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# Tight versus Loose Organizational Coupling within Inter-Firm Networks in the Enterprise Software Industry – The Perspective of Complementors

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## ABSTRACT

Facilitated by new standards and middleware technologies, enterprise application software is increasingly characterized by a high degree of modularity. On an organizational level, this is reflected by the goal of dominant system vendors (hubs) to form loosely-coupled hub-and-spoke networks with smaller niche players (spokes) that complement their solutions. This paper aims at explaining differences regarding the extent to which spokes strive for loosely-coupled partnerships as opposed to closely-tied relationships with a particular hub. The type of coupling is indicated by the level of hub-specific investments and the application of informal governance mechanisms. Following existing theory, the synergistic specificity between the partners' technological, commercial, and social capital is suggested to determine the aspired type of coupling. Moreover, it is argued that a tighter coupling leads to an increased threat of opportunism. However, instead of loosening the partnership, spokes tie themselves even closer to the hub.

## Keywords

Enterprise Application Software Industry, Small and Medium-Sized Companies, Organizational Coupling, Modularity, Relational View, Resource Dependence Theory, Service-Oriented Architectures

## INTRODUCTION

The organizational structure of the enterprise application software (EAS) industry has been undergoing significant changes during the last decades. In the early days of computing, software was custom-developed in a make-to-order fashion, before standardized, monolithic systems that covered most of the business processes of many different customers emerged in the 1970s. During the 1980s, these systems became the state-of-the-art, turning the formerly diverse industry into an oligopolistic structure with a few dominating system vendors (Campbell-Kelly, 2003).

In recent years, however, this trend has been countervailed by a tendency towards disintegration (Bresnahan and Greenstein, 1999; Messerschmitt and Szyperski, 2003). Facilitated by the emergence of standards and middleware technologies, like e.g. service-oriented architectures (Stal, 2002), the formerly integrated systems are more and more characterized by a high degree of modularity (Baldwin and Clark, 1997). From a theoretical point of view, it can be argued that the trend towards disintegrated systems should be reflected by a higher degree of organizational modularity within the industry (Conway, 1968, Hoetker, 2006). As such, partnership networks have emerged in which companies of the EAS industry work together based on mutually agreed standards (Gao and Iyer, 2008). Within these partnership networks, a limited number of large organizations, often referred to as hubs, platform leaders or keystones (Iansiti and Levien, 2004), provide the systems' architecture and generic core functionalities, while smaller software companies (referred to as spokes or niche players) build their solutions upon and complement these platforms (Iansiti and Levien, 2004; Prencipe, 2003). The compatibility and functionality of the spokes' solutions is thereby often ensured through a certification of the spokes' products or resources by the hub organization.

The main reasons for the emergence of hub-and-spoke networks may be seen in the fact that competition and demand heterogeneity have forced large vendors to give up proprietary approaches in order to gain market share and strive for becoming a *de facto* standard (Schilling and Steensma, 2001; Shapiro and Varian, 1999). Hubs face a system competition with rival networks (Farrell, Monroe and Saloner, 1998; Shapiro and Varian, 1999). Since the competitive position of hubs is

based on their ability to create and exploit network effects, they seek to form partnerships with a large number of spokes that offer complementary functionalities. Thus, hubs aim at relational extendability, i.e., they seek to “redeploy and leverage existing relation-specific assets and routines in other relationships” (Bala and Venkatesh, 2007, p. 343). At the same time, however, hub organizations need to ensure that their network keeps its own identity and distinctiveness. That is, hubs do not aim at completely decoupled networks that could be mixed and matched by customers in an unlimited way. Otherwise, the stability of the network would be endangered (Iansiti and Levien, 2004; Snow, Miles and Coleman, 1992).

This trade-off between flexibility and openness on the one hand, and stability and coherence on the other hand, as faced by the hubs, is mirrored by the spoke organizations. While some spokes may strongly focus on tight coupling with the hub in order to generate relational rents, others may seek to stay independent of the hub solutions. The latter may rather form loose partnerships or even provide solutions for different platforms (Iansiti and Levien, 2004). Thus, spoke organizations that enter into the networks fostered by large system vendors may differ substantially regarding the aspired type of organizational coupling with the hub organization.

