COOPERATION AND COORDINATION IN INTERDISCIPLINARY COLLABORATION BETWEEN UNIVERSITY AND INDUSTRY

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ABSTRACT

The interdisciplinary collaboration between university and firm is an important vehicle for innovation in the knowledge-intensive industries. The performance of collaborative innovation depends on partners' efforts to overcome the obstacles from moral hazards and cognitive distance between them. Based on extensive literature review, we explored inherent inhibitors and corresponding enablers to the inter-organizational and interdisciplinary collaboration and further proposed a conceptual framework to shed light on the management of open innovation between university and firm.

Keywords: Collaborative innovation, Cooperation, Coordination, Moral hazards, Cognitive distance

INTRODUCTION

Universities are full of various experts, multiple knowledge and inventions in the early stage that may lead to innovative products near future [1]. Collaborating with university for the research and development (R&D) of new product or process has become common for firms to pursue new business opportunity [2][3]. The university-industry collaboration (hereafter UIC) is also a way for firms to reduce R&D cost and risk by stretching limited resources such as human, equipment and facility [4]. On the other hand, universities seek joint-research partnership with firms to enable them to keep on the leading edge in academic areas by accessing external resources, obtaining research funds, gaining opportunities for field-testing or identifying new research topics [5].

The open innovation, especially interdisciplinary UIC, has been attracting considerable attention [6]. The intent behind interdisciplinary UIC involves a desire to discover new opportunities by pooling different but complementary knowledge and resources. Despite the significant potential benefits, firms and universities face serious challenges from such inter-organizational and cross-disciplinary partnership [4]. The institutional norms are fundamental to the way that public and private organizations perceive and perform their work. Misalignment of interest and low level of mutual understanding can lead to conflicts and tension [7]. It would be worse in interdisciplinary UIC, where the two parties with different knowledge background try to combine distant knowledge to aim at more ambitious R&D targets.

Previous studies have investigated various kinds of obstacles to UIC from the view of inter-organizational collaboration or public-private partnership. Few studies pay more attention to the ways of overcoming obstacles and leave best practices undefined [8]. We focused on cross-disciplinary collaboration between university and firm which is the foundation of open innovation in the knowledge-intensive industries. Our research questions are what are inherent inhibitors and corresponding enablers to interdisciplinary UIC. Based on extensive literature review, we proposed an integrated conceptual framework to shed light on the management of open innovation between university and firm.

THEORETICAL BACKGROUND

Inhibitors to Interdisciplinary UIC

Comparing to inter-firm collaboration, UIC is more complex because both of partners have different mission, interest and incentive system based on different institutional logic [9]. These disparities may cause conflicts, misunderstanding, and distrust [10]. University and firm essentially remain independent economic actors and retain control over their own resource-allocation decisions. Interdisciplinary UIC is an exploratory process through pooling distant knowledge and it is almost impossible to specify all efforts and predict final results in advance [11]. The nature of divergence and dynamic change of R&D progress would make the objectives and scope of joint-research which had ever agreed on between partners gradually changed, modified or extended [8]. Any party who grasps the critical knowledge and resources may have chance to make research outcomes favorable for his own interests and thus the original expected outcomes and commitments may be postponed, deviated or distorted [12].

After Bayh-Dole Act in U.S. and similar law in other countries, universities become economic actors in their own rights and are proactive to pursue technology transfer opportunities for financial gain [13]. There is a profound impact on the subtle relationship between firm and university. When research results of UIC are jointly owned as patents, the party must obtain counterparty's consent to dispose of patents by the nature of co-ownership. Any party is capable to obstruct the practical application of research results by simply asserting its rights [14]. On the other hand, government has encouraged universities to play an active role in fostering technology commercialization which involves licensing of inventions [15] and academic entrepreneurship [16]. Academic faculties can become entrepreneurs or receive the right to become shareholders in the spin-off company [17]. Such third mission of the universities brings the business behaviors and firm-like decision making [18]. If technology is really promising, faculties will probably found a start-up to fully exploit the profits [19]. Firms may perceive the risks of competing business from academic spin-off or technology transfer to competitors [20].

Interdisciplinary UIC establishes a bidirectional linkage to enable the diffusion of knowledge, creativity, skills and people with the aim of creating mutual value [21]. Inter-organizational "cooperation" is as joint pursuit of agreed-on goals and each party's expected benefits are depended on the other's contributions [7]. However, the uncertainty in interdisciplinary UIC makes it difficult to evaluate counterparty's intentions. Once one of partners perceives exchange risks and moral hazards, the interaction will be cut down and the commitment will be diminished

[22]. Ultimately, the collaboration may break down due to partner's failure to cooperate with each other.

