Intermediary-governance as a means to deal with the conflict between 'trying to learn' and 'trying to protect' in technology networks.

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While technology alliances enable firms to achieve numerous benefits such as economies of scale and scope, reduction of risk and uncertainty, and access to new technologies and know-how, they often require these firms to cope with an inherent conflict between two competing objectives: the need to learn and the need to protect. This conflict stems from the fact that conditions necessary to facilitate the learning process simultaneously magnify the danger of losing core and proprietary knowledge. Previous research in the Social Network literature has shown how firms' 'social embeddedness', which can be decomposed into relational, structural, and cognitive embeddednesses, can mitigate the intensity of this conflict via mechanisms such as mutual trust, familiarity, reputation, common systems of meaning, and network culture. However, reaching an 'ideal' level of social embeddedness is far from simple. It is for firms a long, hazardous and highly resource-consuming process. In this paper, our intent is to show that alternatives exist for firms that cannot benefit from favorable levels of embeddedness. In that case, firms may indeed try to enter an 'intermediary-governed network' and, hence, benefit from the mechanisms implemented by an intermediary entity to ease the learning process and protect against possible opportunistic behaviors. This network governance model implies that a separate entity is set up specifically to manage and coordinate the network and its activities. A common form of intermediary-governed network in technology industries is the government-sponsored R&D consortium like SEMATECH in the United States, EUREKA in Europe and the VLSI project in Japan. In this paper, we argue that entering an intermediary-governed network becomes highly valuable for firms when they cannot benefit from their social embeddedness to deal with the conflict between 'trying to learn' and 'trying to protect'; in other words, when the relational embeddedness is low, the structural embeddedness is unfavorable, and the cognitive embeddedness is limited.

Keywords: intermediaries; relational, structural and cognitive embeddednesses; network of technology alliances; R&D consortia.

INTRODUCTION

A growing stream of research in the strategic management literature is devoted to the study of networks of technology alliances (e.g.; Hagedoorn, 1993; Stuart, 1998, 2000; Duysters, Kok and Vaandrager, 1999; Gulati, 1999; Baum, Calabrese and Silverman, 2000; Vanhaverbeke and Noorderhaven, 2001; Reagans and Zuckerman, 2001; Duysters and Lemmens, 2003). This research is mainly aimed at showing that to understand the formation process of an alliance (e.g., Stuart, 1998; Duyster and Lemmens, 2003) or the performance of an alliance (e.g., Reagans and Zuckerman, 2001), it is important to go beyond the alliance itself and to consider the whole network of alliances in which this alliance is embedded. In particular, this research shows that the characteristics of the overall composition of a firm's network of alliances (such as its partners' diversity, the number of its alliances, the history of prior ties, or the extent of direct vs. indirect ties) may significantly contribute to the performance and growth of this firm and influence its selection of future alliance partners.

Gulati (1995) has defined the term 'alliance' as any independently initiated inter-firm link that involves exchange, sharing, or co-development. In line with Hagedoorn and Sadowski (1999), we consider as 'technology alliances' any inter-firm agreements involving joint technology development or technology sharing. Hagedoorn and Sadowshi (1999) distinguish contractual alliances, which are *"joint R&D pacts and joint development agreements through which companies undertake innovative projects with shared resources"*, and joint ventures, which are *"combinations of the economic interests of at least two different companies in a 'distinct' firm which also performs R&D or undertakes innovative projects"*. Firms engage in technology alliances for various reasons: to gain competitive advantage through market power or efficiency, to access or internalize new technologies and know-how, to exploit economies of scale and scope, or to share risk (Powell, 1987; Bleeke and Ernst, 1991; Baum et al., 2000). Whatever the type of alliance, one of the main reasons remains the opportunity to learn from the partner and, in particular, to access and acquire critical information, know-how, or capabilities (Hamel, 1991; Yoshino and Rangan, 1995; Khanna, Gulati and Nohria, 1998).

Despite their numerous benefits, technology alliances may require firms to overcome important tensions between two competing objectives: 'trying to learn' and 'trying to protect' (Gulati and Singh, 1998; Kale, Singh and Perlmutter, 2000). These tensions are especially present in so-called 'learning alliances', where the main purpose is to learn or internalize

critical information or capabilities from the partners (Prahalad and Hamel, 1990; Hamel, 1991; Khanna et al., 1998; Kale et al., 2000). Tensions between learning and protecting stem from the fact that, on the one hand, firms participate in alliances to learn know-how and capabilities from their partners and, on the other hand, they want to protect themselves from the behavior of these same partners that may also have the desire to acquire their own know-how and capabilities (Kale et al., 2000). Consequently, beyond the usual concern about the real efforts made by each party within the alliance (i.e., free riding), these absorption and learning purposes raise concerns about the release of core and proprietary know-how and capabilities, and the potential use by the partner of these know-how and capabilities for purposes other than the alliance's, thereby resulting in the possible dilution of competitive advantage.