In the IS literature, the new network structures in the IS development industry have rarely been addressed. As a recent exception, drawing on the theory of complementarity (Milgrom and Roberts, 1995), Gao and Iyer (2008) argued that the success of inter-organizational arrangements in the software industry is dependent upon the position of the organizations within a software stack that reflects the architecture of the overall system. This paper takes the spoke perspective and aims at theoretically explaining variations in the extent to which spoke organizations aim at tight as opposed to loose coupling with the hub in order to leverage the benefits of complementary resource endowments within a hub-and-spoke network in the EAS industry. By analyzing the mediating role of organizational coupling between partnering firms, this paper contributes to existing literature on the influence of technological complementarity on inter-organizational division of labor (Gao and Iyer, 2008). Moreover, it adds to adjacent disciplines and the reference theories that this study draws on through applying these theories to the special case of inter-firm partnerships to develop EAS.

The following section presents the theoretical foundations of this research. Subsequently, a theoretical framework will be developed that explains why some spoke organizations tend to tie themselves closely to the hub organization, while others choose to form looser partnerships. Then, the results will be discussed and conclusions will be drawn.

## **THEORETICAL FOUNDATIONS**

In the face of the underrepresentation of inter-organizational EAS development within the IS literature, it seems reasonable to draw on the more general literature on inter-organizational division of labor in developing a theoretical framework on organizational coupling in IS partnership networks. From an organizational perspective, the relational view of competitive advantage (Dyer and Singh, 1998) provides a rationale why firms enter into close partnerships. On an industry level, the principle of modularity (Baldwin and Clark, 1997; Schilling and Steensma, 2001) describes a common way to design complex products. Both approaches will be shortly summarized subsequently.

The relational view (Dyer and Singh, 1998) argues that firms may create competitive advantages through forming close partnerships with other organizations that provide complementary resources. Complementary resources are defined as “distinctive resources of alliance partners that collectively generate greater rents than the sum of those obtained from the individual endowments of each partner” (Dyer and Singh, 1998, p. 666f). In order to realize the potential benefits of complementary resources, firms have to invest in relation-specific assets and knowledge-sharing mechanisms (Dyer and Singh, 1998). The relational view can be considered in line with earlier attempts to apply the resource-based view (Barney, 1991) to inter-organizational arrangements (Eisenhardt and Schoonhoven, 1996). In addition to these earlier approaches, however, the relational view also draws on the theory of transaction cost economics (TCE, Williamson, 1981), which argues, among others, that increasing asset specificity leads to higher transaction costs due to the fact that organizations that invest in relation-specific assets run the risk of their collaborators behaving opportunistically (Williamson, 1981). Proponents of TCE perceive this as a trade-off and suggest an integration of specific transactions into the hierarchy of organizations. On the contrary, the relational view emphasizes transaction value instead of transaction costs and holds that both inter-firm investments in relation-specific assets and transaction cost discrimination become simultaneously feasible through applying appropriate governance mechanisms (Zajac and Olsen, 1993).

While the relational view advocates close relationships between organizations that jointly create a product, the concept of modularity has been defined as “building a complex product or process from smaller subsystems that can be designed independently yet function together as a whole” (Baldwin and Clark, 1997, p. 85). It is important to note that modularity is not restricted to products, but can be applied to all kinds of systems, e.g., the disaggregation of organizational structures (Schilling, 2000; Snow et al., 1992). Indeed, the modularity of a product can be expected to be mirrored by the modularity of

the organizational structure (Conway, 1968). Consequently, once a product’s architecture that is modular in a sense that it decouples the various components that the system is composed of, has been established, the organizational structure is proposed to follow this design pattern (Hoetker, 2006; Schilling and Steensma, 2001). Generally, some systems tend to become more modular over time, while others move towards integration (Bresnahan and Greenstein, 1999; Schilling, 2000). The degree of modularity of a system is suggested to decrease with an increase in the synergistic specificity between its components. Synergistic specificity refers to “[t]he degree to which a system achieves greater functionality by its components being specific to one another” (Schilling, 2000, p. 316). Thus, a tighter organizational coupling can be understood as an optimization of the components of a system working in a particular configuration, resulting in combinations that “achieve a functionality unobtainable through combinations of more independent components” (Schilling, 2000, p. 315f).

