Fit for the Task: Complementarity, Asymmetry, and Partner Selection in Alliances

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ABSTRACT

Most existing theories of relationship formation imply that organizations establish ties to procure complementary resources, and that doing so adroitly generates relational rents.

While this entails a responsibility for organizations to recognize and harness complementarity, most theories struggle with ambiguity around the concept of resource complementarity, neglect its power implications, and rely on rules-of-thumb that assign no role to managers' intentions.

To explain the formation of ties that successfully combine critical resources, we propose that a positive interplay among resources only exists insofar as organizations use task requirements to guide their combination. As such, a well-matched tie is one that manages task resource interdependence while offsetting imbalances in task-related resources.

We test our theory on project-based, inter-organizational partnerships for public construction in Italy. We find that: (1) The probability of tie formation increases with the quality of the match between the task and actors' resources; (2) There are two distinct, task-related dimensions along which this happens: depth and scope; (3) The effect of these dimensions dwarfs the effect found by measures that assess complementarity irrespective of task; and (4) The probability of tie formation decreases when a task calls for resources that potential partners possess in unequal amounts.

Keywords: complementarity; power; tasks; resource-dependence theory; networks

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INTRODUCTION

While interorganizational linkages have become central to competitive success in many industries, their ability to deliver on their potential depends on multiple factors, with partner selection being one of the most influential (Mitsuhashi and Greve 2009; Shah and Swaminathan 2008).[2] The relevant literature almost unanimously acknowledges that resources are a primary strategic motive for alliance formation (Ahuja 2000; Galaskiewicz 1985; Gulati and Gargiulo 1999) and that crucial complementary assets or capabilities best drive the search for partners (Harrigan 1985) and the likelihood an alliance succeeds (Brouthers et al. 1995)

Recent contributions have integrated these ideas within the framework of matching theory (Mitsuhashi and Greve 2009), which holds as a fundamental tenet that relationships need to simultaneously address the preferences, opportunities, and constraints of all parties, and not just those of a single actor (Logan 1996). In line with matching theory, we frame the question addressed in this study as: "How do firms select *one another* as alliance partners?" Within such a framework, resource complementarity becomes the primary criterion for assessing the quality of the match between two potential partners, as complementary resources and capabilities effectively align partners' preferences on resource-related matters. Matching theory provides a valuable theoretical integration, but its potential in the context of alliance partner decisions will only be fulfilled with two important clarifications, which this paper aims to provide. First, there is a need to correct ambiguities about the concept of resource complementarity as it is commonly used in the research on strategic alliances. With some rare exceptions (e.g., Cassiman and Veugelers 2006), extant theories typically treat complementarity as a stable property of pairs of factors (Ennen and Richter 2010), such as the dissimilarity in partners' resource endowments, or the lack of overlap among the market niches they occupy (Das and Teng 2000; Gulati and Gargiulo 1999; Harrison et al. 2001). However, focusing on the enduring characteristics of a firm dyad makes the matching perspective largely redundant, as it

[2] We use the terms "interfirm linkages," "partnerships," and "strategic alliances" interchangeably to refer to collaborative agreements between interdependent firms to share resources on an ongoing or time-bound basis.

implicitly assumes that firms' preferences, opportunities, and constraints are constant across time and context. Second, matching theory needs to account for the fact that, while the potential for complementarity inspires firms to be interested in one another's resources, one firm's contributions of complementary resources may be larger and more critical than the other's, creating a difference in bargaining power that would render an interfirm linkage less likely to match the preferences of both parties (Casciaro and Piskorski 2005).

In this paper we propose and test a theory in which the complementarity and resource imbalance of a given alliance are inseparable from the task that alliance formed to undertake. In other words, our framework judges an alliance "well-matched" (or not) on the extent to which their alliance begets a pool of resources that is (1) fit for the task at hand and (2) balanced enough to avoid traps of power and dependency in the task at hand.[3] The following statement from the CEO of a pharmaceutical company illustrates the first of these ideas: "Accessing knowledge and resources held by a potential partner is not necessarily beneficial for us; the resources we look for are largely dependent on what we want to do, thus on the task that we want to jointly execute. I will try to establish cooperation with a potential partner as long as it possesses resources that we do not have and that are functional to the goals and the activities we want to undertake. While in principle anyone is complementary, in reality that depends on the tasks that have to be executed."