Previous research in the Social Network literature has shown how firms' social embeddedness may help them overcome the duality between learning and protecting via mechanisms like mutual trust, respect, reputation, or common systems of values and norms. However, reaching an 'ideal' level of social embeddedness is far from simple. It is for firms a long, hazardous and highly resource-consuming process. In this paper, our intent is to show that alternatives exist for firms that cannot benefit from favorable levels of embeddedness. In that case, firms may indeed try to enter intermediary-governed networks. Provan and Kenis (2008, 2009) have recently stressed the importance of considering the different network governance models. Intermediary-governed networks correspond to what Provan and Kenis call the 'network administrative organization' (NAO) governance model[*]. Under this model, the network is governed by a separate and external entity in a centralized way. A common form of intermediary-governed network found in technology industries is the government-sponsored R&D consortium. Indeed, governments have supported the establishment of R&D consortia in numerous countries and regions to spur the development of cooperative R&D and help their industries gain a strong competitive position on the international scene. SEMATECH in the United States, EUREKA in Europe and the VLSI project in Japan are government-sponsored R&D consortia that have extensively been covered in the trade press. While these R&D consortia differ along various governance aspects, their broad mission is rather similar; i.e., to offer a framework that stimulates and eases collective research. They have all emerged in

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[*] We prefer to use the term 'intermediary-governed network' as the activities undertaken by intermediary entities may be much broader than administrative in technology industries; i.e., they can perform tests, develop prototypes, undertake fundamental research, and prepare technological 'road maps'. We find rather 'restrictive' to call them administrative entities in technology industries.

contexts where the innovation process could not be undertaken efficiently. When the innovation process requires the contribution of several firms linked through technology alliances, two dimensions are essential for its success: a wide exchange of knowledge and information, and mutual trust. These two dimensions are highly intertwined: when the partner firms share their knowledge and information, trust progressively emerges; in turn, when trust is present, partner firms are less reluctant to share core knowledge and information. As exposed below through the examples of SEMATECH, EUREKA and the VLSI project, we see that when firms alone are not able to successfully undertake the innovation process through spontaneous networks of technology alliances, these intermediary-governed networks offer a highly valuable framework where knowledge and information can be exchanged more easily and where trust progressively emerges.

In 1987, SEMATECH (SEmiconductor Manufacturing TECHnology) has been established in the United States in reaction to the domination of the global market for semiconductor memory chips by Japanese firms. 14 firms proposed the creation of this research, development and testing consortium in the semiconductor manufacturing industry and called for federal contributions. The initial purpose of this R&D consortium was to recover market share from Japanese firms and to reestablish supply and materials infrastructure in the United States (Ferguson, 1988; Browning, Beyer and Shetler, 1995). SEMATECH is only open to firms headquartered in the United States or substantially controlled by U.S. citizens. SEMATECH supports three broad categories of research projects[†]: Joint Development Projects (JDP), Equipment Improvement Projects (EIP) and SEMATECH Improvement Projects (SIP) (Link, Teece and Finan, 1996). SEMATECH's board decides which projects, from a large number of projects proposed, to initiate. In each of these projects, the SEMATECH research facility in Austin, member firms, equipment suppliers, and sometimes universities or national laboratories can be involved. SEMATECH's staff includes many employees of member firms, in order to improve the transfer of knowledge from SEMATECH to member firms (Grindley, Mowery and Silverman, 1994). Clear intellectual policies are implemented, and goals, technological 'road maps', rules, cooperative practices, and contracts are consensually defined. This framework of research collaboration favors

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[†] A JDP is intended to develop a new tool, material, or process supporting phase requirements of future generations of technology. In an EIP, either existing manufacturing equipments or systems are improved from a competitive manufacturing perspective. Finally, a SIP is conducted at the SEMATECH research facility in Austin and requires at least six months to be completed.

contribution of each member firm and fosters trust among them (Browing, Beyer and Shetler, 1995).

In the European Union, the creation of a "European research area" has taken place to reduce the overlap among national research policies of the member states, and to remedy the absence of a coherent European policy on research (Georghiou, 2001). EUREKA (European Research Coordination Agency) is an inter-governmental[‡] and 'industry-led' initiative that was launched in 1985 to foster transnational cooperation in Europe on high technology R&D. In particular, EUREKA has been intended to stimulate cooperation between firms and research institutes in advanced civilian technologies. In contrast to SEMATECH, EUREKA has not developed its own central research facility. It has adopted a 'bottom-up' and non-bureaucratic style with a very small secretariat (Georghiou, 2001). It mainly 'labels' selected cooperative projects[§] and makes them eligible for national funding programs. As pointed out by Georghiou (2001) regarding EUREKA, *"characteristics which are particularly appreciated include the flexibility to change the direction of work, 'variable geometry'[**] in choice of partners, strong and controllable IPR and confidentiality protection, a low administrative burden and a clear position with respect to competition law"*. In accordance with the 'industry-led' style adopted, firms, rather than the EUREKA secretariat or any government, propose and define their project in response to their needs. Once the project has been selected, firms' managers decide alone who is involved, how the project is managed, who contributes what, and how the results will be shared. Firms also own 100 % of the intellectual rights of all results deriving from the project. The EUREKA secretariat simply acts as a facilitator, helping participants to communicate, collaborate, and obtain funding from their national government. Participants must define in advance the legal aspects of the collaboration, including confidentiality, cooperation agreement, protection and ownership of results, and exploitation of results (Mothe and Quélin, 2000).