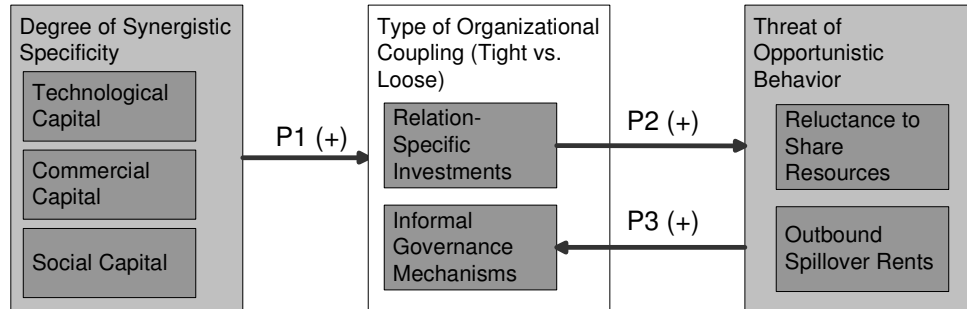


Figure 1. Theoretical framework

In this study, it is argued that the degree of synergistic specificity of a hub’s and a spoke’s technological, commercial, and organizational capital (Ahuja, 2000) influences the type of organizational coupling that the spoke strives for. The tighter the organizational coupling, the higher will be the threat of opportunistic behavior on part of the hub organization. Instead of relying on a looser form of coupling, however, it is argued that spokes even intensify their relationships with a certain hub organization through informal governance mechanisms. Figure 1 summarizes the theoretical framework that will be elaborated on subsequently. Table 1 provides definitions for the key constructs of the framework.

Construct	Definition
Synergistic Specificity	The degree to which a dyad or network of organizations achieves greater value if the technological, commercial, and social capital of its members is specific to one another (based on Schilling, 2000).
Type of Organizational Coupling	The way in which an organization ties itself to another organization, resulting in differences regarding responsiveness and distinctiveness (based on Dyer and Singh, 1998; Orton and Weick, 1990).
Informal Governance Mechanisms	Implicit mechanisms to coordinate division of labor, e.g. mutual adjustment based on socialization and trust (based on Adler 1995).
Relation-Specific Investments	Investments into assets that increase the value of a particular relationship with another organization while being of lower usefulness in other relationships (based on Dyer and Singh, 1998).
Opportunistic Behavior	Taking advantage of opportunities at the expense of a partner through not sharing resources and seizing knowledge spillovers to commercial ends (based on Williamson, 1981).

Table 1. Definitions of important constructs in the context of this study

## THE TYPE OF ORGANIZATIONAL COUPLING

Organizational coupling has been defined in a dialectical way, considering both responsiveness and distinctiveness (Orton and Weick, 1990). Systems are tightly coupled if there is responsiveness without distinctiveness. If, in turn, systems are distinctive but not responsive, they are decoupled. If there is both distinctiveness and responsiveness, a system is loosely coupled (Orton and Weick, 1990). Based on the relational view of the firm, it is argued that small and medium sized partners of large system vendors may strive for a tighter organizational coupling, i.e., low distinctiveness and high responsiveness, in two important ways.

