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Antecedents and performance consequences of governance structures in R&D alliances

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Abstract: Traditionally governance structures are classified into "hierarchy or market" or "equity or non-equity." However, such classifications may not be effective in characterizing all governance structures of research and development (R&D) alliances. Therefore, the first objective of this study is to investigate why there exist different organizational governance structures in managing R&D alliances; the second objective of this study is to give strategic advice in choosing appropriate forms with respect to various characteristics of R&D alliances. Through the theoretical lens that integrate both transaction cost economics (TCE) and the resource-based view (RBV), a model that focuses on six major factors is developed for determining governance structure choices, namely, technological uncertainty, cultural difference, asset specificity, technology complementarity, appropriability of the individual firm's know-how, and trust. An R&D alliance with higher technological uncertainty, larger cultural differences, and greater concerns for protecting an individual's know-how is more likely to adopt non-integrated alliances as the governing structure. An R&D alliance with a higher degree of asset-specificity, greater technology complementarity and greater trust among partnering organizations is more likely to adopt integrated alliances as the governing structure; an R&D alliance in the face of lower technological uncertainty will tend to adopt integrated alliances. The more aligned the choice of the governance structure with its determinants, the better the R&D alliance will perform, and vice versa.

Key words: organizational governance structure; organizational control; resource-based review; transaction cost economics; R&D alliance

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Competition in the marketplace has turned to whether firms can create and commercialize knowledge in a timely and cost-efficient manner, particularly in the context of technology-intensive industries where the pace of technological development is increasing; product life cycles are shortening; and the expense of updating capital equipment is rising. In response to these competitive pressures, firms often look for alternatives to in-house R&D. R&D alliances represent one such alternative to facilitate inter-firm collaboration and jointly conduct R&D activities[1].

Despite the popularity of alliances, firms always face the challenges of settling appropriate structures that fit the characteristics of their alliances[2]. Such an interorganizational issue is particularly critical not only because it relates to the operations and decision making of more than one firm but because it leads to the collective competitiveness of alliance member firms. Among various governance structures of strategic alliances, two most discussed forms are equity alliances and non-equity alliances, which are often considered the variations of "hierarchy" and "market" structures, respectively. However, a growing amount of literature argues that equity involvement or market/hierarchy taxonomy oversimplifies the complex nature of interorganizational governance. For example, Geringer and Hebert[3] maintain that control is not necessarily a strict and automatic consequence of ownership. Particularly in R&D alliance governance, the problem of using equity/non-equity taxonomy is evidenced by the fact that most R&D alliances are non-equity alliances, which vary significantly, and there is no proper classification for these alliances[4]. Given that how an alliance is controlled as an important dimension of the governance of R&D alliances, this study aims to explore the governance structures of R&D alliances from the perspective of control.

Control in an alliance is characterized as the process by which the focal firm influences an alliance as a whole to behave in a manner that achieves other partners' objectives[5]. Two distinctive governance structures of R&D alliances, based on the types of control, are defined in this study as integrated alliances and non-integrated alliances. In integrated alliances, all the partners jointly share profits and risks and an alliance management team makes most of the decisions in a top-down manner, which are followed by the other partners. Closer coordination and more frequent communications are extended to

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all levels of an alliance organization. On the other hand, in non-integrated alliances, an R&D project is divided into a few distinctive tasks for which each partner is primarily responsible, technically and/or financially. As the chain of command decentralizes to each partner rather than centralizes to an alliance management team, partner firms make their own decisions directly without the formal consent from other partners. For example, Fujitsu Siemens Computers, an alliance formed in the late 1990s, shows relatively distributed decision making. Evidence suggests that Fujitsu Computer (Europe) and Siemens Computer systems are equally contributing their technological resources and capabilities to create this alliance. By uniquely pooling Fujitsu's leading-edge product designs with Siemens' manufacturing and marketing capacities, the alliance has become the top supplier of personal computer products in Europe.