[‡] EUREKA is not an institution of the European Union. It has always had a wider membership, initially including the ten EFTA countries and Turkey and later extending to the current 27 members, including Russia.
[§] Three main types of projects can get the EUREKA label (Mothe and Quélin, 2000; Georghiou, 2001): large 'strategic' projects mobilizing dozens of partners, commanding very large budgets and aiming to structure entire networks; 'umbrella' structures encouraging meetings and new projects, and especially involving small firms; and ordinary projects.
[**] As Georghiou (2001) puts it: *"the term 'variable geometry' is a common usage in the realm of European co-operation. It refers euphemistically to a situation in which countries participate in actions on an à la carte basis with a lack of any obligation to include partners from a particular country for reasons of political or financial equity"*

Finally, the promotion of R&D consortia has a long history in Japan (Branstetter and Sakakibara, 1998). The Ministry of International Trade and Industry (MITI) has taken a central role in fostering the development of these consortia (Hayashi, Hirano and Katayama, 1989; Okimoto, Sugano and Weinstein, 1994; Yamamoto, 1994). One of the famous and most successful R&D consortia in Japan is the VLSI (Very Large Scale Integrated Circuit) project that was established in response to the dominance of IBM and its threat to Japanese computer industry. VLSI's committee was made up of member-firm vice presidents and departmental managers. This committee selected research topics and allocated resources (Sakakibara, 1983), and revised the decisions over the life of the R&D consortium (Kartz and Ordover, 1990). Research employees of each member firm and researchers from MITI's electro-technical laboratory participated in the consortium. VLSI developed clear-cut R&D tasks and goals; hence, better collaboration was possible. Formal and informal exchanges of information among researchers from different laboratories and firms increased throughout the duration of the R&D consortium. The success of VLSI can be attributed in large part to MITI officials, who guided the projects, engaged in pre-planning of the research with the interested firms, and assigned scientists from the MITI electro-technical laboratory to participate in the consortium (Katz and Ordover, 1990). Moreover, the expectation of future subsidies from the ministry and the potential threat of exclusion from future projects encouraged the contribution of member firms and prevented free-riding and cheating.

These three examples of intermediary-governed networks show how mechanisms developed and implemented by intermediary entities may help firms reach their innovation goals. Some of these mechanisms are aimed at facilitating the exchange of knowledge and information between partner firms, and others at generating trust and confidence among them. When spontaneous networks of technology alliances face difficulties in achieving the innovation goals, these intermediary-governed networks offer a highly valuable framework. Therefore, our main questions are: Can we consider these intermediary-governed networks as remedies to imperfections in inter-firm technological networks? Under which conditions should firms try to enter these intermediary-governed networks?

The paper proceeds as follows. First, we examine the inherent conflict between the 'trying to learn' and 'trying to protect' objectives found in technology alliances, and especially in learning alliances (Kale et al., 2000). On the basis of the existing literature, we show, in the second section, how relational, structural, and cognitive embeddednesses can mitigate the

intensity of this conflict. Our third section explores the various network governance models. Finally, we develop propositions regarding the decisions made by firms to enter intermediary-governed networks.

IMPACT OF SOCIAL EMBEDDEDNESS ON
THE CONFLICT BETWEEN LEARNING AND PROTECTING

Conflict between 'trying to learn' and 'trying to protect' in technological networks

As explained in the introduction, although firms can benefit in various ways from engaging in technology alliances, it requires them to cope with an inherent conflict between two competing objectives: the need to learn and the need to protect (Gulati and Singh, 1998; Kale et al., 2000). This conflict originates from the firms' desire to learn know-how and capabilities from their alliance partners and their simultaneous fear of being threatened by the behavior of these partners having similar incentives (Kale et al., 2000). Indeed, as the learning process requires firms to expose their proprietary knowledge to their alliance partners, it simultaneously raises concerns relative to the release of their core know-how and capabilities, and the potential use by these partners of their know-how and capabilities for purposes other than the alliance's. Given that firms do not 'unlearn' and may have hidden agendas driven by the opportunistic desire to access and internalize the partners' core proprietary skills much faster than their partners can, protecting core proprietary know-how and capabilities remains highly relevant within technology alliances.

Relational, structural and cognitive embeddednesses as a means to mitigate the conflict

The duality between learning and protecting in technology alliances and the possible ways to cope with this duality have been explored within diverse theoretical frameworks, and in particular, within Transaction Cost Economics and Social Network frameworks. The driving research question has been: *"What factors enable a firm to not only learn critical skills or capabilities from its alliance partner(s), but also protect itself from losing its own core proprietary assets or capabilities to the partner?"* (Kale et al., 2000). Research on learning alliances has, first, analogized this duality to a 'learning race' (Pucik, 1988; Reich and Mankin, 1986; Hamel, 1991), in which partners try to 'outlearn' each other. This leads to situations where if one partner contributes too little to the relationship for fear of being

outlearned, the alliance may be doomed to fail (Khanna et al., 1998), and if it contributes too much, its alliance partners can gain the upper hand (Doz, 1988).

According to Transaction Cost Economics research, when the risks of conflict are high, the level of transaction costs will be important and, therefore, more hierarchical governance structures such as equity joint ventures become more appropriate (Williamson, 1985). Transaction Cost analysis argues that, equity joint ventures help to align incentives by creating "hostages" that assure each partner has a continued interest in the maintenance of the agreement (Williamson, 1983; Pisano, 1989).

