



Research Paper

Interdependence, integration process, and innovation performance in technology acquisitions: A governance perspective

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ABSTRACT

This study develops a governance perspective on technology acquisition that aims to explain the relationships among key acquisition attribute (technology interdependence), governance forms (tight versus loose integration processes), and innovation outcomes in technology acquisitions. This perspective provides two theoretical predictions: (1) the governance choice proposition describes the positive relationship between the level of target-acquirer interdependence and the likelihood of selecting a tight integration process, and (2) the discriminating alignment proposition argues that acquisition performance will be enhanced when a fit exists between the chosen governance form and the underlying acquisition attributes.

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INTRODUCTION

Technology acquisition aims to rapidly enhance the acquirer's technological innovation by combining target firm's knowledge-based resources (Shang and Poon, 2013; Tseng, 2017). Engaging in such a relation involves the integration of the participating firms—a particularly important governance decision concerning “the managerial actions taken to combine two previously separate firms” (Cording et al., 2008: 744). Prior literature on technology acquisitions generally addresses two issues. One is concerned with the acquisition attributes compelling firms to select certain governance choices of the integration process (e.g., Puranam et al., 2009). The other is concerned with the effect of the integration process on acquisition performance (e.g., Lin and Ho, 2018). Despite their importance, the links among acquisition attributes, integration process, and performance outcomes in an acquisition are not fully understood.

This study, therefore, intends to provide a *governance perspective on acquisition* to explain the aforementioned links. One conceptual base for this perspective is grounded on transaction costs economies (TCE; Williamson, 1991a, 1999). TCE views the firm as a governance structure and

tight/loose integration processes as discrete governance forms varying in adaptations and governance costs, and the purpose of the firm is to economize on governance costs. The other conceptual base is grounded on the knowledge-based view (KBV) of the firm that argues acquisitions as a means to generate, combine, and coordinate knowledge (Conner and Prahalad, 1996; Grant, 1996; Kogut and Zander, 1996). The acquirer's decision on loose or tight integration process depends on the resulting efficiency in the generation and coordination of knowledge (Puranam et al., 2009; Arvanitis et al., 2015). From the governance perspective proposed in this study, interdependence between target's and acquirer's technologies is viewed as the key attribute of acquisition that determines the choice of governance form. In acquisitions characterized by low technology interdependence, given that knowledge is often tacit, uncoded, nonverbalized, and embedded in organizational routines, a loose integration process involving less disruption to both firms' valuable routines is able to protect tacit knowledge and facilitate the creation of autonomous innovation (Capron and Mitchell, 2009; Hira, 2017). In acquisitions characterized by high technology

interdependence, on the contrary, cognitive limitations due to bounded rationality (Simon, 1962) prevent each economic actor from describing all its knowledge and absorbing all the other's knowledge. A tight integration process that provides sufficient knowledge interaction and communication can facilitate the creation of coordinated innovation (Nickerson and Zenger, 2004; Lin and Ho, 2018).

Williamson (1991a) and Nickerson and Zenger (2004), in their studies, argued that technology acquisitions, which differ in their key attributes (that is, technology interdependence), are aligned with governance forms (that is, tight versus loose integration processes), which differ in their governance dimensions (that is, administrative controls, incentive intensity, autonomous innovation, and coordinated innovation), so as to effect an economizing result. This study proposes two main propositions concerning technology acquisitions: (1) the governance choice proposition argues that the greater the target-acquirer interdependence, the greater likelihood the acquirer will choose a tight integration process rather than a loose integration process, and (2) the discriminating alignment proposition argues that acquisition performance will be enhanced when a fit exists between the chosen governance form and the underlying acquisition attributes.

THEORY AND PROPOSITIONS

Following Williamson (1999), and Karim and Mitchell (2000), the theory development section specifies five conceptual elements—human actors, unit of analysis, description of the firm, purposes served, and efficiency criterion. Performance implications of the theory are also provided.

Human actors

The behavioral assumptions include bounded rationality—economic actors only have limited information, attention, and processing ability (Simon, 1962; Cyert and March, 1963) and potential self-interest—economic actors manifest themselves as “adverse selection, moral hazard, and, more generally, as opportunism” (Williamson, 1999: 1089). Although reputations for trustworthy actions may be rewarded whereas reputations for untrustworthy actions are punished in long-term exchange relationships, trustworthiness is conditional upon the benefits created from trustworthy status over time, contrasted with the benefits created from self-interested behavior (Poppo and Zenger, 2002: 710). Cooperation in the present is encouraged by the expected pay-offs from future cooperation. As Williamson (1996: 710) argues, “because commercial relations are invariably calculative, the concept of calculated risk (rather than calculated trust) should be used to describe commercial transactions.” In the context of

acquisitions, trust and deception coexist as a result of asymmetries and errors in both target and acquiring firms' views regarding trust and trustworthiness. The acquirer may have a generalized distrust of target firm, especially when the target firm operates in similar industries and could become competitor (Graebner, 2009: 448). The target firm's distrust of the buyer derives from the buyer's imposing unwelcome practices on the target firm, replacing target managers, or even closing the target firm entirely (Paruchuri et al., 2006). At least, economic actors in an acquisition may not be fully trustworthy in the relationship, indicating a potential self-interest seeking opportunistic behavior (Williamson, 2010: 219).

