Analysis of Key Elements for Constructing High-Quality University-Enterprise Technology Cooperation Projects: A Case Study of a Cloud Computing AIOps Industrialization

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Abstract. Under national policy impetus, enterprise-led integration with academia is trending in industry-academia-research collaboration. This paper, using a cloud computing project, examines key elements of university-enterprise partnerships. It highlights challenges like communication issues and benefit distribution, emphasizing the R&D manager's role. Empirical findings provide methods to enhance these collaborations, offering strategic guidance for building effective innovation networks.

Keywords: University-Enterprise Cooperation; Innovation Management; Cloud Computing; AIOps.

1 Introduction

In the realm of innovation management, the alignment of industry, academia, and research under corporate leadership, steered by domestic policies, has emerged as a pivotal trend. Enterprises, at the vanguard of this integration, leverage technology cooperation to harness new productive forces and accrue positive externalities, thereby minimizing innovation costs, mitigating the risks of solitary innovation efforts, and cementing their market leadership. Conversely, universities and research institutions recognize that deep engagement with enterprises is essential for tackling authentic industry challenges and securing funding that is instrumental for the development of robust research teams.

Despite these potential synergies, university-enterprise cooperation often faces challenges characterized by a disparity in enthusiasm, with scenarios of "one-sided interest" not uncommon. [1]A review of literature and field research indicates that these challenges stem from inadequate communication, opacity in information sharing, a proliferation of stakeholders, elongated collaboration chains, and suboptimal benefit-sharing mechanisms. These factors contribute to the underwhelming outcomes of domestic industry-academia-research collaborative projects, particularly in technology sectors,

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where the evaluation of results is challenging, and the establishment of a sustainable cycle of investment and output remains elusive.

Diverging from the predominant focus on policy reviews in domestic research, this paper presents an in-depth case study of technology cooperation within a leading science and technology enterprise.[2][3][4] It spotlights the enterprise R&D team's central role in joint university-enterprise R&D projects, providing a nuanced analysis of the project initiation, innovation network construction, and the critical elements sustaining high-quality collaboration. The paper's innovation stems from an internal perspective on large-scale technology enterprise projects, dissecting the dynamics of technology-driven, high-quality cooperative projects, and proposing constructive recommendations for improvement through practical case integration.

2 Constructing High-Quality Project-Centric University-Enterprise Technical Cooperation Framework

This study presents a refined model for university-enterprise technical cooperation, emphasizing the unique dynamics of project initiation, resource synergy, and complementary competencies. It spotlights the critical need for mutual reinforcement of resources, derived from the inherent traits of the partners, and bridges the collaboration gaps inherent in such specialized projects. Through practical case analyses, the paper extracts pivotal elements for establishing an effective, project-focused technical cooperation framework.

2.1 Analysis of the Characteristics of University-Enterprise Technical Cooperation

Table 1 illustrates the robust complementarity between enterprises and universities in technical cooperation, operating within a complementary capabilities and resource framework. The project structure typically features the enterprise as the initiator, goal-oriented around performance objectives, with the integrated resources and capabilities of both sectors acting as catalysts for innovation. The standard model involves the enterprise posing a research challenge, which university faculty then address, leveraging their expertise, under the joint mentorship of both entities.

Table 1. Analysis of the Characteristics of University-Enterprise Technical Cooperation

	Enterprise R&D Team	**University R&D Team**
Problem Origin	Market demand	Sponsored by national research funding
Expertise Experience	From industry	From academic area
Labor Cost	High	Low

Data	Extend data from industry, but usually constrain by the company regulation	Lack of data
Validation Platform	In house or provided by supplier	Simulation Platform
Timeline	Required continuous output	Unstable input & output

From Table 1, it can be seen that the collaborative innovation between the two parties can break through key difficulties, enabling technology-based enterprises to maintain sensitivity to cutting-edge technologies in key general technologies. This type of model requires high capabilities from the enterprise's R&D team, and the maintenance and continuous iteration after the landing of the joint research results are more independent. Under this model, enterprises will face many typical challenges.

2.2 Analysis of Challenges in University-Enterprise Technical Cooperation

The challenge of the Gap between two parities.

