REVIEW

of the official reviewer for dissertation work

Seitkhan Galiya Gazizkyzy on the theme "Features and Mechanisms of Managing The Formation of Digital Hubs in Kazakhstan", submitted for the degree of Doctor of Philosophy (PhD) in the educational program 8D04105 Innovation Management

№	Criteria	Eligibility (one of the options must be checked)	Justification of the position of the official reviewer
1.	The topic of the thesis (as of the date of its approval) corresponds to the directions of development of science and/or state programs	1.1 Compliance with priority areas of science development or government programs: 1) The thesis was completed within the framework of a project or target program financed from the state budget (indicate the name and number of the project or program) 2) The thesis was completed within the framework of another state program (indicate the name of the program) 3) The dissertation corresponds to the priority direction of the development of science, approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan (indicate the direction)	The dissertation corresponds to the specialized scientific field of research for 2025–2027 titled "Research in the field of social and humanitarian sciences." The dissertation is aligned with the "Concept of digital transformation, development of information and communication technologies industry and cyber security for 2023 - 2029 years," the "State Program "Digital Kazakhstan", and the "National Project "Technological Breakthrough through Digitalization, Science, and Innovation for 2021-2025". The dissertation also corresponds to the priority area of scientific development in Kazakhstan for 2025–2027 titled "Intellectual Potential of the Country," as approved by the Supreme Scientific and Technical Commission under the Government of the Republic of Kazakhstan. The dissertation research was carried out within the framework of the project: "Strategy for the development of regional potential of Kazakhstan: assessment of socio-cultural and economic potentials, development of roadmap, models and development scenarios" (grant of the Ministry of Education and Science of the Republic of Kazakhstan, BR18574240, 2022-2024).
2.	Importance for science	The work makes/does not make a significant contribution to science, and its importance is well disclosed/not disclosed	The dissertation makes a substantial contribution to the advancement of research on management of the establishment of digital hubs, its features and mechanisms in the Republic of Kazakhstan.

			The relevance of this study lies in examining how Kazakhstan's ongoing digital transformation through Hubs—driven by national programs like Digital Kazakhstan and the 2023–2029 Digital Transformation Concept—can enhance economic competitiveness, improve public services, and foster an innovation-driven digital economy. The author assesses the digital potential of Kazakhstan's regions, analyzes the current state of digital hub development, identifies management mechanisms (structural, technological, innovation, investment, institutional, and social), estimates graduates' career intentions in the field of digitalization , and proposes a management model for their establishment.The study also develops an online platform in the form of a website with a map of the hubs located across the RoK, including digital and IT hubs. The significance of this research is convincingly articulated, supported by both the breadth of the problem addressed and the depth of the proposed solutions.
3.	The principle of independence	Self-reliance level: 1) <u>High;</u> 2) Medium; 3) Low; 4) No independence	The level of independence demonstrated by the doctoral candidate is assessed as <u>high</u>. The dissertation demonstrates strong autonomy in formulating the research problem, critically analyzing the mechanisms for managing the formation of digital hubs, and developing an original concept of innovation management in the digital hubs of the Republic of Kazakhstan. The candidate independently selected and substantiated the research methodology, which includes system and structural approach with the use of the following quantitative and qualitative methods: generalisation, systematisation, comparison, historical and logical analysis, statistical analysis, correlation-regression analysis, test method of integral index, applying the D-Best model. A particular indication of the candidate's autonomy is the