Proposition 1: Moral hazards relate to the collaboration breakdown in interdisciplinary UIC.

The collaboration from distant knowledge domains will provide new insights for the development of breakthrough innovation [23]. However, if cognitive distance such as the degree of diversity in research methodologies and in the use and interpretation of knowledge between partners is too large, low level of mutual understanding may lead to poor communication and thus hamper cross-disciplinary "coordination" [24][25]. Small cognitive distance allows grater comprehensibility but yields redundant knowledge since partners have similar perceptions, interpretations and evaluations [26]. Certain degree of cognitive distance between partners creates advantages in knowledge pooling and the development of new and unexpected ideas [27]. On the other hand, due to institutional heterogeneity, academic faculties at university and R&D engineers in industry may have different mindsets in ways of doing things. It holds the problem of communicability since the two parties lack a common ground of experience and skills enabling them to speak a mutual understandable language.

The more novelty the joint-research collaboration aims at, the greater is likely to be the amount of random trial and error from the full use of all knowledge sets [28]. Large cognitive distance from few overlapping of technological portfolios between partners may lead to conflicts and frictions in trial selection and diminish the possibility to efficiently identify valuable solution. This would slow or possibly halt the progress of collaboration and ultimately the collaboration may break down due to partners' failure to coordinate with each other. Dissimilarity of norms and knowledge may constrain partners' ability to effectively combine the resources and knowledge they bring to the table, to synchronize their actions, and to realize the expected payoffs [29]. The cognitive distance yields an opportunity for innovation as well as acts as a barrier against collaboration.

Proposition 2: Cognitive distance relates to the collaboration breakdown in interdisciplinary UIC.

Enablers to Interdisciplinary UIC

It is imperative for actors in collaboration to enforce partners to jointly pursuit of agreed-on goals and reducing behavioral uncertainty [1]. Legal contract is as a necessary evil to clearly define rights and obligations and acts as an umbrella arrangement between partners to encourage confidently interaction [1]. Mutual expectation and obligations in a specified reciprocal exchange are established in the contractual framework. Legal contract can specify the responsibilities of the parties, penalties for nonconformance and contingencies as to when and how the collaboration can be terminated [30]. Carefully designed contractual terms can increase the probability of detecting and penalizing opportunistic behavior [31]. Therefore, legal contract binds all partners to fulfilling the actions needed to achieve goals [32] and can lay the groundwork for relationship building and trust formation [33].

Both of university and firm have individual objectives (e.g. university pursues academic publication and firm aims at how new technology can be commercialized) and common objectives (e.g. creating impact to economic and society) that drive them to build partnerships [4]. Legal

contract should contain mechanisms to encourage cooperative behavior and lead to a win-win outcome [34]. Firm and university should figure out the complementarity of interest which is sufficient to benefit either party. For example, collaboration of bilateral quid pro quo typically would be based on contractual allocation of IP ownership rights to the firm and publication rights to the university [35]. It was up to the firm and university to assess if the package of exchanges and joint activities would justify the commitment required for the collaboration [20]. A clear and equitable IP policy that can be applied flexibly to the needs of partners would be optimal for interdisciplinary UIC to reduce uncertainty about counterparty's intentions and behaviors [1].

Proposition 3: The more legal contact guides cooperative behaviors, the more the potential will be to reduce the collaboration breakdown which result from moral hazards.

Legal contract is not sufficient to prevent all of risks because the full contingencies are difficult to predict or articulate in advance [36]. The uncertainty in the exploratory process of interdisciplinary UIC makes it practically impossible to establish a full set of rules for resolving future problems and conflicts. Psychological contract, as the implicit understanding of the mutual obligations under mutual beneficial relationships, is a set of unwritten expectations and perceptions including the reciprocal promises and obligations. It plays an important role in binding partners to some action for implicit and/or explicit promises of future exchange [37]. "Tit-for-tat reciprocity" (i.e. fair dealing) is based on the perceived degree of obligation, such that partners are willing to bear initial disproportional cost because they expect counterparty will equalize the distribution of cost and benefits over time out of a sense of duty [38]. When the collective action is executed in a reciprocal fashion, partners will continue or expand their mutual commitments. Joint accomplishments can create a feeling of strategic interdependence and anticipation of great gains in the future [39].