Unit of analysis

The fundamental unit of analysis is technology acquisition—acquisition of a technology-based firm by the acquirer in order to “graft acquired technological capabilities” onto its own resource base (Puranam et al., 2006: 263). Considering that it is difficult for any single firm to develop relevant technologies exclusively through internal technology sourcing, technology acquisitions help a firm advance technological innovations that both guard against technological obsolescence and resolve organizational inertia (Capron and Mitchell, 2009: 294). Technology acquisition, hence, is the engine of organizational change and technological development in acquisition-based growth, and plays an important role in corporate renewal strategy (Chakrabarti and Mitchell, 2004; Barkema and Schijven, 2008).

This study argues that interdependence between target's and acquirer's technologies is the key attribute of acquisition that influences how two actors can effectively combine their technologies through different governance forms. Interdependence, having long been a main topic in theories of organizational design, refers to the extent to which “value of performing one activity depends on how another activity is performed” (Puranam et al., 2009: 315). Technology interdependence can create uncertainties and constraints in the developments of new products, processes, and capabilities which in turn motivates the firm to absorb such constraints through acquisitions (Makri et al., 2010). Firms managing interdependence, nonetheless, can only shift rather than extirpating their interdependencies (Pfeffer and Salancik, 2003). After acquisition, this interfirm interdependence quickly shifts to intrafirm interdependence once the integration process begins.

Describing the firm

In technology acquisitions, the firm can be described as a governance structure aiming to coordinate existing

knowledge, create new knowledge, and protect the value of knowledge at differential governance costs (Karim and Mitchell, 2000: 1063). The acquiring firm is able to devise various governance mechanisms—"information disclosure, discussion, dispute settlement of a private ordering kind"—which permit two actors to work through their interdependence and get on with the tasks (Williamson, 1999: 1090). Governance mechanisms in an acquisition includes formal and informal incentives and organizational controls, structures, and cultures, which are well identified as critical constructs of *the postacquisition integration process* (Haspeslagh and Jemison, 1991), including *structural integration, cultural integration, and integration speed*. Structural integration concerns the necessary degree to which two previously separate organizational units are combined within a common boundary under a single authority (Puranam et al., 2009: 313), while cultural integration is the necessary degree to which two firms cooperate to form a shared identity and a common culture (Stahl and Voigt, 2008: 162). As for integration speed, it involves the amount of time required for making changes in both firms in order to be fully integrated (Schweiger and Goulet, 2000: 79).

In technology acquisitions, this study contends that *tight integration process* (that is, fast and high levels of structural and cultural integration) and *loose integration process* (that is, slow and low levels of structural and cultural integration) are discrete governance forms (Puranam et al., 2006: 263; Lin, 2014: 1841) that differ in four major governance dimensions: (1) autonomous innovation, (2) coordinated innovation, (3) administrative controls and bureaucratic costs, and (4) incentives to motivate innovation efficiently. Tight versus loose integration processes are fundamental design choices with regard to the grouping of acquired and acquiring firms' knowledge workers who are capable of "apply[ing] theoretical and analytical knowledge, acquired through education, to developing new products or services" (Janz et al., 1997: 878). Through a tight integration process, the acquirer uses high-level linking mechanisms, such as standard operation processes, hierarchical controls, and acculturation processes in order to completely absorb the acquired firm's technological resources. Alternatively, the acquirer may use a loose integration process as a means to preserve the target firm's autonomous organizational status and support the acquired knowledge workers' innovativeness that made the target firm attractive in the first place (Nahavandi and Malekzadeh, 1988; Haspeslagh and Jemison, 1991; Homburg and Bucerius, 2006). The discussion hereafter concerns how the aforementioned dimensions are configured to achieve the two governance forms.

In technology acquisitions, a loose integration process is superior in the creation of autonomous innovations—innovations where prices serve as "sufficient statistics". In other words, changes in demand or supply of an innovation are reflected in price changes, so that