			development of the author's own online platform in the form of a website with a map of the hubs located across the RoK, including digital and IT hubs. The dissertation is characterized by coherent logic, interdisciplinary integration, and a high degree of research responsibility on the part of the author.
4.	The principle of inner unity	4.1 Justification of the relevance of the thesis: 1) Justified; 2) Partially justified; 3) Not justified.	The relevance of the dissertation is well justified and grounded in an objective analysis of the current state of digital hubs located in the Republic of Kazakhstan. The author demonstrates a clear understanding of the institutional and managerial challenges associated with the mechanisms of management and fundamental directions for the establishment of digital hubs in the Republic of Kazakhstan. The rationale for the study is aligned with national priorities in digitalization policy, including the strengthening of the role of domestic information and communication services in the world market, support of domestic enterprises and companies engaged in production and export of information services to improve the competitiveness of the information industry and economic modernization of our country. The dissertation also highlights the the nesseccity of the adoption of comprehensive approaches to implement measurements for the management of digital hubs, implement state programs, and create national growth strategies to successfully accomplish the desired goals, which enhances the applied significance of the research. Overall, the relevance of the topic is logically embedded in the broader scientific framework of the dissertation and is supported by a solid analysis of both theoretical foundations and empirical conditions.
		4.2 The content of the thesis reflects the topic of the thesis: 1) Reflects;	The content of the dissertation reflects the stated research topic. The main sections of the work correspond to the overall aim and research objectives, and the structure maintains a clear

		2) Partially reflects; 3) Does not reflect	focus on mechanisms of managing the formation of digital hubs
		4.3. The purpose and objectives correspond to the topic of the thesis: 1) correspond; 2) partially correspond; 3) do not correspond	The aim and objectives of the dissertation are consistent with the stated research topic. They are clearly formulated and aligned with the key aspects of the mechanisms of managing the formation of digital hubs.
		4.4 All sections and provisions of the thesis are logically interconnected: 1) completely interconnected; 2) the interconnection is partial; 3) there is no interconnection	The structure of Galiya Gazizkyzy Seitkhan's dissertation is logically coherent and methodologically well-aligned. Chapter 1 presents the theoretical foundations of the study, supported by the analysis of the evolution and economic essence of digital hubs, digital hub establishment management, foreign experience in managing the establishment of digital hubs, and methodological basics of establishment the digital hubs and the author's digital maturity assessment model. Section 2.1 provides a comparative analysis of digital potential in the regions and industries of the Republic of Kazakhstan. Sections 2.2 and 2.3 present two empirical studies: – the assessment of digital hubs in the regions of the Republic of Kazakhstan; –correlation-regression analysis revealing the problems of digital hub management in the Republic of Kazakhstan. The 3rd section of the dissertation introduces the recommendations and mechanisms for managing the establishment of digital hubs in Kazakhstan, and D-BEST model, scale and criteria for managing the establishment of digital hubs. Overall, the dissertation demonstrates a clear and consistent progression from theory to practice, ensuring the internal coherence and integrity of the research.
		4.5 The new solutions (principles, methods) proposed by the author are reasoned and evaluated in comparison with	The dissertation presents a thoughtful and well-structured critique of existing approaches to manage the formation of digital hubs, particularly a methodology is proposed to evaluate

		the known solutions: 1) critical analysis is present; 2) partial analysis; 3) the analysis does not represent one's own opinions, but quotes from other authors	the performance of digital hubs according to a scale and criteria calculated on five points. The author's proposed solutions are grounded in a solid theoretical foundation and are substantiated by robust empirical evidence collected through a multistage research process. 1. The candidate introduces the concept of a digital hub which defined as a center that drives activities fo- cused on the implementation of the "triple helix" model, which encompasses the col- laboration between government, academia, and business to foster innovations and startups through the application of digital technologies. 2. The employment of the integral index in the study enables a thorough evalu-ation of Kazakhstan's regions' digital potential. This evaluation encompasses the multidimensionality of key indicators, including the utilization of digital technologies, the digital literacy of the population, and the contribution of ICT to the economy. 3. The dissertation also recommends the mechanisms developed for the formation of digital hubs: the structural and technological mechanism, the mechanism of innovation, the investment mechanism, the institutional mechanism, and the social mechanism; Altogether, the study offers both conceptual and practical contributions, reflecting the candidate's ability to connect theory with real-world application in a meaningful and contextually relevant manner.
5.	Scientific novelty principle	5.1 Are the scientific results and provisions new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	The scientific results and findings presented in the dissertation are partially new. The author has developed novel theoretical and applied contributions, including a contextualized conceptualization of digital hubs, which encompasses the collaboration between government, academia, and business to foster innovations and startups through the application of digital technologies. The research demonstrates originality both in the interpretation