For the above two distinct governance structures commonly observed in R&D alliances, transaction cost economics (TCE) points out environmental and behavioral uncertainties imbued in transactional exchange as key determinants of whether or not firms should enter into a collaborative relationship[6]. As Williamson[7] called for more research into how existing firm capabilities influence governance, and much remains to be done in this area, we attempt to address, in response to this call, how the resource-based view (RBV) complements the traditional TCE approach to the governance choices of R&D alliances. As a resource owner, a firm's ability to create, appropriate, and sustain value from the owned resources partly depends on the extent to which the firm is able to access the complementary resources in alliances and how well such matched resources are exploited to gain collective competitiveness. The dual theoretical lenses, based on TCE and RBV, will shed more light on the determinants of governance structures in R&D alliances.

1 Organizational Control and Governance Structures in R&D Alliances

The term "governance structure" is frequently used and discussed in organization literature, but it often refers vaguely to only one or two dimensions of governance structures. In fact, governance structures can be conceptualized through different sets of decision making, coordination mechanisms, and incentives[8], and with different levels of influence in controlling and coordinating the activities in a partnership[2].

Among various classification schemes upon the legal form of organization, many scholars attempt to capture the alliance forms by the equity/non-equity dimension[9]. However, a proxy of equity involvement may not fully capture the nuances of many different patterns of relationships between partnering firms, either closely or loosely coupled. It is then logical to expect that more patterns of inter-firm relationships can be better explained by other notions. As the key to managing alliances is the integration, exploitation, and protection of strategic resources, control is the underlying mechanism for managing such resources[10] and determines how partners can influence the decision-making process and the outcome of alliance. In an empirical work, Mjoen and Tallman[10] reject the traditional governance hypothesis that relies strictly on ownership to delineate the degree of control. Actually Geringer and Hebert[3] contend that ownership is only one of the control mechanisms, and that "selective control" over some critical activities or resources is often more effective and desirable than overall control. They also suggest that there are three dimensions of control: the mechanisms of control, the extent of control, and the focus of control.

In light of the above perspectives, we thus define two distinctive control-focused governance structures for R&D alliances: "integrated alliances" and "non-integrated alliances." A new means of classifying collaborative arrangements may open a way to better empirical inquiries and many questions of central interest to academics and practitioners.

Integrated alliances are characterized by all the partners jointly sharing profits and/or risks of an alliance according to an agreed proportion even though distinctive tasks may still be assigned to each firm. The alliance management team makes major decisions, which will be followed by all the partners. The needs for coordination and communication are extended to all the levels of an alliance. On the other hand, non-integrated alliances are characterized by each firm being technically and/or financially responsible for its assigned tasks, which are often negotiated. Each firm makes most decisions related to the assigned tasks without the needs of consent from other alliance partners and the needs for coordination and communication are limited to higher level managers and are minimal for individuals. Note that we do not consider that the governance structure of an R&D alliance will be on the extreme side of either integrated or non-integrated alliances. The actual governance structures of an R&D alliance should be located in the spectrum between the two extremes. Therefore, when integrated alliances are proposed to be a preferred governance structure in this paper, we mean that the structure on the spectrum closer to integrated alliances side is preferred.

We thus argue that the differentiation of these two control-focused governance structures, namely, integrated alliances and non-integrated alliances, is critical to our understanding of the antecedents of governance choices.

2 A Model for Choices of Governance Structure in R&D Alliances

2.1 An integrated framework of economic and strategic approaches

Academic interest in strategic alliances can be dated

back to economic literature in late 1970s. Afterwards a number of management studies [2, 11-12], mainly inspired by transaction cost economics (TCE)[6], have analyzed the alliance governance choices and their performance outcomes. TCE frames governance as a cost-minimizing and discriminating alignment between uncertainty and control[6]. Despite TCE's intuitive appeal, one major weakness of the TCE construct in the alliance domain is that it overemphasizes the individual parties' minimization of transaction costs while holding other factors constant. This weakness limits the TCE's explanatory capability, particularly when dealing with hybrid structures such as alliances. A better perspective is desirable for studying the governance decisions of R&D alliances.

