sharply with low performance levels. Project and teamwork facilitation also demonstrates a substantial deficit, indicating insufficient practice-oriented training. In contrast, professional knowledge shows minimal gaps, suggesting that current programs prioritize theoretical preparation over transversal and digital competencies, reinforcing the need for competency-aligned curriculum redesign.

Table 6 – Competency Gap Analysis

Competency Name	Importance (FAHP Weight)	Performance Level	Gap Level
Professional Knowledge	Medium	High	Low
Innovation and Entrepreneurship	High	Medium	Medium
Communications and Interaction	Very High	Medium-Low	High
Digital and Multimedia Competence	High	Low	Very High
Project and Teamwork Facilitation	Medium	Low	High
Note: Compiled by the authors from the source epvo.kz [12].			

As mentioned above, the FAHP results reveal a significant gap between the priority of key competencies and their actual development in educational programs. Communication, digital, and facilitation skills are undervalued in curricula despite their high importance, while existing assessment systems fail to reflect real competency levels. This confirms the need for curriculum revision and the adoption of FAHP-based competency assessment to better align educational outcomes with labor market demands.

To conclude, the FAHP method allowed for identifying hidden priority shifts in the competency system. Communication and digital skills turn out to be more significant than is recognized in existing assessment systems. Table 7 summarizes the main results, challenges, and recommendations for their solution based on competency gap analysis.

Table 7 – Recommendations for improving educational programs for training specialists in "Project Management" in Kazakhstan universities

FAHP Result	Challenges	Proposals
High weight of communication skills	Disciplines developing communication skills are insufficiently represented	Revise curricula taking into account the development of students' communication skills
Low level of digital competence	Limited use of multimedia means and digital tools in teaching	Introduce mandatory disciplines on digital literacy
Low level of facilitation	Limited team management skills	Implement separate practice-oriented courses on developing project competencies and facilitation skills
Mismatch between weights and actual indicators	Ineffective system for assessing competency levels and the quality of educational programs	Transition to an assessment system based on the FAHP method, taking into account competency weights and student performance
Note: Compiled by the authors from the source epvo.kz [12].		

To sum up, the FAHP-based system proposed in this study combines algorithmic weighting with expert interpretation. The competency model based on the FAHP method can contribute to reforming curricula, particularly the development of project-oriented and practice-oriented modules. By identifying gaps in digital, communicative, and project-oriented competencies, universities can implement targeted training programs and separate courses aimed at increasing graduates' readiness for professional and interdisciplinary teamwork.

Conclusion

Content analysis of master's and doctoral programs in the specialty "Project Management" in Kazakhstan universities showed the presence of a professional cycle including disciplines on project management, risk, quality, and portfolio management, as well as the study of international project management standards (PMBOK, ISO 21500, IPMA). This core forms the instrumental basis for the practical training of specialists and is oriented towards ensuring compliance with international standards.

At the same time, systemic differences were revealed in the target orientation of training, conditioned by the duration of study.

First, educational programs with a 1-year duration are oriented predominantly towards forming professional competencies and training practitioners ready to perform project functions in a corporate environment.

Second, educational programs with a duration of 1.5 years implement a combined model, combining practice-oriented training with the development of analytical and research skills. Educational programs with a 2-year duration aim at forming pedagogical, methodological, and research competencies, ensuring personnel training for scientific-educational and expert activity.

Third, analysis of the curricula structure shows that differences between programs are concentrated not in the basic component, but in the volume of elective disciplines in the professional component.

Typically, the professional component consists of elective disciplines, including courses on digitalization, big data analysis, and the foundations of artificial intelligence in project management.

Fourth, the higher education system of Kazakhstan lacks a unified model for training project management specialists. Instead, three functionally distinct training trajectories are implemented: professional, hybrid, and scientific-pedagogical. This indicates the fragmented nature of requirements for future specialists' competencies and learning outcomes. In our view, this is due to the absence of unified competency frameworks and unified criteria for assessing the quality of educational programs.

To sum up, the current system for training project management specialists in Kazakhstan universities is oriented towards forming professionals capable of working in a digital, interdisciplinary, and project-oriented environment; however, differences in program goals and structures necessitate the development of a systemic, multi-criteria methodology for assessing their quality, which is the subject of subsequent methodological analysis.

The results obtained based on FAHP allow for targeted identification of competency deficits at both individual and institutional levels, facilitating the transition from universal requirements to personalized development trajectories. In the conditions of Kazakhstan, where the professional development of faculty is closely tied to accreditation and career growth, the proposed system forms a data-driven basis for developing training modules on digital pedagogy, project activity facilitation, and the development of communication skills – competencies emphasized by both national educational policy and employer expectations [1, 2].

Overall, the FAHP-oriented competency assessment system demonstrates both high potential and a significant degree of responsibility regarding the conditions of Kazakhstan's higher education. Ethical implementation requires proactive bias reduction, strict data management, preservation of the role of human judgment, and alignment with national quality assurance mechanisms. With responsible implementation, the proposed methodology represents a scalable, transparent, and context-sensitive tool for improving teaching quality, supporting professional development, and promoting competency-based education in Kazakhstan.

Despite these advantages, the study has a number of limitations. The proposed structure is largely based on theoretical modeling and limited empirical verification. Large-scale implementation across multiple Kazakhstani universities has not yet been conducted, and contextual factors such as differences in institutional culture, resource availability, and student profiles may influence assessment results. Therefore, future research should focus on pilot implementations in various universities of Kazakhstan to validate the model and refine its parameters.