Corporate engineering projects exhibit a high degree of developmental certainty and adhere to stringent protocols. In contrast, academic research is inherently more uncertain, with resolution strategies and technological roadmaps often evolving as research progresses. There is a significant divergence in project governance between the two realms. University research is tailored for in-depth, focused breakthroughs, whereas corporate R&D aims to transition innovations from the lab to commercialization, necessitating substantial and sustained resource investment.

The challenge of continuity of research investment.

Corporate research projects, rooted in industrialization, demand a significant period for academic faculty and students to acclimate to the research challenges and undertake relevant studies and empirical work, despite their existing research experience. The duration of this acclimation is variable, contingent on actual conditions and the commitment of both parties.[5] Generally, a long-term, stable university-enterprise partnership is more conducive to the continuous production of high-quality outcomes.

In practice, the timing and coordination of efforts differ from typical projects. From the corporate perspective, R&D projects require ongoing investment and output, necessitating collaboration across multiple departments. Conversely, the academic research team's pace and capacity for time investment are subject to the fixed schedules of doctoral, master's, and undergraduate students. Influenced by teaching activities, thesis defenses, vacations, campus recruitment, and professional qualification examinations, the rhythm and available time for student investment fluctuate significantly. This inconsistency with the R&D, product, and business tempo of corporate projects can lead to substantial conflicts and uncertainties.

The Challenge of Recognizing Collaborative Outcomes.

Innovation within enterprises and universities is gauged by disparate criteria due to their distinct systemic affiliations[6]. Enterprises prioritize the measurable business impact and efficiency of R&D investments, demanding high precision with little margin for error[7]. The intricacy of innovation, particularly when integrating external networks, compounds this challenge, often delaying tangible outcomes.

Universities assess researchers through a broader lens, with Principal Investigators' (PIs') perspectives on industry collaboration varying by career stage. Early-career PIs, focused on tenure, may perceive industry projects as diverting and uncertain, with limited support for their academic goals. Conversely, tenured PIs, with a solid research foundation and less pressure, are more likely to engage in industry projects, seeking industrial validation for their work. This shift reflects evolving national policies and educational assessment systems.

The evaluation of collaborative projects between industry and academia is often standardized, relying on methods such as economic and practical value certification by enterprises, joint awards, and recognition of outstanding partnerships. However, technological complexity and differing sector mechanisms pose challenges in assessing the success of these collaborations.

2.3 Core Elements of Establishing University-Enterprise Technical Cooperation

Building a robust university-enterprise technical cooperation network demands the strategic leveraging of complementary strengths across all participants, ensuring the efficient deployment of their capabilities.

R&D Manager.

For newly established university-enterprise collaboration projects, there is often a lack of prior cooperative foundation, inherently increasing project complexity. These collaborations typically span one year or more, with enterprises committing funds and resources, and academic institutions contributing research capabilities. Close coordination is essential to solidify the project's execution. The R&D manager in such enterprises must juggle multiple roles, including project manager, technical lead, resource coordinator, and relationship manager across various stakeholders, emerging as a pivotal figure in the innovation network's construction and a critical factor in ensuring the project's success. As the enterprise is the funding body, the R&D manager is also tasked with assessing and evaluating the company's product and technology strategy, as well as its R&D capabilities, making them a key element in the technical cooperation project.

Research Project Planning.

Corporate R&D managers must undertake several key tasks: 1) Perform literature reviews to grasp the developmental prospects and trends within their field; 2) Investigate the research output, patents, and collaborative projects of potential partners to

assess their capabilities; 3) Evaluate the potential collaboration teams' competencies through direct interviews with research teams and consultations with academic experts; 4) Conduct bibliometric analyses to trace the research interests and evolution of academic teams, informing the planning of research collaboration models with universities.

Complex issues in enterprises are often decomposed into distinct research topics, with academic outcomes eventually integrated into the corporate system. For software algorithms, ongoing validation and iteration are essential. This process involves: 1) Defining the scope of R&D deliverables by considering the academic team's expertise, size, output quality, and the research domain; 2) Assessing potential risks based on the university's experience and resource allocation, and preparing for collaboration by mobilizing internal R&D resources and establishing testing and acceptance protocols.

To ensure practical application, the integration and acceptance of research outcomes require engineering support from the enterprise. It is crucial to anticipate the functionality and performance of technical solutions from the planning and theoretical stages to avoid last-minute adjustments to the technical roadmap that could arise from integration challenges.