As the RBV is widely used to explain the sources of the competitive advantages of firms, the complementarity of resources owned by the firm and its partners becomes one of the rare, valuable, immobile and non-substitutable resources, leading to a long-lived competitive advantage. For example, in the context of R&D alliances, firms often seek partners with complementary resource combinations (e.g., financial assets, technical capabilities, and marketing savvy) in pursuit of competitive advantage.

The discussion above highlights the complementary nature between RBV and TCE regarding the governance structures of alliances. In the following sections, we shall derive and discuss each of the propositions.

2.2 TCE perspective: cost-related determinants of a governance choice

Under TCE, governance forms that minimize the costs of exchange arising from uncertainty and asset specificity are considered efficient[6]. Although scholars who hold traditional views like Williamson[6] may see opportunism by alliance partners as a key source of transaction costs, we take a broader view as emphasized by Matthews[13] that transaction costs are "the overheads of conducting a set of transactions…and maintaining the system of property rights." In this subsection, three major factors will be discussed and linked with the governance choices in R&D alliances.

Technological uncertainty refers to the probability of unexpected changes in technologies; for instance, the current technology development effort may be rendered obsolete because of new generations of technology. Folta[14] argues that technological uncertainty also comes from the fact that it is difficult to discern which capabilities are critical for future success.

The needs for less hierarchical control under technological uncertainty can also be understood from the perspective of the option pricing theory as argued by Folta[14]. A firm's governance should be able to make future discretionary investments through a more flexible and less hierarchical structure so as to avoid the opportunity cost of irreversible investments[15]. In non-integrated alliances, since each firm is technically and financially responsible for its assigned tasks, partners can avoid the high-level commitment and thus enable them to assign technical and financial tasks autonomously. Furthermore, because of the loosely coupled partnership in non-integrated alliances, partners can change their commitment more easily to avoid the potential loss due to technological uncertainty. Therefore, from the TCE perspective, it is logical to argue that an R&D alliance with high technological uncertainty will perform better under non-integrated alliances. Accordingly, the first proposition is given as follows.

Proposition 1 An R&D alliance encountering higher technological uncertainty is more likely to adopt non-integrated alliances as the governing structure; contrarily, an R&D alliance in the face of lower technological uncertainty will tend to adopt integrated alliances.

Organizational culture refers to the set of values, beliefs, understandings, and ways of thinking that are common to the members of an organization[16]. Many problems experienced by firms in alliances can be traced back to cultural differences[17]. Cultural differences play an important part in making the choice of governance structure and they often will increase the transaction costs, including information transmission costs, contracting costs, and monitoring and coordination costs. As for the choice of integrated alliances or non-integrated alliances, we shall examine the transaction costs under different control structures.

We share the broader view held by Matthews[13] that transaction costs are the overheads of conducting a set of transactions. The question is: Under different levels of cultural distance, what control structure minimizes transaction costs? Buckley and Casson[18] maintain that "cultural homogeneity, acting through shared beliefs, reduces transactions costs by avoiding misunderstanding…" In contrast, if the cultural difference is large, it should be comparatively costly to jointly manage an alliance because there will be a lack of shared beliefs and values. Since the integrated alliances' structure involves much higher degrees of coordination and communication, larger cultural differences will naturally and significantly increase the difficulty of collaboration and potential conflicts. Therefore, the non-integrated alliances, characterized by divided responsibility and minimal coordination and communication, can reduce the conflicts and costs of coordination that arise from organizational cultural differences. Accordingly, we argue that when the cultural differences are larger, non-integrated alliances will be a more efficient form that reduces transaction costs.

Proposition 2 An R&D alliance with larger cultural differences among partnering organizations is more likely to adopt non-integrated alliances as the governing structure, while the R&D alliance with smaller cultural differ-

ences is more likely to adopt integrated alliances.

Asset specificity is of special significance in the TCE developed by Williamson[19]. Specific assets refer to the non-recoverable and idiosyncratic investments that firms make in a particular relationship, or the assets that are suitable for a particular transaction and cannot be easily reorganized to be used outside the relationship of the parties to the transaction[20]. The problem of specific assets is that it is impossible to redeploy transaction-specific assets without losing productive value. In joint R&D, specific assets are not limited to specific technological investments. The R&D process itself can create or increase asset specificity.