suppliers and consumers can take the right actions. This is ideal when target and acquiring firms "respond independently to parametric price changes" and maximize their utility respectively (Williamson, 1991a: 278). The KBV studies suggest that the most valuable forms of knowledge are created through socially embedded and path-dependent routines that are difficult to imitate (Nelson and Winter, 1982; Conner and Prahalad, 1996). Moreover, routines are often tacit because they are uncodifiable and require extensive interpersonal interactions. Owing to their tacitness and organizational embeddedness, routines and the knowledge they create are often firm-specific (Karim and Mitchell, 2000: 1063). In the situation where knowledge creation represents a gradual and path-dependent process, the acquired knowledge workers largely depend on the elements of their pre-existing routines—"submitting research proposals and updates, supervising technicians, calibrating equipment, keeping data logs, accessing and reviewing scientific journals, discussing ideas and progress with colleagues and supervisors, and so on" (Paruchuri et al., 2006: 547). Given that these elements of the scientist's routines reside not only within individuals, but also in the social relationships within the firm, the acquirer tends to develop "integrative knowledge" and "integration capabilities" (Mitchell and Shaver, 2003: 174) that do not disrupt target's valuable routines, thereby maintaining the social fabrics of its own (Cyert and March, 1963). The integration process, as indicated by the KBV scholars, typically involves challenges by reconfiguring, realigning, and rationalizing the acquired firm's and the acquirer's routines (Karim and Mitchell, 2000). A loose integration process, serving as a means to change both actors' routines slightly and gradually, therefore helps to maintain the very innovative capabilities of the acquired firm (Puranam et al., 2009:313) and continuing patterns of knowledge creation in the acquiring firm (Capron and Mitchell, 2009: 299).

Coordinated innovation represents the second dimension of governance. In technology acquisitions, the underlying knowledge between the acquiring and the acquired firms is characterized by high interdependence if the combined technological capabilities cannot be used without coordination or adjustment made to one or both actors. Under such circumstance, tight integration can be considered as potential tactics to solve coordination problems arising from "the lack of shared and accurate knowledge about the decision rules that others are likely to use and how one's own actions are interdependent with the others" (Gulati et al., 2005: 419). By grouping target and acquiring firms within a common administrative boundary, inter-unit coordination is enhanced by the centralized decision making and the authority to use coordination mechanisms, such as programming—agreements on what and when each units' actions must be taken, hierarchy—a single authority making individual knowledge workers dedicate to the task of coordination, and informing them

about how other interdependent knowledge workers should behave, as well as reciprocal feedback—mutually coordinated adaptation on an ongoing basis (Gulati et al., 2005: 420; Puranam and Srikanth, 2007: 809). In addition, a shared organizational identity through cultural integration also shapes informal organizational processes, including trust, common language and firm-specific communication channels, all of which can facilitate coordination (Kougt and Zander, 1996; Lin and Ho, 2018). As a result, a tight integration process is better than a loose integration process in achieving coordinated innovation in technology acquisitions.

If postacquisition integration is viewed as organizational transformation, the logistics of the transformation itself may be costly (Zollo and Singh, 2004). Between two governance forms in an acquisition, a tight integration process achieves interdependence-coordinating gains through added administrative controls, along with several additional bureaucratic costs. First, a tight integration process that includes high degrees of hierarchical elements can introduce a set of short-term changes in order to create a fully integrated organization—possibly new colleagues and supervisors, new tasks and routines, new relationships and values, and even, new work locations (Paruchuri et al., 2006: 548; Puranam et al., 2009: 315). Second, a tight integration process causes long-term disruption in structure and culture due to substantive incompatibilities (Chakrabarti and Mitchell, 2005: 7). Studies of integration process (Nahavandi and Malekzadeh, 1988; Schweiger and Goulet, 2000; Zollo and Singh, 2004; Stahl and Voigt, 2008) have addressed the challenges of combining incompatible routines, human resource policies, and national and organizational cultures. Given that knowledge workers rely on intricate task and social context to execute their routines (Nelson and Winter, 1982; Capron and Mitchell, 2009), the disruption resulting from being tightly integrated is expected to influence postacquisition innovation performance of technological personnel (Ranft and Lord, 2002).

Finally, talented knowledge workers with hard-to-measure skills are often attracted to small organizations providing high-powered incentives (Zenger, 1994) where performance consequences are tightly linked to actions (Williamson, 1991a: 279). In technology acquisitions, target firms, being smaller and more flexible than large acquirers, tend to be unencumbered by multi-layered administration or strategic commitments to large numbers of stakeholders after acquisition. A tight integration process involves extensive changes to organizational processes of the acquired firm and such changes are characterized by extensive intrafirm linkage ambiguity—“a lack of understanding of the causal link or path between an action and its performance outcome within a focal firm”, which weakens the link between reward and effort for the acquired individuals (Cording et al., 2008: 746). Moreover, arguments from agency theory have suggested that

grouping formerly distinct firms under a single authority increases the possibility of free riding (Puranam et al., 2006: 265) due to ambiguity about actions required to generate performance gains (Ellis et al., 2011: 1263), as well as ambiguity about “temporal distance” between acquisition integration and performance outcomes—shorter time frames are not sufficient to capture how integrated R&D capabilities contribute to innovation performance (Cording et al., 2008: 747). Since long as intrafirm linkage ambiguity is heightened following a tight integration process, self-interested individuals in the acquiring firm may behave opportunistically in the target-acquirer integrated R&D activities. Target knowledge workers are therefore likely to leave after the target firm is fully integrated by the acquirer, critically undermining innovative capabilities of the target firm (Ranft and Lord, 2002). Even if target experts are retained via high-powered incentives, lowered unit autonomy and discretionary behavior accompanying a tight integration process can still lead to demotivation of target experts for engaging in innovation (Puranam et al., 2009). As a result, a tight integration process makes it difficult for individual knowledge workers to appropriate the returns of their innovations and their incentives therefore diminish (Cohen and Levinthal, 1989). As Williamson (1991b: 78) suggests, the waste of bureaucracy is principally due to maladapted operations, and inferior internal incentives and controls. Intrafirm linkage ambiguity and disruption caused by a tight integration process therefore contribute to the added bureaucratic costs in the merged organization.