Another stream of research rooted in the Social Network literature has, instead, explored the way so-called 'social embeddedness' can mitigate conflicts in alliances. The majority of strategic alliances are contractual in nature without equity-sharing (Hagedoorn, 1996). Therefore, it is interesting to analyze whether social embeddedness contributes to the reduction of transaction costs and so reduces the need for more hierarchical governance structures (Gulati, 1995). The concept of social embeddedness has been introduced in economic sociology by Granovetter (1985, 1992), who studied how the economic actions of actors and the outcomes of their behavior can be affected by both their dyadic (one-on-one) relationships (referred to as 'relational embeddedness') and the broad structure of their overall network of relationships (referred to as 'structural embeddedness'). Since then, an extensive body of research has emerged studying the distinct levels of embeddedness (Granovetter, 1992; Uzzi, 1997; Lam, 1997; Gulati, 1998; Gulati and Gargiulo, 1999; Dacin, Ventresca et Beal, 1999; Hite, 2003; Simsek, Lubatkin and Floyd, 2003; Hagedoorn, 2006) and, especially, the distinction between relational and structural embeddednesses.

In line with Nahapiet and Goshal (1998), we take this distinction one step further and consider three levels of embeddedness: the relational, structural and cognitive embeddednesses. Figure 1 offers a schematic description of these three types of embeddedness. The network of technology alliances of firm A consists of four technology alliances (direct ties) with firm B, firm C, firm D and firm E. Relational embeddedness refers to the quality and depth of these four dyadic relationships. The network of technology alliances of firm A consists also of two indirect ties resulting from its relationship with firm B, which is itself engaged in two other technology alliances with firm F and firm G. These direct and indirect ties reflect the structural embeddedness of firm A. Finally, cognitive embeddedness refers to the proximity in

the representations, interpretations and systems of meaning among firms composing the network of technology alliances of A.

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Insert Figure 1 about here

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In the following, we explain how the levels of embeddedness affect the intensity of the conflict between 'trying to learn' and 'trying to protect'; in other words, we intend to show how relational, structural and cognitive embeddednesses can help partners balance the acquisition of new capabilities with the protection of existing proprietary assets in alliance.

Relational embeddedness refers to specific dyadic ties. The level of relational embeddedness increases with the quality and depth of personal connections and relationships between the alliance partners (Granovetter, 1985; Uzzi, 1996, 1997). It therefore captures a variety of phenomena such as trust, respect, information sharing, confiding, familiarity and friendship (Uzzi, 1997) but also the degree to which partners consider one another's needs and goals (Granovetter, 1992). Previous research has shown that prior relationships between partners tend to increase the relational embeddedness for subsequent alliances thanks to mutual trust, respect and friendship (Podolny, 1994; Burt and Knez, 1995; Gulati, 1995; Gulati and Gargiulo, 1999). Indeed, Gulati (1995) and Dyer and Singh (1998) explain that firms have a higher propensity to engage in alliances with firms with which they have collaborated before. Allying with previous partners enables firms to economize on costs and time necessary to search for trustworthy and valuable partners.

Relational embeddedness can affect the intensity of the conflict between learning and protecting in technology alliances for two main reasons. First, at the learning level, the existence of close relationship between the alliance partners can facilitate the learning process. A close relationship enables them to better understand where the relevant information, know-how and expertise reside in the partner and who exactly possesses it (Dyer and Singh, 1998; Kale et al., 2000). Moreover, prior research has shown that the presence of close and intense interaction (von Hippel, 1988; Marsden, 1990) and an iterative process of exchange (Arrow, 1974; Badaracco, 1991) facilitate the transfer of know-how, which is tacit and sticky by nature. Second, at the protection level, the mutual trust and confidence that characterize high relational embeddedness reduce the need for protection by minimizing the

likelihood that a party will engage in opportunistic behavior aimed at unilaterally absorbing or stealing information or know-how that is core or proprietary to the other parties (Sabel, 1994; Kale et al., 1999). This type of trust, based upon close interaction and relationship and mainly developed at the personal level, has been compared to 'behavioral trust' by Madhok (1995) and 'knowledge-based trust' by Gulati (1995). This form of mutual trust contributes to the reduction of opportunistic or self-serving behaviors.

Structural embeddedness goes beyond the dyadic level to the broader network in which the dyadic alliance is embedded (Granovetter, 1992; Gulati, 1998). In this paper, we use the concept of structural embeddedness to refer to the overall pattern of connections between firms (Burt, 1992) and, in particular, the presence or the absence of alliance ties between them (Scott, 1991; Wasserman and Faust, 1994). This type of embeddedness includes direct ties between firms (alliance ties) but also indirect ties in the sense that two firms can be tied to a common third-party partner (i.e., they have a same third alliance partner but are not linked in an alliance themselves).