Meanwhile, opportunism due to asset specificity can be complicated and intensified by particular operational or business relationships after a joint partnership, and such relationship and its consequence can hinder the progress of a project. The opportunism problem is a central concern for all partnering firms, stronger firms and weaker firms, in R&D alliances, when the degree of asset specificity is high. The major solution to such opportunism is to pursue more centralized and tighter control; for example, vertical authority relationships and hierarchical control procedures presumably show greater safeguarding capabilities[20]. Therefore, from the TCE perspective, we argue that integrated alliances, characterized by more centralized and tighter control, will be a better choice for the R&D alliances with a higher asset specificity. Hence, we suggest the third proposition as follows:

Proposition 3 An R&D alliance with a higher degree of asset-specificity is more likely to adopt integrated alliances as the governing structure, while an R&D alliance with a lower asset-specificity is more likely to adopt non-integrated alliances.

2.3 RBV perspective: competence-based determinants of a governance choice

From the competence-based perspective, different firms should take into account the characteristics of their specific resources and advantages to pursue different strategies for profit. Such a view emphasizes the value creation and sustainability of competitive advantages of a firm through continuous accumulation and utilization of valuable resources, including tangible and intangible resources[21]. For the purpose of the effective management of resources, three other major determinants of the governance choice in R&D alliances are identified: technology complementarity, concerns for protecting an individual firm's know-how, and trust, where the former indicates the accessibility of complementary resources and the latter two indicate the accessibility of intangible resources. These three determinants are closely associated with selective and specific control in alliances as we shall explain in the following.

Complementarity refers to the extent to which the alliance partners are able to bring non-redundant distinctive competencies to the partnership[22]. For example, an R&D alliance, composed of firms with specialties in optics and electronics respectively, leads to optoelectronics and the development of the fiber-optics system, and the combination of biotechnology and pharmacy leads to a biotechnology alliance[15]. From the resource-based view, the use of R&D alliances can be justified by the pooling or integration of necessary or imperfectly imitable resources owned by the allied firms so as to create a unique strength or competitive advantage.

Due to the needs of R&D resources and capabilities, firms often seek to cooperate with others to gain access to the complementary capabilities[14] in order to generate their sustainable competitive advantages. As is pointed out by Hagedoorn[23], it is almost impossible for a company to have an all-embracing competence in every field of technology and science, and thus it is crucial for companies to build close collaboration between each other so as to access complementary technology inputs. Sakakibara[24] also argues that capability heterogeneity in R&D cooperation is important not only in the project, but also in the process of resource accumulation or learning. Here we define the technology-related resource complementarity as technology complementarity.

We argue that since more coordination and communication are required with higher technology complementarity, a joint R&D project with higher technology complementarity will perform better under integrated alliances, which are characterized by a unified authority system, more coordination and communication between partners, and thus a more integrated use of key resources. Therefore, we propose the fourth proposition:

Proposition 4 An R&D alliance with greater technology complementarity among partnering organizations is more likely to adopt integrated alliances; on the other hand, an R&D alliance with lower technology complementarity is more likely to adopt non-integrated alliances.

Learning from partners represents the primary motivation for firms to enter into alliances[25]. In many cases transferring particular technological know-how is one of the major goals or deals of an R&D alliance. A firm's organizational learning capability can create a competitive advantage. Khanna et al. [26] emphasize that by picking up skills from its partners a firm can actually unilaterally earn private benefits. According to the RBV, learning from competitors or cooperating partners can be crucial to the creation and sustainability of a firm's competitive advantage, since such learning helps a firm internalize the desired outside intangible resources such as know-how and expertise. On the other hand, from the resource perspective, one of the first priorities for the firm is to keep one's own valuable resources securely in the firm and secure its competitive advantage[21]. The choice of alliance

thus depends on the protection levels of each firm's know-how.

We argue that a joint R&D that has greater concerns for the needs to protect individual firms' know-how would prefer to adopt non-integrated alliances because each firm is technically responsible for its assigned tasks and the chain of command mainly lies independently within each participating firm in non-integrated alliances. Contrarily, since integrated alliances provide a better environment for learning due to a unified chain of command, closer collaboration, and more frequent communication, an R&D alliance with fewer concerns for the protection of individual firms' know-how would prefer to adopt integrated alliances. Therefore, based on the resource perspective, the fifth proposition for the governance structure of joint R&D is proposed as follows.