Execution.

University-enterprise technical cooperation projects are inherently complex, characterized by a multi-governance structure. This complexity is evident in: (1) the multiplicity of decision-making bodies involved in agreements, which on the academic side are subject to various levels of institutional regulations, and on the corporate side encompass considerations of intellectual property, data, trade, and more; (2) the diversity of personnel involved, ranging from faculty and students of different standing on the university side, to product departments, R&D managers, and occasionally downstream suppliers responsible for acceptance, testing, and delivery on the corporate side. These factors engender intricate contractual relationships, demanding high standards of R&D managers and their supporting functional teams, as demonstrated through practical experience.

3 Case Study: A Cloud Computing AIOps Technology Cooperation Project

A cloud AIOps project, led by an R&D manager with robust academic and industry experience, navigates varied management and technical strategies across the cloud computing lifecycle due to diverse business scenarios. University-enterprise collaborations within this domain aim to resolve pivotal issues in AIOps, improving operational quality and generating impactful research and educational outcomes.

The complexity of cloud AIOps presents unique challenges, prompting the creation of innovation networks, often spearheaded by enterprises in conjunction with multiple university research teams. These collaborations have led to swift advancements, including numerous patents and scholarly articles, significantly elevating the capabilities of participants, and integrating findings into industry practices.

However, a comparative analysis of similar projects reveals stark performance disparities. While some have achieved notable technical milestones and enhanced team competencies, others, managed traditionally, have yielded fewer tangible results and limited R&D contributions, suggesting a need for more effective collaboration models. This paper selects typical projects as well as control group projects, and the comparative results are presented in Table 2.

Table 2. Case Study: Comparison of Project Execution and Results

	Project A **(The construction of an innovation network led by a R&D manager as an example)**	**Project B** **(A cooperative project delivered traditionally as an example)**
Project Brief	To ensure comparability, both types of projects are research topics in the field of cloud AIOps. The business types, research funding, and duration are consistent.	
Execution	Pre-project: The enterprise side proactively organizes several workshops to ensure that the collaborative team fully understands the business scenarios; the academic side takes the initiative to introduce the university's curriculum system, and provides the enterprise side with an introduction to statistical knowledge and other foundational knowledge related to the project. Project execution：Both parties work together to tackle challenges and jointly invest resources. Feedback is provided promptly on the content delivered by the academic side. While maintaining the ultimate goals of the existing cooperation, there is a relatively flexible attempt to explore different technical routes, maintaining a certain degree of flexibility.	Pre-project: The contract is signed and the project delivery is initiated immediately, with less emphasis on introducing the business to the academic partner and minimal proactive effort to understand the research foundations of the university side. Project execution：There is a focus on the traditional "client-contractor" model of delivery, with the enterprise side playing a more supervisory role in overseeing the project delivery.
Project Performance	During the 2-year project period, collaborative outcomes were continuously generated throughout the process: 5 high-level papers were produced; 5 patent applications were filed, along with 3 awards and outstanding case studies; 2 technologies were implemented and verified in real business environments.	During the 2-year project period, there was some technical implementation and application, but there were fewer other quantifiable outcomes.
Summary	As shown in Table 1, Project A effectively demonstrates the characteristics of university-enterprise technological cooperation, with a tighter collaboration, and from the results, the outcomes of the cooperation are quite abundant. In contrast, projects managed under the traditional client-contractor delivery model tend to produce fewer outputs and are less capable of leveraging the advantages of both university and enterprise in technological cooperation.	

4 Conclusion

This paper, from the corporate perspective, distills the unique characteristics, differences, and adjustments inherent in university-enterprise technical cooperation. It addresses the challenges, such as divergent technological approaches, varying investment timelines, and the complexities of recognizing collaborative outcomes, which contribute to the difficulty of establishing high-quality partnerships. Utilizing real-case scenarios from enterprises, the paper dissects the construction of collaborative projects, focusing on the selection of R&D managers, the curation of research topics, and the execution strategies. A specific cloud AIOps project is highlighted to elucidate the key elements of successful collaboration. The paper encapsulates a suite of practical methodologies that, upon empirical validation, have demonstrated significant variance in team performance. The methods proposed, analyzed in conjunction with the stakeholders' attributes, offer a reference for entities seeking to initiate innovative university-enterprise collaboration networks.

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