First, the relational view of competitive advantage holds that in order to realize benefits resulting from a partnership, firms have to invest in relation-specific assets (Dyer and Singh, 1998). Generally, asset specificity decreases with “the degree to which an asset can be redeployed to alternative uses and by alternative users without sacrifice of productive value” (Williamson, 1990, p. 142). Translated to the case of inter-organizational relationships, asset specificity refers to the degree to which assets are of lower usefulness in other relationships. Regarding the assets that are generally deemed necessary in order to develop and market software products, the individuals that are involved in the development and marketing process were found to be very important, rendering software production a people business (De Marco and Lister, 1987). More specifically, the knowledge of the involved individuals plays a pivotal role in developing and marketing software (Robillard, 1999). This is reinforced in the EAS industry, where knowledge about both software development and business processes is needed. Thus, in the here analyzed context, relation-specific investments mainly refer to investments in relation-specific knowledge creation.

Second, spokes may strive for substituting formal governance mechanisms for more informal ones. Generally, the application of effective governance mechanisms plays a special role for value generation through inter-organizational relationships because its impact on value generation is twofold (Dyer and Singh, 1998). First, from a TCE perspective, governance mechanisms may lower transaction costs and thus directly increase relational rents. Second, effective governance mechanisms may foster the generation of relational rents by increasing the willingness of partners to engage in value creation initiatives, i.e., to combine complementary resources and to invest in relation-specific assets and knowledge-sharing mechanisms. Generally, two types of governance mechanisms may be distinguished. Formal governance mechanisms refer to instruments that are codified by contracts, technological standards or through other formal devices that enable the partners to exercise control (e.g. the discussed certification). On the contrary, informal governance mechanisms are understood as implicit coordination measures like e.g. mutual adjustment based on socialization and trust (Adler, 1995; Kraut and Streeter, 1995).

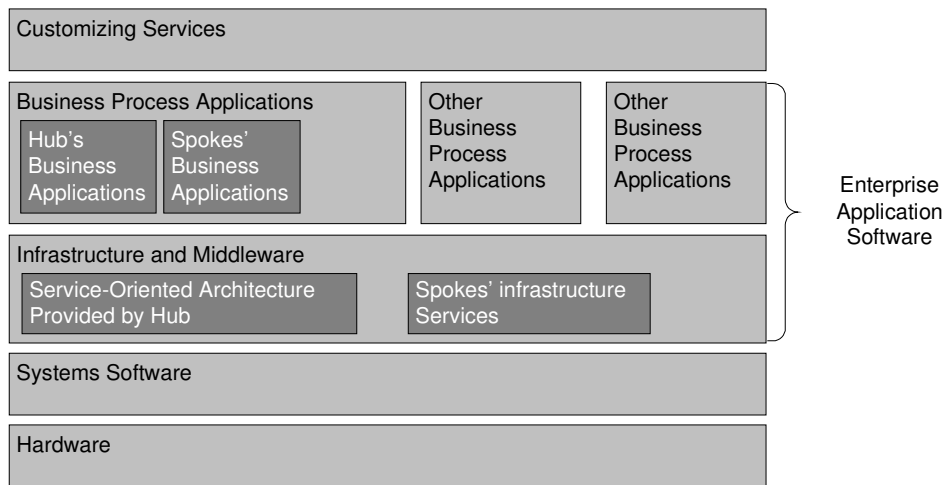
## SYNERGISTIC SPECIFICITY AND ORGANIZATIONAL COUPLING

In order to better understand the notion of synergistic specificity in the context of hub-and-spoke partnership networks in the EAS industry from a spoke’s perspective, it is instructive to analyze the reasons why spokes enter into partnerships. Generally, organizations that suffer from a shortage of resources may enter into partnerships to overcome these resource gaps (Eisenhardt and Schoonhoven, 1996; Lavie, 2006). However, in order to access resources through inter-firm collaboration, firms not only have to be willing to overcome their own resource gaps, but also have to be attractive as a potential partner themselves, i.e., they have to possess certain resources which their potential collaborator lacks. This “duality of inducements and opportunities” (Ahuja, 2000) is particularly problematic for small and young companies. On the one hand, small and young companies often face what Eisenhardt and Schoonhoven (1996) call “strategic vulnerable positions” and are therefore prone to a lack of resources. On the other hand, due to their limited size and often short period of existence, small and young companies will hardly be able to offer significant resources to potential partners, thus reducing the possibilities to overcome their own resource gaps through partnering (Ahuja, 2000).