Structural embeddedness can affect the intensity of the conflict between learning and protecting in technology alliances for two main reasons as well. First, at the learning level, studying the influence of various network structures on the efficiency of the learning process and information collection has been at the root of an extant research and has led to numerous debates (Brass, Galaskiewicz, Greve and Tsai, 2004). While closed networks (where direct ties are also indirectly tied to each other) generate trust (Coleman, 1988), networks with 'structural holes' (where direct ties are not themselves indirectly connected but are tied to different portions of the networks) give access to a greater diversity of knowledge and information (Burt, 1992, 2001). Two views thus coexist regarding the influence of network structures on the learning process. One view is that a closed network enhances the coordination of actions and facilitates the exchange thanks to mutual trust and frequent interactions and communication (O'Reilly and Pfeffer, 1983; Coleman, 1988; McCain, O'Reilly and Pfeffer, 1989; Zenger and Lawrence, 1989). The other view is that a network with structural holes favors diversity of skills, information and experience, and gives access to broader array of ideas and opportunities; hence, it enhances capacity for creative problem solving (e.g., Bantel and Jackson, 1989; Ancona and Caldwell, 1992; Pelled, Eisenhardt and Xin, 1999).

Second, at the protection level, common third-party ties (i.e., indirect ties) create an information channel, where opportunistic behavior becomes more easily reported. When network ties are dense and redundant[††], information (or gossip) about uncooperative behaviors circulates more readily among the network's members, who can jointly mobilize sanctions (Brass et al., 2004). This information channel can damage reputation and, thus, serves as an effective deterrent (Raub and Wessie, 1990; Burt and Knez, 1995). It intensifies what Gulati (1995) has called 'deterrence-based trust' and Madhok (1995) calls 'structural trust'. This type of trust arises from the costly (formal or informal) sanctions that might be imposed if partners engage in opportunistic behavior. It thus alleviates the fear that partners act opportunistically (Bradach and Eccles, 1989).

Finally, cognitive embeddedness refers to the proximity in the representations, interpretations, and systems of meaning among firms (Cicourel, 1973; Abrahamson and Fombrun, 1994; Nahapiet and Ghoshal, 1998; Simsek et al., 2003) within a network. As developed by Tsai and Ghoshal (1998), cognitive embeddedness *"is embodied in attributes like a shared code or a shared paradigm that facilitates a common understanding of collective goals and proper ways of acting in a social system"*.

Cognitive embeddedness can also affect the intensity of the conflict between learning and protecting in technology alliances for two main reasons. First, at the learning level, a consistent cognitive embeddedness within a network of technology alliances can ease the learning process in each alliance thanks to the subsequent idiosyncratic and shared language and vocabulary used in the network as a whole (Nahapiet and Ghoshal, 1998). As explained by Nahapiet and Goshal (1998), a shared language can facilitate the learning process and information collection in three ways: it increases access to people and their information and fosters the transfer of this information; it provides a frame of reference for observing, interpreting and understanding the partners' know-how, but also for evaluating the benefits of the exchange; and it enhances the combination capability. Second, at the protection level, the need for protection will be reduced as expectations converge (Williamson, 1991) and common broad rules are used for action under uncertainty (Camerer and Vepsalainen, 1988). Common values, beliefs, and rules enable a convergence of interests that renders opportunistic behaviors less likely (Ouchi, 1980).

[††] Alliances are considered as redundant when they provide access to the same information (Burt, 1992), or complementary capabilities (Gomes-Casseres, 1994).

Figure 2 summarizes the three levels of embeddedness.

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NETWORK GOVERNANCE MODELS

Considering the influence of social embeddedness on the conflict between 'trying to learn' and 'trying to protect', it becomes clear that low relational embeddedness, unfavorable structural embeddedness and limited cognitive embeddedness can be damaging for the success and performance of a technology alliance. However, reaching an 'ideal' level of social embeddedness is far from simple and automatic. Indeed, building a network of technology alliances is for firms a long, hazardous and highly resource-consuming process. Moreover, networks do not 'naturally' offer favorable levels of embeddedness. When firms face difficulties in developing their network of technology alliances or cannot efficiently benefit from their social network, they can decide to enter intermediary-governed networks, where an intermediary entity is able to facilitate the learning process and to protect against possible opportunistic behaviors.

Provan, Fish and Sydow (2007) and Provan and Kenis (2008, 2009) have recently pointed out the dearth of research on the way inter-organization networks govern themselves. In contrast to traditional research in the Social Network literature, their focus is on the structures and processes of the entire network rather than on the organizations that compose the network. Networks should not only be seen as mechanisms of social embeddedness but also as mechanisms of coordination and governance (Jones, Hesterly and Borgatti, 1997; Grabher and Powell, 2004; Provan, Fish and Sydow, 2007). In reaction to the lack of research exploring how activities occurring within a network are managed and coordinated, Provan and Kenis have developed a typology of network governance models. They have identified three basic network governance models: shared or participant governance, lead organization governed, and network administrative organization (NAO) governed. First, networks adopt the shared or participant governance model when they are collectively governed by the network members themselves with no distinct and formal administrative entity. The strength of this model is its flexibility and its responsiveness to the needs of network members. Second, networks with lead organization governance are coordinated through and by one of the members. Usually,

this member can play this lead role due to its size, bargaining power, resources or legitimacy. It makes all the decisions, manages the network activities and assists the member firms in achieving network goals. An example of this model is the Japanese Keiretsu. The strength of this second model is to avoid the frequent inefficiency of the shared governance models in the long run. However, resentment, resistance and lack of contribution may appear under this second model; especially when the agenda of the lead organization dominates the other network members. Third, the NAO governance model corresponds to what we call the intermediary-governed network. This model implies that a separate administrative entity is created specifically to manage and coordinate the network and its activities. This entity may be a single individual playing the role of facilitator or broker, or it may be a formal organization consisting of an executive director, staff, and board (McEvily and Zaheer, 2004; Provan, Isett and Miward, 2004). Regarding the specific case of government run NAOs, Provan and Kenis (2008) write: *"Government run NAOs are generally set up when the network first forms, to stimulate its growth through targeted funding and/or network facilitation and to ensure that network goals are met (Goldsmith and Eggers, 2004). Such NAOs are established locally for purposes of accomplishing broad goals, such as those related to regional economic development (Gebauer, Nam, and Parsche, 2005; Piore and Sabel, 1984; Saxenian, 1994)"*.