In summary, a tight integration process represents a governance form in an acquisition characterized by strong administrative controls and weak incentive intensity. In the combination of target’s and acquirer’s knowledge, it displays a strong ability to create coordinated innovation while a weak ability to generate autonomous innovation. A loose integration process, as shown in Table 1, is the polar opposite.

Purposes served

In TCE, the purpose of the economic organization is to economize on governance costs—to implement “effective adaptation and the elimination of waste” (Williamson, 1991a: 276, 1991b: 77, 1999: 1090). Following Williamson, this study argues that technology acquisitions, which differ in their attributes (that is, technology interdependence), are aligned with governance forms (that is, tight versus loose integration processes), which differ in their governance costs, so as to effect an economizing result. More generally, the purpose of the firm is to economize on the combination of two critical sources of governance costs, namely *bureaucratic costs* and *coordination costs* (Gulati and Nickerson, 2008: 689–690; Mesquita and Brush, 2008: 785). Coordination costs are costs that arise from managing

Table 1: Distinguishing governance dimensions of loose/tight integration processes.

	Governance form	
	Loose integration	Tight integration
Instruments		
Administrative controls	Weak	Strong
Incentive intensity	Strong	Weak
Performance		
Autonomous innovation	Strong	Weak
Coordinated innovation	Weak	Strong

task interdependence, including time, effort, and resources the firm spends on effective coordination of tasks (Jones and Hill, 1988; Rawley, 2010). Such costs are fundamentally driven by the indivisibility and complexity of the participants' activities (Simon, 1962; Teece, 1996). Coordination costs in an acquisition refer to the costs arising from handling the complexity inherent in decomposing tasks and managing their interdependent parts between acquired and existing units (Gulati and Singh, 1998; Mesquita and Brush, 2008). Lower governance costs imply that acquisition actors make adjustments and adaptations for successful innovations at low cost. The subsection discusses governance costs in the postacquisition integration as a function of interdependence between target's and acquirer's technologies, and a set of institutional environment parameters.

Efficiency criterion

The importance of interdependence stems from the perspective of information processing between tasks, suggesting that higher levels of task interdependence lead to greater uncertainty and increased needs of information processing (Galbraith, 1977; Tushman and Nadler, 1978). The concepts of complexity and bounded rationality also advance our understanding of how interdependence can cause problems in task coordination. According to Simon (1962: 486), a complex system is defined as a system "made up of a large number of parts that interact in a non-simple way", and can be categorized into decomposable, nearly decomposable, and non-decomposable systems according to the levels of system complexity. Following Simon's concept, prior research has defined task complexity as the numbers of tasks, organizational routines and processes, and the degree of interdependencies among these properties in the production of goods and services (e.g., Macher, 2006: 830; Mesquita and Brush, 2008: 788).

When interdependence is zero, each task represents a stand-alone entity that can be evaluated by its own merits. For instance, pooled interdependence (Thompson, 1967) is a simple task structure in which each actor behaves as a

self-contained unit "to the extent and degree that the conditions for carrying out its activities are independent of what is done in the other organizational units" (March and Simon, 1958: 28). To use Simon's language, pooled interdependent tasks are "decomposable" in the sense that tasks can be subdivided into subtasks and each subtask draws from specialized human assets. According to Nickerson and Zenger (2004: 620), the combination of decomposable technologies represents a *directional search* in the problem-solving process—a search guided solely by simple performance feedback or experience from prior trials. Directional search is suited to low-interaction problems because technological combinations are pursued by altering one technological element at a time, observing the resulting changes in the system, and then either continuing this change if the system performance increases, or, stopping the change if the system performance declines (Gavetti and Levinthal, 2000). The key feature of this search form is that actors independently pursue trials and observe performance.

In an acquisition, independently decomposable technologies are better governed by a loose integration process, since increased task autonomy provides high-powered incentives to motivate target's and acquirer's knowledge workers to pursue trials that expand or create knowledge grounded on their existing knowledge embedded in the maintained path-dependent routines and social fabrics (Karim and Mitchell, 2000; Capron and Mitchell, 2009). Although knowledge coordination is also a critical concern, coordination problems in governing independent technologies are largely unimportant "when problems are decomposable and directional search is desired" (Nickerson and Zenger, 2004: 623). Given that tight integration incurs added bureaucratic costs to which no added coordination benefits can be ascribed, such a process is unnecessary. Loose integration instead offers both firms' knowledge workers incentives to make optimal use of their knowledge, thereby protecting and enhancing their own accumulation of specialized knowledge (Paruchuri et al., 2006).