The hub-and-spoke networks that have emerged in the EAS industry seem to be a possible way-out of this dilemma. Through their partnerships with a hub, spokes can access external resources and dynamic capabilities (Teece, Pisano and Shuen, 1997). These resources and capabilities may be divided into technological, commercial, and social capital (Ahuja, 2000). In a generic way, technological complementarity between software firms may be analyzed along five layers as proposed by Gao and Iyer (Figure 2, Gao and Iyer, 2008).

EAS comprise both the infrastructure and middleware layer as well as the business process application layer (see Figure 2). Within the hub-and-spoke networks, hub organizations can be assumed to provide the architecture that the spokes’ solutions are based upon. Moreover, they may provide basic business applications that serve as standards of entire industries or types of business processes. In other words, hubs are large systems providers that may have their core business either at the infrastructure and middleware layer or at the business application layer. Innovating system architectures and basic business process functionality on a regular basis is deemed especially crucial in a dynamically changing environment like the EAS

industry (Henderson and Clark, 1990). In most cases, spoke organization can be assumed to lack the ability to provide these system-wide innovations. Thus, partnering allows them to gain access to complementary resources. In order to generate customer value, however, it may be more or less necessary for the spoke to ensure that its own solution is closely aligned (i.e., integrated) with the hub platform. This is reflected by the degree of synergistic specificity regarding technological capital between a spoke's and a hub's solutions. In a similar way, regarding commercial capital, hub companies that usually act on a global scale and have a large installed base of customers may offer small spokes the possibility to access markets and marketing channels that might otherwise be unreachable. Furthermore, hubs may dispose of social capital that spokes could benefit from in that they improve their own visibility and credibility by making use of the hub's reputation and high profile and encourage hub personnel to recommend and promote the spoke's solution. Again, if customer value is particularly high due to the exploitation of commercial and social capital of hub and spoke in an integrated rather than isolated manner, synergistic specificity of social and commercial capital is high.



**Figure 2. Software stack model (based on Grove, 1996)**

In line with the relational view of competitive advantage, it is argued that in order to benefit from the synergistic specificity with the hub's technological, commercial, and social capital, spokes have to invest in hub-specific assets. In order to participate in the hub's partner network and enable the access to complementary resources and capabilities, spokes have to invest in hub-specific knowledge accumulation for becoming a certified partner. In order to get this certification, spokes have to obtain knowledge about the functioning of the hub's platform and the interfaces. Once the spokes have accomplished the certification, continuous investments in hub-specific technological and market-related knowledge accumulation are necessary for keeping up with new developments in the dynamic EAS industry.

In order to actually exploit the access to synergistic external resources, spokes may rely on informal governance mechanisms. Especially, for the purpose of gaining access to external sticky knowledge, spokes may have to put effort and invest in the creation of partner-specific absorptive capacity (Cohen and Levinthal, 1990). For instance, partnering with a hub may provide the spoke with immediate access to explicit information on technological issues. In order to gain a competitive advantage through leveraging complementary resource endowments, however, spokes may need to access know-how within the hub that is not amenable to codification, e.g. because it resides within the experience and long-time collaboration of certain individuals. Thus, further hub-specific investments into absorptive capacity and knowledge-sharing may be necessary. This assertion is substantiated by the findings of Yli-Renko et al. (2001), who argue that the acquisition of external knowledge from key customers is positively influenced by social interaction, the quality of the relationship, as well as the network ties provided by these customers. Yli-Renko et al.'s results may be transferred to hub-spoke relationships in the EAS industry, holding that through informal governance mechanisms like social interaction, spokes may exploit the access to complementary resources residing within the hub organization.