Figure 3 offers a graphic illustration of the NAO governance model. Under this model, firms can still interact and work with one another outside the network governed by the intermediary entity (as it is the case between firm A, firm B and firm F, and between firm E and firm G). However, the alliances taking part in the intermediary-governed network are coordinated through and by the separate intermediary entity.

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INTERMEDIARY-GOVERNED NETWORKS AS REMEDIES
TO UNFAVORABLE LEVEL OF SOCIAL EMBEDDEDNESS

For the sake of clarity of exposition, we consider, in the following analysis, each type of embeddedness separately and examine how intermediary-governed networks can help firms

remedy unfavorable levels of relational, structural and cognitive embeddednesses respectively.

Intermediaries and relational embeddedness

As explained before, high relational embeddedness can help partners overcome the duality between learning and protecting in technology alliances. However, a close relationship between alliance partners is not always present and the level of mutual trust, respect and friendship may be low. In this context, firms can decide to enter an intermediary-governed network like a government-sponsored R&D consortium. Indeed, at the learning level, the intermediary entity can directly intervene in the dyadic tie and assist the learning process by putting at the firms' disposal specialist facilities, performing collective activities such as training and seminars, developing prototypes and pilot facilities, or conducting tests and diagnostics. When firms have no potential partner that is close enough to successfully transfer knowledge, entering an intermediary-governed network might become valuable.

> *Proposition 1: The lower the relational embeddedness between a firm and its current and potential alliance partners, the higher the likelihood that it enters intermediary-governed networks to benefit from mechanisms - like tests, diagnostics, or development of prototypes - enabling to favor the learning process at the dyadic level.*

Second, at the protection level, intermediary-governed networks can reduce the risk of opportunistic behavior in the dyadic tie via standards, norms and regulation. Indeed, when mutual trust is absent, standards, norms and regulation promoted by intermediary entities such as SEMATECH or EUREKA are useful mechanisms to counteract possible opportunistic or self-serving behaviors. While these mechanisms can 'formally' drive and calibrate the dyadic relationship; intermediary entities may also use less 'formal' mechanisms such as the development and diffusion of values and culture (Jones, 1996; Jones et al., 1997). These formal and informal schemes enable partners to reduce the risk of opportunism but may also lead to direct sanctions ranging from ostracism to financial penalties. These sanctions make the opportunism more costly and reduce the likelihood that firms will exploit the alliance partners' vulnerabilities even if there is an opportunity to do so. As a result, when a firm cannot benefit from strong relational embeddedness with its current or potential partners to

prevent opportunistic behaviors, it will find valuable to enter intermediary-governed networks to remedy the absence of mutual trust and confidence.

Proposition 2: The lower the relational embeddedness between a firm and its current and potential alliance partners, the higher the likelihood that it enters intermediary-governed networks to benefit from mechanisms - like standards, norms, regulation, values or sanctions - enabling to reduce the risk of opportunistic behaviors at the dyadic level.

Intermediaries and structural embeddedness

We have previously explained how structural embeddedness can mitigate the conflict between 'trying to learn' and 'trying to protect' in technology alliances. First, the structure of a network is critical for firms to determine with whom to ally - as direct and indirect ties convey information about the resources and capabilities (important for learning aspects) and reliability and credibility (important for protection aspects) of potential partners. Second, network structure can promote learning - a closed network facilitates coordination, and structural holes enhance creativity in the problem solving - and protection - the structure can create information channels through which information about opportunistic behaviors is easily diffused and thus reputation damaged.

However, developing a network of technology alliances that enables identification of 'ideal' partners and optimal learning from alliance partners while simultaneously protecting against opportunism is far from trivial. Intermediary-governed networks form an important option in this respect as governance is centralized. First, intermediary entities can act as brokers and permit firms to gather superior information on each other as they have the ability to collect and diffuse information about firms' resources, capabilities, and needs (Hagardon and Sutton, 1997; McEvily and Zaheer, 1999) as well as information about firms' reputation (Hadfield, 2000). They contribute to the appropriate match between partners in terms of resources and skills but also reduce the risks for firms to ally with recurrent opportunistic partners. Moreover, they can encourage and ease the rapprochement between firms that might not normally work together (Provan and Kenis, 2008).

Proposition 3: The less favorable the structural embeddedness of a firm within its own network of technology alliances, the higher the likelihood that it enters intermediary-governed networks to benefit from mechanisms - like collection of information about partners reputation, and partners' resources, skills and capabilities - enabling to identify partners that are trustworthy and have the necessary set of resources, skills and capabilities.