In contrast, task complexity increases following the rise in interdependence because interdependent units must

communicate and set up agreed decision-making and task schedules, so that all units' separate tasks can be aligned to one another. It exists in a partnership when one actor must continuously anticipate the other actor' outputs, communicate its own outputs to the other's, and provide and receive feedbacks from the other actor (Gulati and Singh, 1998). When reciprocal feedbacks among actors are necessary, the combination of all actors' activities is associated with reciprocal interdependence (Thompson, 1967)—a system where inputs, conversations, and outputs are inseparable. In Simon's language, such tasks are nondecomposable. According to the concept of bounded rationality, each decision maker in a simple relationship may be able to optimize its operation in a manner of unbounded rationality (Aggarwal et al., 2011: 707). As complexity increases, decision makers, nonetheless, become uncertain about the other's actions and engage in a great number of forecasting because each actor is only rational to a restricted degree and is in fact irrational in the remaining parts of other actors. As a result, unit autonomy and discretionary behavior, lacking proper governance to "infuse order, thereby mitigating conflict and realize mutual gains" (Williamson, 2010: 216), are likely to cause problem in an interdependently complex production system, such as bottlenecks due to uneven development of components and problems resulting from a more complex structure of production technology (Foss, 2001: 156).

Given that actors are self-interested and boundedly rational, high levels of hierarchical control, in a situation where complexity is pervasive, can be regarded as a solution to coordination problems deriving from managing interorganizational (Gulati and Singh, 1998) or intraorganizational (Puranam et al., 2009) relations. In the context of acquisitions, the importance of a tight integration process in combining interdependent technologies may be reflected in "endogenously created technological uncertainty" (Foss, 2001: 167)—uncertainty that arises when further adaptations and mutual adjustments between acquired and existing technologies alter tasks and introduce new unknown interdependencies between tasks. For instance, the complexity of technologies may make the autonomous units difficult to know in advance the particular requirements (that is, best time and place to use a technology) for efficient coordination. In acquisition of interdependent technologies, the rearrangement of tasks and routines aims to take advantage of new information and capture the value of complex technologies (Karim and Mitchell, 2000). Thus, a tight integration process is needed when complexity and endogenously created uncertainty require sequential delineation and reallocation of technological resources as a means of timely reducing coordination costs and improving performance of the combined technologies.

Figure 1 shows my theory predictions that governance costs for each governance alternative vary in the degree of technology interdependence between target and acquiring

firms (k) and a set of institutional environment parameters (θ). Let $L(k;\theta)$ and $T(k;\theta)$ represent expressions of the expected governance costs associated with loose and tight postacquisition integration processes. While all cost curves are upward sloping (Williamson, 1991a: 283; Nickerson and Zenger, 2004:627), the comparative low cost is most desirable. The purpose of the firm is thus to achieve the lowest governance costs in a given acquisition. Assume that, for simplicity, exogenous variables are unchanged and differences in governance costs are entirely due to interdependence attribute, the comparative-cost relations will be: $0 < L(0) < T(0)$ and $L' > T' > 0$.

The first inequality reflects bureaucratic costs of tight integration exceeding those of loose integration, for the latter incurs less intrafirm linkage ambiguity and disruption. Without interdependence, autonomous units independently create their knowledge with effectiveness, due to high-powered incentives and the familiarity with knowledge creation routines (Karim and Mitchell, 2000; Paruchuri et al., 2006). Tight integration is then disadvantageous for acquiring independent technologies, since the added bureaucratic costs generate no added coordination benefits through integration that, however, changes as interdependence sets in. In the situation where complexity and endogenously created technological uncertainty among tasks become more relevant and consequential as interdependence deepens, coordinated interaction and communication are required (Foss, 2001). The second inequality, $L' > T'$, reflects the marginal disability of loose integration as compared with tight integration in the coordination of interdependent knowledge through acquisitions. That is, the coordination costs of loose integration exceed those of tight integration when interdependent units are unable to respond to uncertainty and complexity quickly because of maladaptation and disagreements as a result of unit autonomy and discretionary behavior. Although the transfer of governance forms from loose integration to tight integration creates added bureaucratic costs, gains from solving coordination problems are expected to outweigh such added bureaucratic costs in the presence of high-level interdependence between target's and acquirer's technologies. This is because coordination costs raise with interdependence (Thompson, 1967; Gulati and Singh, 1998), whereas bureaucratic costs in an acquisition are not directly determined by the level of interdependence (Puranam et al., 2009:316).