Trust is fundamental to the psychological contract [40] and comprises positive expectations about what counterparty will do in situations that are not and often cannot be explicitly enclosed in the legal contract [32]. Trust is as a common belief that counterparty will make good-faith efforts to behave in accordance with any explicit and implicit commitment and will not take excessive advantage of other even when the opportunity of opportunism or appropriation of benefits is available. When partners trust each other, they can focus on the R&D challenges at hand instead of devoting precious time and efforts to haggling over rights to potential inventions or on the process for dealing with unexpected issues [1]. Firm and university in the joint-research collaboration are often required to share sensitive or confidential information and tacit knowledge. Not all of information and knowledge can be safeguarded by legal contracts. If the collaboration is perceived as low levels of trust, partners are less likely to exchange complete knowledge and information required to make the collaboration successful [41]. Thus, explicit trust development activities should be undertaken at the launch of the collaboration instead of allowing it implicitly developing as time passes, it is also necessary to monitor how trust increases over time [36].

Legal contract provides some safety and ground rules that enhance the development of a trusting relationship [32] but excessive contractual formality may erode the accumulation of trust by implying insufficient confidence in counterparty' integrity and denying their opportunities to demonstrate their trustworthiness. A complementary governance mechanism is to rely on private sanctions that do not depend on third-party enforcement (e.g. financial penalty), such as a "shadow of the future", the invocation of future interactions and benefits [39]. Therefore, legal contract and

psychological contract are intertwined and complementary governance mechanism to mitigate risks of opportunistic behavior. [29].

Proposition 4: The more psychological contact guides cooperative behaviors, the more the potential will be to reduce the cooperation failures which result from moral hazards.

Cognitive distance between partners can be crossed, bridged and overcome by sufficient exchange of information and knowledge which entails a mapping from one's cognitive range to another's cognitive domain [26][42][43]. Boundary spanning capability includes the efforts that involves the activities, processes or tools to promote, drive or boost the flow of knowledge and the exchange of information across the boundaries of different organizations [44]. Boundary spanning capability is also defined as the organization's ability to engage specialist in related areas of knowledge in order to facilitate the sharing of expertise [45]. It helps to develop critical common ground about who knows what and who knows how for effective communication and task allocation [11] and even to result in the generation of new knowledge to facilitate coordination [46].

Boundary spanning capability of organization can be carried out by various means such as boundary spanners, boundary spanning communication or even specialized organization (e.g. Technology transfer office at university) [47][48]. Boundary spanners, who are individuals with boundary-spanning capability, can cope with knowledge heterogeneity by translating and relaying information and thereby they can facilitate effective dialogue between partners [46]. Boundary spanners are most effective in moving fluid knowledge by using language and their cognitive power to mediate the movement of information [49]. Their core function is to promote coordination and facilitate problem solving through translating and actively framing knowledge which can bridges cognitive gaps between partners [47]. Boundary spanning capability need not necessarily be held by all individuals in the collaboration. Rather, organizations must ensure to dispose of sufficient individuals placed in the right functions or dedicated teams that have this capability [46].

Coordination is as the linking, synchronization or alignment of each other's action [50]. For dealing with uncertain and interdependent tasks, partners require rich, fast and responsive communication to help them understand status and counterparty's activities, so that they can adjust their actions in response. Communication management generally as the main means of boundary spanning typically involves the policy, rule, tool and platform of information-sharing, decision-making and feedback mechanisms in the collaboration. It ensures stable flow of critical information and knowledge between partners to manage task interdependency and make sure requirement is being met [38]. Face-to-face meeting, mutual training, in-depth discussion and jointly decision-making would facilitate the transfer of knowledge [28] and increase comprehension on counterparty's capabilities, expectations, and ways of doing things. No matter what kind of means, boundary spanning capability of organizations bridges the cognitive distance by sufficient exchange of knowledge and information and therefore promotes effective coordination.

Proposition 5: The more partners invest in boundary spanning capability, the more the potential will be to reduce the coordination failures which result from the cognitive distance between them.

High level of information exchange and knowledge transfer can be driven by boundary spanning capability. However, recipient's capacity to deal with information loads and assimilate the new knowledge is key issue to achieve effective mutual understanding [51]. Organizational absorptive capacity is determined by R&D capability accumulation in technological capital [52]. Organization with larger amounts of technological capital will generally show a better performance in dealing with cognitive distance, when compared to organization with smaller amounts of technological capital [25]. Organizational absorptive capacity can be defined as the ability to connect different types of knowledge or different knowledge bases and thus surmount the cognitive distance.