We build our arguments on the idea that tasks are a useful lens for applying matching theory to alliance partner selection because, by formulating a task, partnering firms generate precise information about their individual objectives, their means for progressing toward them, and/or the constraints each partner faces (Hackman 1969). As such, tasks define which resources are required, and which combinations of resources are worth forming an alliance to obtain. Moreover, by creating demand for specific resources, tasks set the stage for interdependence between a task and the resources assigned to accomplish it. Therefore, to achieve its aims, this study develops constructs for

[3] The distinction between resources and capabilities has been widely adopted in the resource-based view (Amit and Schoemaker 1993) and the managerial literature in general. For the specific arguments developed in this paper, it is not so important whether the assets in questions are "based on developing, carrying, and exchanging information" (one trait that distinguishes capabilities from resources) or not. Therefore, for the sake of conciseness, from now on we will frequently use the term "resources" to refer to both factors.

task-contingent resource complementarity (*task resource complementarity*) based on the extent to which the resources pooled by a given firm dyad meet task requirements and manage interdependence—an approach we argue offers a better fit with a matching theory of alliance partner selection. Furthermore, this research develops constructs for task-contingent resource imbalance (*task resource imbalance*) as a means of capturing the potential that complementary resources pooled for a given task create a power imbalance in a dyad, which we propose as an important additional criteria for judging if a given partnership is well-matched.

We test our theory in the setting of public construction works in Italy. Public construction typically requires the deployment of multiple specialized technological resources and capabilities. Industry players are often unable to master the full range of these factors. Thus, the need to combine complex resources is key in this industry and, as a consequence, it is common for firms to establish collaborations to marshal a resource lineup that would be difficult to assemble and coordinate using arm's-length contracting alone (Eccles 1981). Arguably, collaborating firms that have confidence in their ability to command the right resource mix at the right time, without incurring power-related tensions, should be able to bid more aggressively in construction tenders. If these motives are important, we should see that partnerships that are well-matched for the task at hand are more likely to be established than partnerships that are mismatched or that are well matched purely on dyadic characteristics. We should also see more contracts awarded to well-matched partnerships. Indeed, our empirical findings generally support this hypothesis.

THEORY DEVELOPMENT

Complementarity, Resource Imbalance, and the Partnering Decision

While we argued earlier for the importance of being well matched for the focal task, extant literature rather highlights the need for firms to match dyadic attributes. According to Milgrom and Roberts (1995), complementarity arises when doing more of one activity increases the returns from doing more of another activity. However, network research and work on strategic alliances favor a definition of complementarity that considers the nature of the elements (e.g., resources, activities) being combined. These fields typically discuss complementarity at the interorganizational level, and they variously define complementary assets as those that fill ‘gaps’ (Gulati and Gargiulo 1999) and ‘round out’ (Zaheer et al. 2013) the resources available to a collaboration’s partners. According to this literature, complementarity is found in interactions among dissimilar resources (Das and Teng 2000; Kale et al. 2000), which create synergy (Parkhe 1991) and complement one another’s weaknesses (Chung et al. 2000). Resource dissimilarity also makes firms less likely to compete (Rowley et al. 2005) and more likely to learn from one another (Sarkar et al. 2001). Accordingly, complementarity is supposed to create incentives to form an interfirm linkage.

Resource complementarity is usually operationalized as the diversity in the resource endowments or market niches of the dyad’s members (e.g., Chung et al. 2000; Mitsuhashi and Greve 2009), on the grounds that “firms in different niches are more likely to have complementary capabilities that can make them interdependent and lead to alliances between them” (Gulati and Gargiulo 1999: 1461). In this conceptualization, the resource complementarity of two potential partners grows with the size of their resource endowments and decreases with their overlap. Since the existing literature does not explicitly rule out any resource as the basis for the assessment of diversity, we may refer to this dyadic construct as *general resource complementarity*. Overall, the following baseline hypothesis is consistent with the theory and the findings of this literature:

> **Baseline hypothesis on resource complementarity**: *A higher level of general resource complementarity between two firms will increase the probability that they establish an alliance with one another.*

While complementarity can be a source of interdependence, recent studies have shown that resource interdependence actually comprises two distinct theoretical dimensions: mutual dependence, or the sum of dependencies of two organizations, and power imbalance, or the power differential between them (Casciaro and Piskorski 2005; Wry et al. 2013). It follows that any framework attempting to accurately portray the power–dependence implications of resource complementarity for alliance formation will need to account for the effect of mutual dependence and power imbalance.