Second, the intermediary entity and its staff may play a key role of governance as they can coordinate the inter-dependent tasks, ensure the transfer of the knowledge among member firms, but also monitor the interactions and resolve possible disputes and conflicts (Provan and Kenis, 2008). Moreover, they are able to publicize defaults under the rules and, thereby, can threaten firms to damage their reputation in the event of opportunistic behavior. Their ability to implement reputation mechanism is highly valuable for firms when their own network structure does not allow mutual hostage situation. One might consider this intermediary entity as a nexus of multiple relationships (Howells, 2006) and, thus, as a keeper of indirect channels for information and reputation effects. Opportunistic behaviors become more easily reported within the intermediary-governed network and sanctions can be mobilized.

Proposition 4: The less favorable the structural embeddedness of a firm within its own network of technology alliances, the higher the likelihood that it enters intermediary-governed networks to benefit from mechanisms - like coordination of network activities - enabling to favor the learning process throughout the network.

Proposition 5: The less favorable the structural embeddedness of a firm within its own network of technology alliances, the higher the likelihood that it enters intermediary-governed networks to benefit from mechanisms - like threat of reputation damage or internal dispute resolution mechanism - enabling to reduce the risk of opportunism.

Intermediaries and cognitive embeddedness

As mentioned before, when the network of technology alliances is characterized by strong cognitive embeddedness, the conflict between 'trying to learn' and 'trying to protect' is likely to be reduced. However, a commonality of values, visions, and languages is not observed in every network. Developing this commonality is a long process and does not necessarily appear with the 'natural' evolution of the network. Sometimes, the intervention of intermediary entities can be determinative in this respect. Specifically, intermediary entities can foster a convergence of goals and visions within the network. As explained by Howells (2006), numerous intermediaries have emerged in technology industries to respond to the difficulties firms sometimes meet in identifying their own precise technological potentials and needs, and in defining an innovation and business strategy to adopt. To this end, these intermediary entities, often at the strategic level between the policy level and the operational level, perform fundamental activities such as technology forecasting (for instance, road maps and technological watch), and may also help individual firms articulate their needs and requirements. Services supplied by intermediary entities at this preliminary innovation stage are then various: diagnostics, scanning and technology consulting. When assisting firms at this preliminary stage, intermediary entities have the ability to influence the strategic and innovation choices of the members, and thereby to promote a convergence of representations, interpretations, and systems of meaning among them. As a result, when the firms' technology alliance network does not show a commonality of values and visions, it is more likely that this firm will enter intermediary-governed network, where potential partners are committed to network-level goals (Provan and Kenis, 2008). As written by Provan and Kenis (2008): *"when there is general consensus on broad network-level goals, both regarding goal content and process, and in the absence of hierarchy, network participants are more likely to be involved and committed to the network and more likely to work together"*.

Moreover, intermediary entities may be involved in the protection and commercialization of results. They can provide alliance partners with IP advice and management, and help them identify market opportunities and develop business plans. When guiding firms at these downstream stages in the innovation process, intermediary entities have the ability to increase the legitimacy of the network as a whole and of its members as they foster the speed of diffusion and uptake of new products and services for subsequent customers. Hence, this is

another opportunity for intermediary entities to stimulate a network culture, a convergence of representations, interpretations, and systems of meaning among them.

> *Proposition 6: The more limited the cognitive embeddedness within a firm's network of technology alliances, the higher the likelihood that it enters intermediary-governed networks to benefit from mechanisms - like diffusion of network goals, visions and values - enabling to favor the learning process and to reduce the risk of opportunistic behaviors within the network.*

CONCLUSION

The main purpose of this paper has been to understand the role intermediary entities can play in technology alliance networks. Technology alliances, and specially learning alliances, require the partners to overcome the conflict between two competing objectives: the need to learn and the need to protect. Research in the Social Network literature has shown that social embeddedness through each of its dimensions - relational, structural and cognitive - can influence the intensity of this conflict. In this paper, our intent has been instead to examine how entities other than the alliance partners themselves can help to deal with this conflict. Particularly, we have examined the decision made by firms to enter intermediary-governed networks such as government-sponsored R&D consortia. In intermediary-governed networks, activities are managed and coordinated by a separate and external entity in a centralized way. We argue that entering intermediary-governed networks becomes highly valuable for alliance partners when they cannot benefit from their social embeddedness to deal with the conflict between 'trying to learn' and 'trying to protect'. Indeed, reaching an 'ideal' level of social embeddedness is far from simple. It is for firms a long, hazardous and highly resource-consuming process. When entering an intermediary-governed network, firms can benefit from the mechanisms implemented by an intermediary entity to ease the learning process and protect against possible opportunistic behaviors.

Despite the novelty of our research question, this paper is not without its shortcomings as it does not consider the interrelation between each level of embeddedness. Several studies have however shown that these levels are interrelated in a complex way (Dacin et al., 1999; Hagedoorn, 2006; Hagedoorn and Frankort, 2008); in some cases, they will mutually reinforce each other, in other cases, they won't. We have essentially considered the levels of

embeddedness in isolation. While this limits the richness of our present contribution, it identifies an important area for future works.