As Figure 1 shows, two curves intersect so that $L(k^*) = T(k^*)$. This result implies that loose integration is the least costly form of governance for low levels of target-acquirer technology interdependence (that is, $k < k^*$), and that tight integration is the least costly form of governance for high levels of target-acquirer technology interdependence (that is, $k > k^*$). The intersection of curves L and T , denoted by k^* , identifies the *critical value* of technology interdependence at which the governance-costs (that is, the combination of

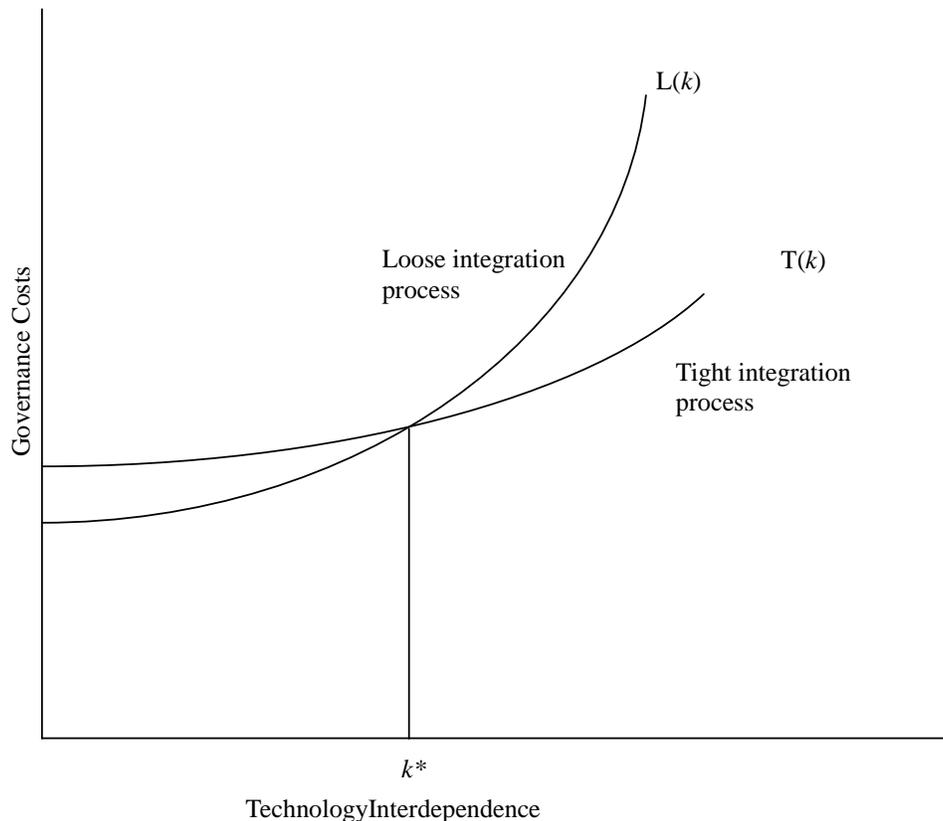


Figure 1: Governance costs as a function of technology interdependence.

bureaucratic costs and coordination costs), economizing governance choice shifts from one form to another. At k^* , the adjacent governance forms are nearly equally efficient because of their equivalent governance costs (Gulati and Nickerson, 2008: 690). Hence, this study predicts that:

Proposition 1. *In a technology acquisition, the greater the interdependence between target's and acquirer's technologies, the greater likelihood the acquirer will choose a tight integration process rather than a loose integration process.*

Performance implications

TCE suggests that economic organizations aim to economize on governance costs by “assigning transactions (which differ in their attributes) to governance structures (the adaptive capabilities and associated costs of which differ) in a discriminating way” (Williamson, 1985:18). The notion of discriminating alignment is that exchange efficiency will be improved when a fit exists between the chosen governance structure and the underlying transaction attributes. Such a fit, as Williamson (1991a: 277) argues, influences the performance of any intra- and

interorganizational exchanges. Williamson's discriminating alignment hypothesis is extended into technology acquisition. When coordination problems between target and acquiring firms are negligible—broadly, when target's technologies supporting an acquisition are independent from the acquirer (that is, $k < k^*$), loose integration serves as the least-cost governance form where both actors' knowledge workers are provided with strong incentives to create autonomous innovations embedded in unchanged routines and social fabrics, and where the merged firm incurs few added bureaucratic costs.