Social exchange (Blau 1964; Emerson 1962) and resource dependence (Pfeffer and Salancik 1978) theories provide the classical framework for the study of power. They analyze power as a property of the social relationship (rather than an attribute of the actor), and see it residing in one actor's control over things its exchange partner values.[4] The framework further argues that an actor's power is somewhat neutralized when confronted by a partner with an equal, opposing power. Together this suggests that a pattern of dominance can emerge in dyadic relationships when the critical complementary resources controlled by each partner are imbalanced.[5]

An obvious occasion for the exercise of power is the bargaining process that precedes the reaching of an agreement in any alliance contract, since the conjunction of complementary resources in an alliance generates a surplus (Lippman and Rumelt 2003) and, therefore, motives for the partners to compete over the distribution of that surplus, alongside with incentives to cooperate with one another (Kogut 1989). The bargaining process revolves around the rules by which alliance profits are distributed, as well as the control on the activities of the alliance. Alliance research has proposed and found that the way profits are distributed among alliance partners is strongly linked with the resources they contribute (Blodgett 1991; Mjoen and Tallman 1997) and that the allocation of management control of the partners over the alliance favours the member that has contributed more resources (Bjorkman and Lu 2001; Chen et al. 2009; Mjoen and Tallman 1997). Furthermore, the extent to which a partner achieves its objectives about the alliance is positively related to the degree of management control the partner has over the alliance itself (Choi and Beamish 2004; Yan and Gray 2001). Therefore, it is likely that at the alliance negotiation stage, the partner that can contribute fewer resources will expect to appropriate a smaller share of the surplus, and to wield comparatively less influence over the alliance outcomes. Anticipating such problems, weaker firms may prefer to establish collaborations with partners whose resource endowments are more symmetric. Indeed, some empirical studies have shown that resource imbalance affects both the formation and the outcomes of

[4] Obviously, for such a "control" to exist it is also necessary that the resource is "critical"; that is, that the sheer scarcity of alternatives, or time and place constraints, prevent the partner from accessing alternative resource providers at no cost. The theory we develop focuses on how resource endowments affect bargaining power, and through its mediation, the attractiveness of an alliance. Therefore, it implicitly assumes both a modicum of criticality, and that criticality is not so extreme as to override the resources endowments as the key source of dependence and power. Arguably, this assumption is implicit in all studies that relate resource endowments to inter-partner negotiation.

[5] Usually, in any relevant business environment there are fewer potential providers of large resource sets than of smaller ones, so that other things being equal, larger resource sets are more critical. Accordingly, other things being equal, an actor that commands a larger set of task resources than the partner, tends to be in a dominant position not only because it controls more of relevant resources, but also because the set of its task resources is comparatively more critical.

inter-organizational relationships (e.g., Bae and Gargiulo 2004; Kalaignanam et al. 2007).

As with resource complementarity, extant research does not explicitly exclude any resource as the basis for assessing a potential bargaining power imbalance, except that financing is not considered a crucial source of bargaining power for the firm (Mjoen and Tallman 1997). Therefore, in line with previous terminology, we refer to this dyadic construct as *general resource imbalance*. Overall, the following baseline hypothesis is consistent with the theory and findings of this literature:

> **Baseline hypothesis on resource imbalance**: *A higher level of general resource imbalance between two firms will reduce the probability that they establish an alliance with one another.*

While these hypotheses are useful starting points, we see a need for a more realistic and comprehensive view of the resource-based drivers of partner selection in alliances, since firms can occupy non-overlapping niches without being complementary to one another (Rothaermel and Boeker 2008), and since they are known to enter partnerships not only to access dissimilar resources, but also with the goal of accessing more resources of the same kind (Dussauge et al. 2004; Hennart 1988). Regarding resource imbalances, it seems implausible that any resource an organization is endowed with represents an equally relevant basis of influence. Therefore, it is important to develop a more precise and contextual understanding of power and influence than *general resource imbalance* allows. The next section argues that we can make progress on both issues by applying the concept of task.