			and extension of the employment of the integral index for the evalu-ation of Kazakhstan's regions' digital potential. The method employed provides an objective ranking of regions, reveals disparities in digital development, and substantiates strategic measures to eliminate digital inequality. The dissertation reflects the author's independent research perspective, contains original theoretical insights, and offers well-substantiated practical recommendations that have not previously been presented in the national academic literature.
		5.2 Are the dissertation findings new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	The conclusions presented in the dissertation partially new. They reflect the author's interpretation of the scientifically substantiated mechanisms for the formation of digital hubs: the structural and technological mechanism, the mechanism of innovation, the investment mechanism, the institutional mechanism, and the social mechanism. The results of the applicant's empirical studies have led to the development of strategic measures to eliminate digital inequality, and online platform in the form of a website with a map of the hubs located across the RoK, including digital and IT hubs. The conclusions do not replicate existing academic positions, but rather represent an independent contribution to the advancement of scholarly thought in the fields of management of digital hubs.
		5.3 Technical, technological, economic or management decisions are new and reasonable: 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	The solutions proposed in the dissertation are partially new and well substantiated from managerial, economic, and technological perspectives. The author introduces an original concept of digital hub, with a focus on the implementation of the "triple helix" model. A further novel contribution is the application of a methodology proposed to evaluate the performance of digital hubs according to a scale and criteria calculated on five points. Also the thesis contains the employment of the integral index

			thorough evaluation of Kazakhstan's regions' digital potential. From a technological standpoint, a significant achievement is the development and application of the author's an online platform developed in the form of a website with a map of the hubs located across the RoK, including digital and IT hubs. Thus, the dissertation combines conceptual, practical, and data-driven innovation within the broader context of menachisms for the management of the digital hubs.
6.	The validity of the main findings	All main conclusions are based/are not based on scientifically significant evidence or well-grounded (for qualitative research and areas of training in the arts and humanities)	All major conclusions of the dissertation are grounded in scientifically robust evidence and are well justified. The author draws on both a critical review of contemporary digital hubs management theory and the Triple Helix model, as well as the results of original empirical research—including the employment of the integral index containing a multidimensionality of key indicators, including the utilization of digital technologies, the digital literacy of the population, and the contribution of ICT to the economy. The qualitative conclusions are reinforced by data obtained through correlation-regression analysis to assess the impact of ICT costs on digital hub members, test method of integral index to identify the uniformity of indicator values across regions. The reasoning throughout the dissertation is systematic and scientifically coherent, with all key statements logically derived from the research objectives and questions.
7.	The main provisions for the defense	It is necessary to answer the following questions for each provision separately: 7.1 Is the provition proven? 1) proven; 2) rather proven; 3) rather not proven; 4) not proven 7.2 Is it trivial? 1) yes;	Proposition 1 The concept of a digital hub is defined as a center that drives activities focused on the implementation of the "triple helix" model, which encompasses the collaboration between government, academia, and business to foster innovations and startups through the application of digital technologies. Participants and partners of the digital hub include universities, R&D organizations, research institutes, laboratories, technoparks, incubators, accelerators, public administration

		2) no 7.3 Is it new? 1) yes; 2) no 7.4 Application level: 1) narrow; 2) medium; 3) wide 7.5 Is it proven in the article? 1) yes; 2) no	entities, and other stakeholders. 7.1 Has the proposition been proven? — Partially proven 7.2 Is it trivial? — No 7.3 Is it new? — Yes 7.4 Scope of application: — Broad 7.5 Is it supported in a publication? — Yes Proposition 2 To determine the level of development of digital hub management, a methodology is proposed to evaluate the performance of digital hubs according to a scale and criteria calculated on five points. According to this methodology, the level of development of hubs is average 7.1 Has the proposition been proven? — Proven 7.2 Is it trivial? — No 7.3 Is it new? — Yes 7.4 Scope of application: — Broad 7.5 Is it supported in a publication? — Yes Proposition 3 The employment of the integral index in the study enables a thorough evaluation of Kazakhstan's regions' digital potential. This evaluation encompasses the multidimensionality of key indicators, including the utilization of digital technologies, the digital literacy of the population, and the contribution of ICT to the economy. The method employed provides an objective ranking of regions, reveals disparities in digital development, and substantiates strategic measures to eliminate digital inequality. 7.1 Has the proposition been proven? — Proven 7.2 Is it trivial? — No 7.3 Is it new? — Yes 7.4 Scope of application: — Broad 7.5 Is it supported in a publication? — Yes Proposition 4