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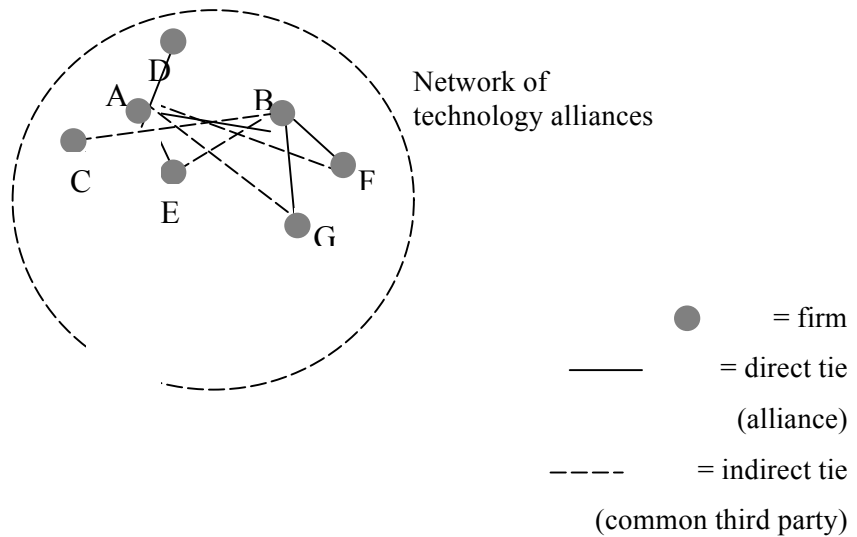Williamson, O.E. (1985). *The Economic Institutions of Capitalism.* New York: The Free Press.

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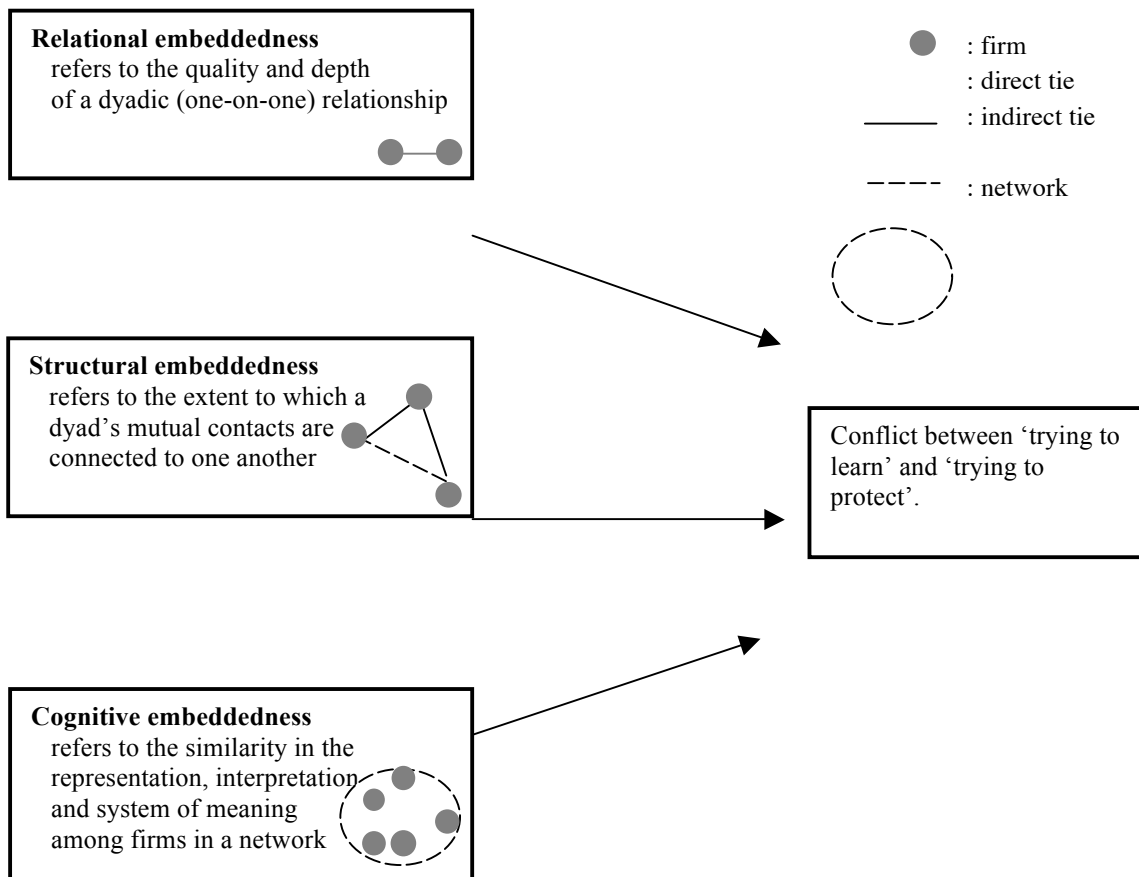
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Figure 1: Relational, structural and cognitive embeddednesses

Network of
technology alliances

● = firm

—— = direct tie
(alliance)

– – – – = indirect tie
(common third party)

Figure 2: Social embeddedness and the limitation of conflicts in technology alliances

Relational embeddedness
refers to the quality and depth
of a dyadic (one-on-one) relationship

● : firm
: direct tie
—— : indirect tie

– – – – : network

Structural embeddedness
refers to the extent to which a
dyad's mutual contacts are
connected to one another

Conflict between 'trying to
learn' and 'trying to
protect'.

Cognitive embeddedness
refers to the similarity in the
representation, interpretation
and system of meaning
among firms in a network

Figure 3: Intermediary-governed network