Tasks and Resource Interdependence

On account of the aforesaid limitations of general resource complementarity, the challenge we face is to develop a concept of resource complementarity that (1) captures resource-related needs and the opportunities of potential partners, while also making allowances for the contextual factors by which certain resource combinations become complementary; and (2) can account for complementarity of resource sets of the same kind.

Penrose (1959) was concerned precisely with how resources interact with one another and with the process of management (Kor and Mahoney 2000). In her view, resource values are elusive because the new services derived from them, and the development of new ways to use them, are being discovered constantly (Penrose 1959). Furthermore, Penrose saw resources as being valuable not on their own, but in terms of the possible combinations with other resources, the content of which firms specify in "plans" that comprise "a purpose, and (…) the resources to accomplish this purpose in some desired manner" (Penrose 1959: 40).[6] This charaterization closely resembles what the organization theory tradition refers to as "tasks," which consist of a certain predefined objective, along with requirements concerning the resources and actions required for accomplishing that objective (Dill 1958; Hackman 1969). We build on this theory to propose that investigating complementarity and resource imbalance should begin with tasks. By their nature, the tasks a firm commits itself to will suggest what resources are necessary to accomplish them, in turn making clear what gaps in resource endowments a firm needs to fill and what type of alliance partner might be useful toward that end. Strategic alliance research has already discussed the importance of tasks for governance decisions (Casciaro 2003) and for partner selection (Geringer 1991). The next section extends these pioneering studies by going beyond the firm level of the relationship, by identifying different dimensions of task resource requirements, and by discussing task-contingent notions of resource imbalance.

Matching Self to Partners and Tasks

Recognizing that tasks define which resources partners need is only an initial—albeit important — step toward identifying complementary inter-organizational combinations. A second step is to appreciate that, in order for alliances to be effective, firms must meet needs for variety as well as for depth in the sets of knowledge, competences, and assets they control (Katila and Ahuja 2002). This entails that resource dependence may arise based on the scope or depth of resources a task requires, and that it may also relate to resources of the same kind.

However, creating an interorganizational set of resources that interplay positively requires more than simply identifying the necessary resources: their fit with one another, as well as with the task needs to be managed (Thompson 1967). The interdependence between a task and the resources

[6] Penrose was also clear about the subjective nature of those plans (Penrose 1959: 76), and, by implication, about the fact that resource characteristics alone are seldom enough to determine their content. Penrose's theory is also in line with key contributions of the Austrian school of economics, for which "factor complementarity presupposes a plan" and "factors are complements in so far as they fit into a production plan and participate in a productive process" (Lachmann 1947: 110).

assigned to it is a relatively underexplored area (Crowston 1997), particularly in an interorganizational context. However, based on extant literature and on the theory developed so far, we can identify a few general criteria for assessing how well the resource set created by a specific partnership can be said to manage basic aspects of that interdependence. Taken together, these criteria define our concept of resource complementarity for organizational dyads.

First, an interorganizational linkage will be perceived as instrumentally useful only to the extent that it combines resources that are relevant for the task envisioned. Second, its usefulness will be proportional to the extent to which it fills a resource gap in the dyad. A dyadic collaboration that does not completely fill the resource gap may contemplate rounding out the remaining gap by creating a multiparty alliance, but this entails additional costs for search, coordination, and governance (Garcia-Canal et al. 2003). Hence, resource combinations that fill more of a task requirement can be regarded as more complementary. Conversely, resources contributed in excess of the depth the dyad's task requires are most often considered redundant, and as such they don't increase the dyad's resource complementarity. Third, resources in which either party is self-sufficient do not contribute to complementarity: one partner's task-related interest in the other's resources only arises when the focal partner does not possess those resources at a depth sufficient to the task, and this applies to both actors. Therefore, only when both actors are not self-sufficient can there be incentives for them to form a partnership. A final criterion is minimal resource overlap. Except for the case when both parties lack the depth of resources a task requires, the simultaneous possession of a given resource by both parties can be problematic, due to the risk that, after learning about each other's competencies (Khanna et al. 1998), either partner is transformed into a credible competitor. Also, overlapping resources will be redundant and not usefully deployable within the task (Hill and Hellriegel 1994).