Organizational absorptive capacity pertains to the ability to explore, assimilate, transform and integrate new knowledge [53] and it depends on the prior knowledge and previous experiences held by the employees in the organization [54]. More diversity in existing knowledge will enable organization to effectively identify and acquire diverse knowledge [52][55]. It implies that organizational absorptive capacity depends on organization's investment in internal knowledge capital and the technological development shapes organization's learning ability [56]. Optimal absorptive capacity is just high enough to deal with the highest cognitive distance without deficits in understanding [57]. Along with the progress of collaboration, organizational absorptive capacity may increase through the accumulation of new knowledge, new skills and new experiences and thereby cognitive distance between partners is gradually reduced [57][58]. With adequate overlapping of knowledge, partners can jointly manage task interdependence and fully negotiate how much alignment as well as how much adjustment each party undertakes to ensure their efforts "click" and yield the desired outcomes with minimal losses.

Proposition 6: The more partners invest in organizational absorptive capacity, the more the potential will be to reduce the coordination failures which result from the cognitive distance between them.

CONCLUSION

Although university and firm can gain benefit from collaboration, activating UIC does not necessarily guarantee its success. The uncertainty and asymmetric knowledge/information in interdisciplinary UIC provides the room for partners to pursue self-interest or opportunism. Legal contract is as basic safeguard to prevent immoral behaviors and enforce partners fulfilling their commitment. However, it is impossible to establish a perfect contract to anticipate and resolve all kind of problems. Psychological contract as the implicit understanding of the mutual unwritten expectations including the reciprocal promise and required contribution fuels the partners' morale and commitment to achieve a win-win collaboration.

There is a trade-off between advantage of innovation by pooling heterogeneous knowledge from partners and disadvantage of low mutual understanding which makes it difficult to deal with highly interdependent tasks. Boundary spanning capability promotes the flow of information and the exchange of knowledge across partners to develop mutual understanding for effective communication and task allocation. However, recipient's capacity to deal with information loads and assimilate newly acquired knowledge is key issue to achieve effective mutual understanding. Appropriate expansion of organizational absorptive capacity enables sufficient overlapping of

knowledge to efficiently manage task interdependence.

Cooperation and coordination failures are quite distinct and they may co-occur in interdisciplinary UIC. We proposed an integrated conceptual framework as Fig.1. The framework suggests the comprehensive analysis to identify different challenges that firm and university may face and proposes different set of solutions to avoid the collaboration breakdown.

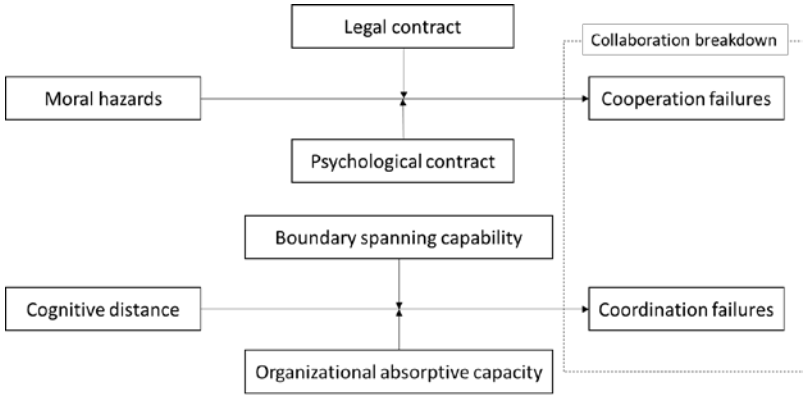

Fig. 1 The framework of cooperation and coordination mechanisms on interdisciplinary UIC

We use independent model to assume cooperation and coordination mechanism do not influence each other and both have a simple additive relationship to the performance of interdisciplinary UIC. It is worth to explore interdependent model which examines the implications of mutual interaction between cooperation and coordination mechanism and additional additive effect on the performance of interdisciplinary UIC due to synergy or to mutual reinforcement. For example, trust as a psychological contract alleviates the worries about moral hazards and thus facilitates the exchange of sensitive information which may be critical to coordination of specific tasks. Further research can address these limitations to develop more comprehensive framework.

References available upon request from the authors