*Proposition 1: The higher the degree of synergistic specificity between the partners' technological, commercial, and social capital, the higher is the spokes' striving for a tight organizational coupling with a certain hub organization.*

## ORGANIZATIONAL COUPLING AND THE THREAT OF OPPORTUNISTIC BEHAVIOR

Spoke organizations that invest heavily in their relationship with a hub cannot easily switch to other platform vendors without losing the majority of their up-front, hub-specific investments and being forced to re-invest in the new platform. This lock-in increases the hub's propensity to behave opportunistically, i.e., to exploit the spokes' lock-in situation and take advantage of opportunities at the spokes' expense in two ways (Lavie, 2006; Williamson, 1981).

First, hubs may be reluctant to share resources with a specific spoke and thus decrease the possibilities of value creation. As discussed above, spoke companies benefit accessing external resources residing inside the hub organization. On the contrary, hubs mainly dependent on the network as a whole and not on the resources of a single spoke. The resource dependence theory (RDT) deals with such inter-organizational dependencies (Pfeffer and Salancik, 1978). Central to this theory is the power distribution between organizational actors that results from dependencies on external resources that are beyond an organization's control. Within the hub-and-spoke networks of the EAS industry, spoke organizations face a situation of considerable power imbalance. From a RDT perspective, through participating in hub-and-spoke networks, spokes attempt to absorb the constraints posed by the limited access to necessary resources. In a situation of power imbalance, however, constraint absorption is unlikely, since the dominant organization prefers maintaining the status quo of power distribution (Casciaro and Piskorski, 2005).

Second, the power imbalance in the hub-spoke relationship together with the high degree of investments in relation-specific assets performed by the spoke may lead to "outbound spillover rents" (Lavie, 2006). The hub may behave opportunistically and capitalize on its dominant position over the spokes by absorbing the spokes' critical knowledge and apply it to commercial ends itself. For instance, the hub may benefit from this knowledge spillover by imitating the functionality of a spoke's solution. For a spoke organization, the imitation of the functionality of its solutions can be considered a very harmful act of opportunistic behavior, since it may dramatically jeopardize the spoke's survival.

*Proposition 2: The higher the hub-specific investments performed by the spoke organizations, the higher is the threat of opportunistic behavior on part of the hub.*

Instead of loosening the partnership with the hub organization when facing the threat of opportunistic behavior, it is argued that spokes may rely on informal governance mechanisms, thus striving for relational specificity (Bala and Venkatesh, 2007; Dyer, 1997). Informal governance mechanisms may allow spokes to even reinforce the existence of synergistic specificity in spite of the hub's discussed unwillingness to share resources with a specific spoke. Furthermore, informal relationships with decision makers within the hub organization that are based on trust may prevent the hub from exploiting the spoke's know-how that is unveiled through the partnership and thus avoid an imitation of the spoke's business model, even though it might be strategically appropriate from the hub organization's point of view.

In a similar way, considering the power imbalance between hub and spoke, Casciaro and Piskorski (2005) propose that dependent organizations engage in unilateral measures to deal with the limited access to resources resulting from power imbalance. The dependent organization is assumed to apply tactics to "restructure dependencies by aiming directly at the constraining party in the relationship" (Casciaro and Piskorski, 2005, p. 167). For instance, dependent actors may attempt to stabilize "the flow of valued resources by socializing members of the constraining organization or through the exchange of other valuable goods, such as status, friendship, or information" (Casciaro and Piskorski, 2005, p. 168). Following this point of view, it is argued that while hubs behave opportunistically on a strategic and organizational level, the governance mechanisms that act as a remedy against the threat of this opportunistic behavior can mainly be found on an individual level.

*Proposition 3: The higher the threat of opportunistic behavior on part of the hub, the more the spokes aim at applying informal governance mechanisms.*

## DISCUSSION

This study suggests a differentiated perspective on organizational coupling between hubs and spokes within the EAS industry. Depending on the degree of synergistic specificity between the partners' technological, commercial, and social capital, spoke organizations may invest in relation-specific assets and aim at governance mechanisms based on socialization and trust, i.e., spokes may strive for relational specificity. Such unique relationships with each spoke organization, in turn, can be assumed not to be in the interest of hub organizations that strive for relational extendability.