Fulfilling these four criteria—relevance, filling gaps, a lack of self-sufficiency, and minimal overlap—is likely to result in an inter-organizational collaboration that rounds out the resources of its component partners better than collaborations that do not fulfill these criteria, leading to greater efficacy and efficiency in performing the focal task. In short, these criteria can form the basis for the assessment that a given alliance is "more resource-complementary" than an alternative alliance. Broadly, these criteria apply to both the scope and depth of task resources. However, when resources are pooled, we can expect the value-creation mechanisms for same-type resources to be somewhat different from those for different-type resources (Zaheer et al. 2013). Therefore, it is meaningful to apply these criteria separately to the depth and scope dimensions, to define the two constructs of *task resource-depth complementarity* and *task resource-scope complementarity*, and posit that:

> **Hypothesis 1a**: *A higher level of task resource-depth complementarity between two firms will increase the probability that they establish an alliance with one another.*

> **Hypothesis 1b**: *A higher level of task resource-scope complementarity between two firms will increase the probability that they establish an alliance with one another.*

The logic we are unfolding also affects our views on issues of power. Indeed, a precise description of power in interorganizational linkages must account for the importance of a given resource for the dependent party (Pfeffer and Salancik 1978). Since we have argued that it is largely the task that determines an organization's interest in certain resources, other things being equal, the task also determines a firm's level of resource dependence and the power of potential partners.[7]

One implication of this view is that power asymmetries in the focal dyad are unlikely to be substantially affected by resources actors possess outside the task resource set. A second implication is that if a party is sufficiently endowed with a certain resource for a given task, it will not be dependent on other parties for that resource and that task. However, task resources in which the parties are not self-sufficient are precisely those that lead to task complementarity. Therefore, our framework implies that imbalances in task-related complementary resources will have a bearing on power and dependence, and consequently on the prospect of establishing an alliance. In sum, assuming interest in the focal task, and the presence of the other conditions that shape resource dependence—the resource is important, alternative resource providers are scarce, and an actor holds discretionary power over the resource (Pfeffer and Salancik 1978)—imbalances in the endowments of task resources should reduce the likelihood that an alliance is established.

The distinction between resource depth and resource scope has bearing here as well. Resource depth involves same-type resources while resource scope involves different-type resources. When

[7] This *ceteris paribus* condition refers again to criticality. Analyzing dependence and power in terms of endowments of task resources carries the implicit assumption that the sets of resources in question are moderately critical, and that their criticality is not so extreme as to prevail on endowments of task resources as the main source of dependence and power.

partners pool resources of the same type, arguably there will be smaller information asymmetries and each party will be better positioned to assess the value of the other's contributions. Accordingly, it can be expected that the rules for sharing the alliance surplus, and for allocating control rights, will more closely reflect the value of each party's contributions, and will be less reflective of sheer bargaining power. Further, if the purpose of pooling same-type resources is to reach the minimum efficient scale, it is likely those resources will be deployed jointly, with an additional improvement in monitoring capability. Therefore, we can expect that imbalances in same-type task resources will give the power-advantaged party fewer opportunities to appropriate value in excess of an alliance's agreed terms. Overall, imbalances in same-type task resources may still be a deterrent of alliance formation, though not as strong as imbalances in different-type task resources. These insights allow us to advance the two related constructs of *task resource-depth imbalance* and *task resource-scope imbalance*—imbalances, respectively, in stores of same-type and different-type task resources.

> **Hypothesis 2a**: *A higher level of task resource-depth imbalance between two firms will reduce the probability that they establish an alliance with one another.*

> **Hypothesis 2b**: *A higher level of task resource-scope imbalance between two firms will reduce the probability that they establish an alliance with one another.*

METHOD

Research Context: The Construction Industry

We perform this study in the context of public works commissioned by governmental bodies in Italy. Each project—for example, land reclamation or the construction of roads, buildings, railways, water purification plants, power stations, etc.—comprises a macro 'task' that firms bid to perform. This context provides an ideal setting for the investigation of partnership formation for two main reasons. First, in response to public calls for tenders many construction companies submit joint bids.[8] They do so through a specific organizational form that is based on the model of the contractual joint venture: the so-called *Associazione Temporanea d'Impresa*, or ATI. Companies that form an ATI and are awarded a contract become jointly responsible for the execution of the construction works, and their