			The following mechanisms have been scientifically substantiated and developed for the development of digital hubs: the structural and technological mechanism, the mechanism of innovation, the investment mechanism, the institutional mechanism, and the social mechanism. 7.1 Has the proposition been proven? — Partially proven 7.2 Is it trivial? — No 7.3 Is it new? — Yes 7.4 Scope of application: — Broad 7.5 Is it supported in a publication? — Yes Proposition 5 An online platform is proposed in the form of a website with a map of the hubs located across the RoK, including digital and IT hubs. 7.1 Has the proposition been proven? — Proven 7.2 Is it trivial? — No 7.3 Is it new? — Yes 7.4 Scope of application: — Moderate 7.5 Is it supported in a publication? — Yes
8.	The principle of reliability Reliability of sources and information provided	8.1 Choice of methodology - is justified or the methodology is described in sufficient detail 1) yes; 2) no	The choice of methodology in the dissertation is well justified and thoroughly described. The author skillfully combines quantitative and qualitative methods, including correlation-regression analysis, the D-Best model, and method of integral index to identify the uniformity of indicator values across regions. The methodological approach is well aligned with the stated research objectives and ensures the reliability of the findings.
		8.2 The results of the thesis were obtained using modern methods of scientific research and methods of processing and interpreting data using computer technologies: 1) yes;	The dissertation is conducted using modern methods of quantitative and digital analysis. The study employs SMART PLS-4 program to process statistical data for correlation and regression analysis, in particular to calculate the correlation matrix and descriptive statistics. Microsoft Excel program was used to calculate the

		2) no	integral and average in-tegral index of regions, using the Z-score normalization of data values. The selected methods and technologies are consistent with international research standards and enhance the validity of the results obtained.
		8.3 Theoretical conclusions, models, identified relationships and patterns have been proven and confirmed by experimental research (for areas of training in pedagogical sciences, the results have been proven on the basis of a pedagogical experiment): 1) yes; 2) no	The main theoretical conclusions and research relationships formulated in the dissertation have undergone appropriate empirical validation. The author applied reliable quantitative methods, including correlation-regression analysis, the D-Best model, and method of integral index to identify the uniformity of indicator values across regions. The methodological toolkit is further complemented by an analysis of the case study of the stage hubs, questionnaire survey of bachelor's degree graduates. Overall, the dissertation is grounded in a solid body of evidence and demonstrates a clear logical connection between theoretical assumptions and empirical findings.
		8.4 Important statements are confirmed / partially confirmed / not confirmed by references to current and reliable scientific literature	The main theoretical and analytical positions of the dissertation are supported by references to a broad range of scholarly sources, including recent publications in international peer-reviewed journals. The author demonstrates strong subject-matter awareness, drawing on both classical theoretical works and up-to-date empirical studies relevant to innovation management and digital hub management. The bibliography includes sources in English, Russian, and Kazakh, reflecting the international and interdisciplinary nature of the research.
		8.5 Used literature sources are sufficient/not sufficient for a literature review	The dissertation presents an extensive literature review that includes a sufficient number of relevant and up-to-date sources, reflecting both international and Kazakhstani contexts. The author covers key areas of research related to digital hub