At a high level of coordination problems when both actor's technologies are highly interdependent (that is, $k > k^*$), tight integration is the least-cost governance form. Although the bureaucratic costs may increase, solving nondecomposable problems that arise from unpredictable technology interdependence through a tight integration process is still an important source of innovative improvements (Foss, 2001: 162). Such coordinated innovations emerge not from independent trials and errors by individual actors, but from the ongoing learning and experience accumulation when experimenting with various coordinated ways of laying out complex production tasks. According to Nickerson and Zenger (2004:621), the coordination of interdependent and nondecomposable

technologies represents a *heuristic search* in the problem-solving process—a form of solution search that “a group of actors cognitively evaluate the probable consequence of design choices rather than relying solely on feedback after design choices are made.” Although solving coordination problems through effective heuristic search can generate superior innovation outcomes, it is difficult to develop group heuristics because actors are boundedly rational and self-interest (Simon, 1962; Gavetti and Levinthal, 2000). In an acquisition, the development of group heuristics necessitates the resolution to inherent conflicts in target’s and acquirer’s beliefs (Kogut and Zander, 1996). A tight integration process that quickly provides formal knowledge transfer channels, develops a shared language to support the channels, and offers “the reconciliation of the divergent beliefs about the proper shape of the search heuristic” (Nickerson and Zenger, 2004: 621) is therefore the least-cost governance solution.

But what happens to a merged organization if its acquisition is not properly aligned with proper governance form? Based on the above discussions, this study holds that the performance implications of loose versus tight integration processes should hinge upon the alignment/misalignment between the chosen governance form and firm- and acquisition- specific attributes (that is, target-acquirer interdependence and other attributes that could influence the acquirer’s governance choice over the target firm). For example, in complex relationships involving technology interdependence, a merged organization that selects a loose integration process lacking adequate coordination mechanisms will be exposed to serious coordination problems, for unit autonomy and discretion make tasks become uncoordinated (Foss, 2001). By contrast, the potential consequences of adopting a tight integration process for a simple relationship include the increased intrafirm linkage ambiguity (Cording et al., 2008), disruption of both actors’ routines (Karim and Mitchell, 2000; Paruchuri et al., 2006), and a loss of flexibility (Williamson, 1985) as a result of the imposition of bureaucratic controls. Such disadvantageous consequences implied by tight integration also dull incentives for innovation (Teece, 1996; Leiblein et al., 2002: 821; Puranam et al., 2009). As a result, a merged organization choosing an inappropriate governance form is more likely to have poor performance. Grounded on these theoretical arguments and the empirical research on the alignment-performance relation (Leiblein et al., 2002; Nickerson and Silverman, 2003; Lin, 2014), this study addresses that:

Proposition 2. *Those merged organizations that govern acquisitions appropriately (that is, a fit exists between the chosen governance form and the underlying attributes—interdependence and other firm- and acquisition-specific attributes) will exhibit higher innovation performance than those that do not govern acquisitions appropriately.*

DISCUSSION

Prior studies on technological performance in acquisitions primarily involve two research streams. One stream focuses on how acquisition performance *ex post* is influenced by firm- and acquisition-specific attributes *ex ante*, such as relatedness (Ahuja and Katila, 2001), complementarity (Makri et al., 2010), and uniqueness (Phene et al., 2012). The other pays attention to the implementation activities in the postacquisition stage (Pablo, 1994; Graebner, 2009), in which proper acquisition integration may affect expected benefits from combining previously separate firms (Haspeslagh and Jemison 1991), sharing knowledge resources (Datta, 1991), transferring know-how (Ahuja and Katila, 2001), and learning and developing new capabilities (Zollo and Singh, 2004). By integrating these two research streams, this study proposes concepts of key acquisition attribute (that is, technology interdependence), discrete governance form used to effectively govern the combined technologies (that is, tight versus loose integration), and acquisition performance, and also develop the governance perspective on the acquisition. Highlighting the importance of the integration process, this study makes two major predictions: (1) for low (high) levels of target-acquirer interdependence, loose (tight) integration is the least costly governance form to combine two firms’ technologies, and (2) a fit between the chosen governance form and the underlying attributes (that is, interdependence and other firm- and acquisition-specific attributes) will lead to superior technological performance after the acquisition.

The governance choice prediction confirms findings of prior research on managing the coordination-autonomy dilemma in technology acquisitions (Puranam et al., 2006), suggesting that the needed level of postacquisition integration largely depends on the nature of both target and acquiring firms’ technologies. In general, the acquirer’s combining with the target firm having interdependent technology is associated with, in Thompson’s (1967) term, long-linked technology or intensive technology. Such an acquisition demands a high level of integration (Puranam et al., 2009), for sequential or reciprocal technology interdependence, as well as jointly R&D and knowledge sharing increase the benefits of target-acquirer coordination. Moreover, the success of the acquirer’s technology development relies on managers and skilled knowledge workers of the target firm to integrate and coordinate both firms’ technologies, and further turn them into new market opportunities (Kapoor and Lim, 2007).