The tension between the differential types of organizational coupling that hub and spokes strive for (loose vs. tight) has important theoretical and practical implications. Spokes may aim at a tight organizational coupling in terms of hub-specific asset investments, but also through informally governing their relationship with the hub. Informal ties on a personal level may indeed be beneficial for spokes to get access to external technological, commercial, and social capital and impede opportunistic behavior. However, spokes may face the problem that sociologists refer to as overembeddedness (Uzzi, 1997).

By successfully relying on strong personal ties in the short run, spokes may miss the opportunity to develop their own resources and capabilities. If the personal network ceases to exist, e.g. due to job fluctuation, spokes may eventually be penalized. Generally, the scenario that the spokes face resembles a classical prisoners' dilemma. If one spoke achieves a tighter coupling with a hub and thereby undercuts the standard coordination mechanisms, it may be beneficial for this spoke. If all spokes do so, however, the whole network and thus its participants may eventually lose ground in the system competition with other networks that coordinate the relationships more efficiently.

Hub organizations may learn from findings of this study and dispense with a purely efficiency-driven view. In order to be successful in the system competition with other networks in the long run, hubs have to find a reasonable balance between efficient coordination in a loosely-coupled network and satisfying the singular spokes. For hub organization, it may be more reasonable to systematically install a certain degree of relational governance that complements the formal governance through standards and certification, instead of letting the coordination through personal ties blossom in an uncontrollable way. As a lesson learned from this study, the goal of hub organizations should be to enable a "mass customization" of the governance in their partner networks, i.e., to efficiently satisfy the spokes' desire for relational governance.

From a theoretical point of view, this study complements existing literature on synergistic specificity, organizational coupling, and the relational view by applying these concepts to the special case of hub-and-spoke partnerships in the EAS industry. Previous research found that technological modularity should be reflected by a more modular organizational structure. This study suggests that the special characteristics of hub-and-spoke networks may lead to differential outcomes. Hub organizations define the system's underlying technology in a more modular way in order to enable the emergence of partner networks. However, the nature of the hub-and-spoke networks may result in a tight organizational coupling between partners.

Future research may further enhance and empirically validate the proposed framework for explaining differential preferences for opposing forms of organizational coupling. Specifically, a refined theoretical framework may consider technological contingencies as moderating factors of the proposed link between synergistic specificity and organizational coupling. As such, an increased standardization of the system's architecture and interfaces as enforced by the hub may reduce the necessity of the spoke to invest in hub-specific assets and to apply informal governance mechanisms. Moreover, the availability of inter-organizational information systems that disseminate information and knowledge throughout the hub-and-spoke network (Hong, 2002) may reduce the spokes' need for personal, informal coordination (Schmidt, 1996) and investments in alternative hub-specific knowledge accumulation. Such collaboration tools would allow the hub to address the needs of multiple spokes simultaneously, while still accounting for the requirements of particular spokes, thus, enabling a "mass customization" of governance. Future research may aim at designing such innovative ICT tools for the governance of hub-and-spoke networks. Additionally, while this study addresses informal governance mechanisms in a general way and mentions e.g. socialization and trust, future research may examine in more detail which, when and how informal governance mechanisms are actually applied.

## CONCLUSION

This study has shown that if the synergistic specificity between the resources and capabilities of a small organization in the EAS industry and its larger partner is high, the smaller company strives for a tight organizational coupling in order to realize potential benefits resulting from external resources. On the one hand, the spoke organization heavily invests in partner-specific resources. On the other hand, it aims at substituting formal governance mechanisms for more informal ones. Partner-specific investments, however, increase the threat of opportunistic behavior that the spokes have to deal with. Yet, instead of loosening the tie with their larger partner in the face of opportunistic behavior, spokes react with a more intense striving for an informal governance of the partnership.



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