			management, mechanisms for the establishment of digital hubs, the Triple Helix model, and digital potential of regions. The selected literature provides a well-grounded theoretical framework and helps identify research gaps that the dissertation aims to address.
9	Practical value principle	9.1 The thesis has theoretical value: 1) yes; 2) no	The dissertation offers a theoretically grounded interpretation of the concept of the formation and management of digital hubs, based on the Triple Helix model. The author formulates an original conceptual framework and mechanisms that illustrate how to manage the formation of digital hubs in the Republic of Kazakhstan. The study integrates elements the multidimensionality of key indicators, objective ranking of regions, Participants and partners of the digital hubs.
		9.2 The thesis is of practical importance and there is a high probability of applying the results obtained in practice: 1) yes; 2) no	The dissertation has strong practical relevance. The author's recommendations for enhancing the innovation potential of universities, integrating the goal-gradient approach into educational platforms, and improving the digital infrastructure of career centers can be applied in university management practices. The Unichecker software tool developed as part of the research has practical potential for monitoring and evaluating the digital services of Kazakhstani universities, offering opportunities for its further implementation in both administrative and educational contexts.
		9.3 Are the practice suggestions new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	The practical recommendations formulated in the dissertation are based on the author's original analysis and represent a distinct contribution to digital hub management practices. These include the integration of the the structural and technological mechanism, the mechanism of innovation, the investment mechanism, the institutional mechanism, and the social mechanism. The employment of the integral index provides an objective ranking of regions, reveals disparities in

			digital development, and substantiates strategic measures to eliminate digital inequality. Such approaches have not previously been introduced in domestic research and may prove valuable in the development of digital hubs in the Republic of Kazakhstan.
10.	The quality of writing and design	Academic writing quality: 1) high; 2) average; 3) below average; 4) low.	The dissertation text is formatted in accordance with academic standards of scholarly writing. The presentation is logical, coherent, and precise in its formulations. The author demonstrates confident use of academic language, adheres to structural conventions, and correctly formats citations and the bibliography. The language of the dissertation is clear and well-balanced, and the terminology is used appropriately without stylistic or lexical overload.
11.	Notes on a thesis	- When discussing the Triple Helix model in the theoretical section of the dissertation, it may also be helpful to briefly acknowledge extended versions such as the *Quadruple Helix*, which would further contextualize the theoretical framework. - The survey results are not presented in sufficient detail. Statistical reliability of the survey results and analysis has not been sufficiently verified, which reduces the validity of the empirical findings. - The empirical base on digital hubs is relatively limited, relying on outdated data spanning the past three to four years (For example, Table 14). A more extensive and up-to-date dataset would enhance the robustness and relevance of the findings, allowing for stronger empirical validation and more accurate policy recommendations. These remarks are clarificatory in nature and do not detract from the scientific or practical value of the dissertation. Overall, they have no impact on the positive assessment of the study, which is marked by depth, conceptual clarity, and a high level of independent scholarly work.	
12.	Scientific level of the doctoral student's articles on the topic of research (in case of defense of the dissertation in the form of a series of articles, the official reviewers comment on the	The doctoral candidate has published a number of scholarly articles that reflect the key components of the dissertation research. These publications appear both in journals indexed in international databases (including Scopus and Web of Science) and in peer-reviewed national journals recommended by the Committee for Quality Assurance in the Field of Science and Higher Education. The articles address both theoretical aspects of the innovation management in digital hubs, as well as	

	scientific level of each article of the doctoral student on the topic of research)	empirical findings on the development of mechanisms and directions in the management of the establishment of digital hubs in Kazakhstan. The clarity of presentation, depth of analysis, and alignment of the publications with the objectives of the dissertation attest to a high scholarly standard and demonstrate the maturity of the author's academic perspective.
13.	Decision of the official reviewer (pursuant to paragraph 28 of the present Model Regulations)	The dissertation by Galiya Gazizkyzy Seitkhan, titled "Features and Mechanisms of Managing The Formation of Digital Hubs in Kazakhstan" meets the requirements set out in Chapter 2 of the "Rules for the Awarding of Degrees" for the degree of Doctor of Philosophy (PhD). The work is characterized by its strong theoretical foundation, relevance of the topic, sound methodology, and practical significance of the results obtained. Based on the review of the dissertation and the author's publications related to the research topic, I consider that the author fully merits the awarding of the degree of Doctor of Philosophy (PhD) in the educational program 8D04105 – Innovation Management. I recommend that Galiya Gazizkyzy Seitkhan be awarded the degree of Doctor of Philosophy (PhD).

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Подпись Кожахметовой А.К. заверяю

Департамент
по развитию персонала