Proposition 5 An R&D alliance with greater concerns for protecting individual know-how in the alliance is more likely to adopt non-integrated alliances; on the other hand, an R&D alliance with fewer such concerns is more likely to adopt integrated alliances.

Although TCE focuses on how transaction costs resulting from opportunism are minimized and does not regard trust as a common or realistic factor that governs transactions, organization scholars[27] have recently considered trust as a key relational factor or mechanism contributing towards alliance success. Moreover, from the neo-institutionalism perspective, trust, among others such as norms and habits, is considered an important factor that explains the institutional environment and interactionism[28].

Trust is built upon an expectation that one partner has for another in the partnership such that their interaction is predictable and the behavior and responses are mutually acceptable to one another. Trust among firms indicates the positive belief that a partner will not take advantage of other partners. Therefore, trust can also be considered as reliability, an important expectation of the partner in the alliance.

Although TCE prescribes the "hierarchy" structure in the absence of trust among alliance partners[29], we argue that social capital, as a private good exclusively owned by alliance members, can be viewed by an RBV as valuable and immobile resources for competitive advantage and that the mutual trust can be considered the driving force for close collaborations and learning. Specifically, trust promotes knowledge exchange and mutual learning in an R&D alliance.

In fact, trust among alliance partners can be considered as a non-substitutable and non-imitable resource. Here we take the RBV and examine how trust impacts on competence of firms under an integrated governance structure. If a contracting firm has a higher level of trust toward other partners, it is more likely for the firm to foster closer collaborations, enhance risk-sharing capacity, and undertake higher resource commitment. Consequently, integrated alliances will be a better form for R&D alliances in fostering both individual and collective competence. This leads to the following proposition:

Proposition 6 An R&D alliance with greater trust among partnering organizations is more likely to adopt integrated alliances as the governing structure; on the other hand, firms with little trust will tend to adopt non-integrated alliances for their R&D alliance.

3 Performance Implication of Alliance Governance Structures

Here we suggest the last proposition, illustrating the relationship between the governance structure fit and the performance. We emphasize that a better fit between the attributes of an R&D alliance and its associated governance structure will yield higher performance. Empirical evidence on the relationship between governance structure choice and alliance performance have been presented by Leiblein et al. [30] in a study of the semiconductor industry, by Yin and Zajac[8] in a research of restaurant franchising, and by Murray and Kotabe[31] in a study of the Fortune 500 list. Better structuring of alliances may facilitate more robust cooperation and reduce the likelihood of failure. Leiblein et al. [30] also argue that the efficiency of alternative forms of governance will be enhanced when a "fit" exists between the chosen governance arrangement and the attributes of the transaction. Appropriate governance forms can enable the organization to take on value-creating activities and thus bring benefits to the partners. As a result, the last proposition concerning the improved performance due to the appropriate choice of governance structure is given as follows:

Proposition 7 The more aligned the choice of governance structure with its determinants, the better the R&D alliance will perform, and vice versa.

4 Results

This paper argues that an integrated framework fusing traditional TCE and recent RBV together can provide a more comprehensive explanation of the governance structure choices of R&D alliances. The integrated model proposed in this paper is illustrated in Fig. 1, depicting our corresponding seven propositions.

5 Conclusion

In the high-tech industries, the need for either established firms or start-ups to develop new technological capabilities may have led to increased reliance on alliance forms that were apt to facilitate risk sharing, cost reduction and mutual learning. However, the radical nature of technological change and the risk of rapid technological obsolescence in those industries may have deterred relation-specific investments or long-term equity-based partn-