Furthermore, future research should explore in more detail the ethical and practical aspects of competency assessment using AI in the Kazakhstani context. These include mitigating bias, ensuring fairness between institutions and regions, protecting personal data in accordance with national regulations, and avoiding excessive reliance on automated assessment. Continuous integration with existing academic management and quality assurance practices will be essential for sustainable implementation.

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ЖОБА ТОБЫНЫҢ ҚҰЗЫРЕТТІЛІКТЕРІН САНДЫҚ ТРАНСФОРМАЦИЯЛАУ: ЖОБА МЕНЕДЖЕРІН ОҚЫТУДЫҢ ТИІМДІЛІГІН БАҒАЛАУ ҮЛГІСІ

Аңдатпа
Цифрлық трансформация жағдайында өзекті мәселелердің бірі жобалық топтардың тиімді жұмысы үшін қажетті жоба менеджерлерінің құзыреттіліктерін бағалаудың заманауи тәсілдерін зерттеу болып та-

былады. Осыған байланысты ғылыми мақаланың мақсаты – Қазақстан Республикасындағы жоғары оқу орындарының білім беру бағдарламаларының мазмұндық талдау әдістеріне және олардың салмақтық коэффициенттерін негіздеу үшін айқын емес аналитикалық иерархиялық процесс (FAHP) әдісіне негізделген жоба менеджерлерінің негізгі құзыреттіліктерін анықтау. Мазмұнды талдау нәтижелері жоба менеджерлерін даярлауға арналған қазіргі білім беру бағдарламаларында жобаны іске асыру кезінде командалық жұмыс үшін маңызды кәсіби, сандық, коммуникативтік және жеке құзыреттіліктер жетіспейтінін көрсетті. Бұл құзыреттіліктердің болмауы жобалық қызметтің тиімділігінің төмендеуіне әкеледі және түлектердің жобаларды практикалық іске асыруға дайындығын шектейді, себебі білім беру бағдарламалары көбінесе теориялық дайындыққа бағытталған, практикалық бағытталу деңгейі жеткіліксіз. Ұсынылған FAHP моделі жоба менеджерінің құзыреттілігін дағдыларды дамыту, командалық жұмыс қабілеті, коммуникативтік және көшбасшылық қасиеттерді қалыптастыру, сондай-ақ білім беру процесіне цифрлық инновацияларды енгізу мүмкіндігі сияқты көрсеткіштер бойынша бағалайды. Бұл модель университеттерге жоғары білікті жобалық басқару мамандарын даярлау саласындағы практикалық сұраныстарды ескере отырып, білім беру бағдарламаларын түзетуге мүмкіндік береді. Сонымен қатар, отандық университеттер құзыреттілікке негізделген оқыту моделіне көшуі және академиялық тәжірибені халықаралық сапаны қамтамасыз ету стандарттарына сәйкестендіруі керек. Нәтижесінде, түлектерді жұмысқа орналастыруда және олардың кәсіби жобалық ортаға бейімделуінде маңызды рөл атқаратын жобаларды басқару менеджерінің құзыреттіліктерінің тиімді құрылымы қалыптасады.

Тірек сөздер: жобаны басқару, жоба менеджері, жоба тобы, кәсіби құзыреттіліктер, сандық құзыреттіліктер, білім беру бағдарламалары, жоғары оқу орындары.

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ЦИФРОВАЯ ТРАНСФОРМАЦИЯ КОМПЕТЕНЦИЙ ПРОЕКТНОЙ КОМАНДЫ: МОДЕЛЬ ОЦЕНКИ ЭФФЕКТИВНОСТИ ОБУЧЕНИЯ МЕНЕДЖЕРОВ ПРОЕКТОВ

Аннотация
В условиях цифровой трансформации одной из актуальных проблем является исследование современных подходов к оценке компетенций проектных менеджеров, необходимых для эффективной работы проектных команд. В этой связи целью научной статьи является выявление ключевых компетенций проектных менеджеров на основе методов контент-анализа образовательных программ высших учебных заведений Республики Казахстан и метода нечеткого аналитического иерархического процесса (Fuzzy Analytic Hierarchy Process – FAHP) для обоснования их весовых коэффициентов. Результаты контент-анализа показали, что в действующих образовательных программах по подготовке проектных менеджеров существует недостаток профессиональных, цифровых, коммуникативных и личностных компетенций, критически важных для командной работы при реализации проектов. Отсутствие данных компетенций приводит к

снижению эффективности проектной деятельности и ограничивает готовность выпускников к практической реализации проектов, поскольку образовательные программы зачастую ориентированы преимущественно на теоретическую подготовку при недостаточном уровне практической направленности. Предложенная FAHP-модель оценивает компетентность менеджера проекта в соответствии с такими показателями, как развитие навыков, способность к командной работе, формирование коммуникативных и лидерских качеств, а также умение интегрировать цифровые инновации в образовательный процесс. Данная модель позволит вузам корректировать образовательные программы с учетом запросов практики в области подготовки высококвалифицированных специалистов по проектному менеджменту. Кроме того, отечественным вузам следует перейти к компетентностной модели обучения, а также привести академическую практику в соответствие с международными стандартами обеспечения качества. В результате сформируется эффективная структура компетенций менеджера проектного управления, играющая ключевую роль при трудоустройстве выпускников и их адаптации в профессиональной проектной среде.