The discriminating alignment prediction confirms the “structure follows strategy” perspective (Chandler, 1962:297), suggesting that the integration process (a kind of governance structure) should be determined by technology interdependence (acquirer’s acquisition strategy), and the fit between strategy and structure will enhance performance of the transaction (Hill et al., 1992;

the coordination costs concerns (Gulati and Singh, 1998) that concentrate on the nature and function of various coordination mechanisms and argue that failing to appropriately coordinate interfirm activities may lead to a decline in performance. Gulati and Singh (1998), drawing from the literature on organizational design (Thompson, 1967; Galbraith, 1977), suggest that the proper governance structure in an interfirm relation is largely determined by partners' interdependence involving factors such as sharing interdependent technologies and co-developing new products. The idea that interdependence increases coordination costs, in forms of greater task uncertainty and information-processing costs (Tushman and Nadler, 1978), and added pressures of conflicts and rapid response (Pfeffer and Salancik, 2003), is widely applied to topics such as alliance governance structure (Aggarwal et al., 2011), market or hierarchy choice (Nickerson and Zenger, 2004), and international partner selection (Roy and Oliver, 2009). By extending the aforementioned idea, this study contributes to the acquisition literature and develops a governance perspective, suggesting that the ability to effectively coordinate target-acquirer interdependence through the appropriate integration process can be an important driver of superior acquisition performance.

Limitations and extensions

The governance perspective on acquisition maintains that, (1) interdependence is the main attribute of acquisition, and (2) governance costs in an acquisition, vary with governance form in the dimensions described above. Governance costs in each governance alternative, then, are expressed as a function of interdependence (k) and a set of institutional environment parameters (θ) with an assumption that institutional environment is unchanging, as shown in Figure 1. However, governance costs functions (that is, $L(k;\theta)$ and $T(k;\theta)$) and critical value (k^*) will shift in response to parameter changes in the institutional environment—changes that will elicit shifts in the comparative governance costs of tight or loose integration (Williamson, 1991a: 287). This sub-section considers how $L(k;\theta)$, $T(k;\theta)$, and k^* will change in response to changes in the institutional environment, such as radical technological change, national culture, and political hazards.

Radical technological change

In an industry, the technology on which a firm's capabilities rest usually evolves from a period of radical change with high technological and market uncertainty to one of the incremental changes and relatively low uncertainty (Tushman and Anderson, 1986; Utterback, 1994). This

also confirms
period of radical change and high uncertainty is usually introduced by a discontinuity that may be competence-

destroying to both target and acquiring firms if the capabilities of exploiting the change are very different, and the knowledge embedded in both firms' knowledge workers and organizational routines are rendered obsolete (Henderson and Clark, 1990; Afuah, 2001). Under the circumstance of this technological discontinuity, governance costs functions of $L(k;\theta)$ and $T(k;\theta)$ in Figure 1 shift upwards due to possible replacement of employees and changes in organizational routines. In general, the governance costs added to tight integration are greater than those to loose integration for two reasons. First, despite the potential changes in routines and procedures existing in both firms, loose integration, compared with tight integration, still provides more flexibility and high-powered incentives to adapt efficiently. Second, although tight integration is conducive to knowledge coordination, the merged firm, in the period of radical technological change, usually engages in wide-ranging search among technical and market opportunities characterized by high uncertainty and extensive intrafirm linkage ambiguity (Puranam et al., 2006: 266; Cording et al., 2008). This added ambiguity may make $T(k;\theta)$ shift further upward and the critical value k^* will shift to the right.

National culture

In cross-border acquisitions, cultural dissimilarity can cause high behavioral uncertainty, which makes cooperation difficult and costly (Maekelburger et al., 2012). Moreover, cultural dissimilarity may reduce interorganizational trust—a firm's expectation that its partner will not act opportunistically in the exchange relationships (Gulati and Nickerson, 2008). Prior research suggests that a lower level of trust in a transaction is likely to decrease confidence and positive expectations about partner behavior, which increases anticipated concerns of appropriation and coordination costs, and the needed level of hierarchical control (Gulati and Singh, 1998). Thus, in the presence of high national cultural distance between target and acquiring firms, loose integration can cause greater governance costs than tight integration, for cross-border coordination problems as a result of target-acquirer interdependence are particularly difficult to solve through a loose integration process. The loose integration curve ($L(k;\theta)$) in Figure 1 will shift upward with the increase in national cultural distance and the value k^* shifts to the left.

Political hazards

In cross-border acquisitions, if the host government's commitments to a given structure of regulation, taxation, or

even property rights regime are easily changed, the acquirer faces added political hazards (Henisz and Macher,

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costs functions of $L(k;\theta)$ and $T(k;\theta)$ in Figure 1 shift upward due to possible policy shifts and concerns of governmental expropriation—issues of credible commitments and security of expectation by the government (Williamson, 1991a: 288). In general, the governance costs added to loose integration are lower than those to tight integration. One of the arguments is that governmental expropriation is more serious for tightly integrated firms that usually involve large replacement of host managers and employees, thereby damaging the host country's employment rate, as well as national pride and sovereignty (Zaheer, 1995). Moreover, the retained host workers can help the acquirer familiarize itself with the host policymaking apparatus, and enhance its ability to identify and react to political hazards (Delios and Henisz, 2003). As a result, loose integration acquires a discounting of host governmental expropriation, thereby reducing the impacts of unfavorable policy responses, so that the critical value k^* will shift to the right.

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