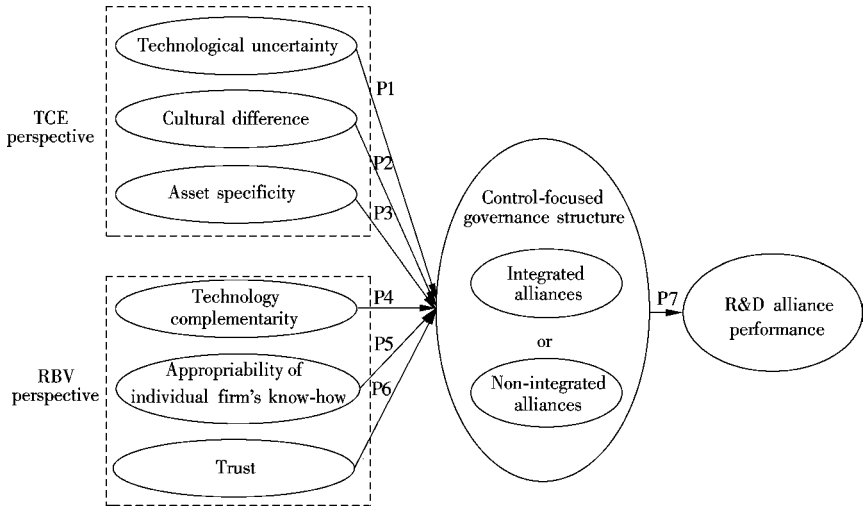

Fig. 1 The governance structure model for R&D alliances

erships, reducing the needs for high involvement forms of alliance governance. Thus the choice of governance structure may have been a result of the balance between the opportunistic costs and the commitment to learning and improving competitive advantage.

In this paper, we first review relevant theories and discuss how they are related to the choice of governance structures in R&D alliances. Then, we combine TCE and RBV as two complementary theoretical perspectives to build an integrated model for the choice of governance structures in R&D alliances. The model offers an integrated conceptual model of governance choices, showing that alliances choose governance structures based on contractual hazards confronted and the need of competence building in R&D alliances. Specifically, the conceptual model uses two theoretical lenses: the cost-related perspective of TCE and the competence-based perspective of RBV, to explain why there exist different organizational governance structures in managing joint R&D, and how such a governance choice yields different performance outcomes. On the one hand, TCE highlights the need to cope with uncertainty and other transaction hazards raised from firms' opportunism, and emphasizes the cost-economizing properties of integrated alliances. On the other hand, the competence perspective of RBV argues that the main logic underlying the governance choice of R&D alliances is the value creation and appropriation through the development of co-specialized capabilities and the protection of firm-specific know-how.

Despite the considerable empirical studies on the formation of alliances and their performance effects, this study contributes to the literature in several ways. First, we clarify different governance structures in R&D alliances by the notion of control, namely, integrated alliances and non-integrated alliances. Our taxonomy sheds new light on interorganizational controls, such as profit and risk sharing, centralized or decentralized chains of command, and the extent to which alliance partners are coordinated and communicated with each other. Secondly, the study develops an integrated model that unifies the strengths of two schools of thought for the choice of the appropriate alliance form. Thirdly, this study also contributes to the practices of joint R&D activities by providing easy guidance on deciding the choice of the governance structure.

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研发联盟治理结构的成因及绩效分析

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摘要:由于传统的理论将治理结构分为"等级、市场"或是"股权、非股权"等,而这些分类方式并不能充分描述研发联盟治理结构的特点,因此本研究首先解释在研发联盟当中,为何必须存在不同的组织治理结构类型;继而探讨在面对不同特性的研发联盟时,如何选择适当的治理结构类型. 结合交易成本经济学理论与资源基础观点,推导出影响研发联盟组织治理结构的 6 个主要因子,分别为技术不确定性、文化差异、资产特殊性、技术的互补性、个别公司独门技术的研发专用性、信任,据此建立本研究模型. 当研发联盟的技术不确定性较高、文化差异较大、独门技术的研发专用性有较多的防范时,则采用非集中联盟;当研发联盟的资产特殊性较高、技术的互补性较大、伙伴之间的信任度较高时,则采用集中联盟. 搭配这些因子的特性选择组织治理结构类型,则研发联盟有更好的绩效,反之亦然.

关键词:组织治理结构;组织控制;资源基础观点;交易成本经济学;研发联盟
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