[8] If they do so, they will be prevented by existing regulations from submitting bids for the same project as members of a different coalition, or as a standalone bidder. This puts pressure on industry participants to select their partners carefully.

association expires at the completion of the works. The legal framework also requires that ATI members publicly designate one member to take the leading role, and to represent the ATI in its relationship with the contractor. According to industry experts we have interviewed, this firm (henceforth, the Lead Firm) is the pivotal actor in the process of partnership formation, in the sense that it is the one that extends offers to other firms (hereafter, Partner Firms) to form an ATI. Overall, in this context inter-organizational collaborations are common and structured in a similar way. Moreover, the assignment of roles in each collaboration is visible to external observers.

The second reason is that public procurement legislation requires large amounts of information to be disclosed, including information on technological resources and the organization of the bidders. Most relevant for this study is the fact that for projects above five million euros, each invitation to tender (1) analyzes the task it envisages and identifies the various resources it requires, classifying them according to standardized technological categories (e.g., excavation, flooring, street furniture, dredging, topographical surveying, railway superstructure, and many more), and (2) specifies the economic amount of the work in each category. This information is a close empirical correlate of what we earlier called 'the resource requirements of the task.' Equally important is the fact that bidding firms are required to show evidence of their capability to perform the task properly, through a certification of resources and competence issued by a specialized and authorized certification body.[9] These legal requirements make it possible for various actors to assess the match between task characteristics and bidders' skills. They also generate information that is extremely useful for the operationalization of our complementarity and power constructs.[10] This information demonstrates that our research setting adequately captures the conditions of resource criticality that underlie our theory development. In fact, for all task resources a large number of alternative providers is always available,

[9] A certificate attests to a firm's capability in particular technological areas, classified by type and depth of competence, with the same taxonomy that public bodies must use to analyze the resource requirements of construction works. The assessment is based on the firm possessing the appropriate technical equipment and personnel, necessary organizational competences, and a track record of performing works of adequate complexity. Therefore, the laws and regulations that govern this field of activity require the measurement (and disclosure) of capabilities that are simultaneously technological and organizational, and are based on concepts that closely approximate the scholarly understanding of capabilities.

[10] Additional regulations set restrictions on the use of subcontracting, especially for works characterized by technical complexity. These restrictions ensure that the execution of a construction project depends on the resources and capabilities the winning coalition possesses at the time of submitting the bid, and that the resources hired from third parties cannot be used to make up for a resource deficit among the bidders.

indicating that criticality is at most moderate. At the same time, a modicum of criticality also exists, due to the need to form ATIs within the deadlines for the receipt of tenders, and the preference of industry participants for forming ATIs with geographically proximate partners.[11]

Econometric approach

We examine factors affecting the likelihood that a pair of firms forms an alliance to jointly bid a construction project contract. Accordingly, the unit of analysis is the triangular configuration of elements (j_1, j_2, z), where j_1 indicates the Lead Firm, j_2 the Partner Firm, and z the Task (in this case, the construction project for which bids are solicited). In all models we estimate the probability that Lead Firm j_1 makes an invitation to Partner Firm j_2 to form an alliance for project z and that j_2 accepts. Thus, our dependent variable is the presence or absence of the j_1–j_2 link in construction project z.

We created these triangular configurations from data on Italian public construction projects offered for tender, and granted, between 2006 and 2008. Since most small projects are carried out by single firms, we focused our analyses on calls for tenders for large- and medium-sized projects (above a threshold of 30 billion Italian lira). We then excluded contracts awarded to single firms, since these would be uninformative about our outcome of interest (the formation of one particular triangular configuration out of many possible ones). In all, 474 contract-winning ATIs fulfilled these requirements. We discuss later the implications of performing our study on contract-winning ATIs. The Telemat database was the source for both the invitations to tender and the contract award notices. We obtained information about firm resources from the Italian Authority for the Supervision of Public Contracts (IASPC), and about other firm characteristics from the Amadeus database.

To investigate what criteria firms use to extend and accept alliance invitations, we compared realized ties ("cases") with those that did not happen ("controls"), a common approach in tie-formation studies (Gulati and Gargiulo 1999; Sorenson and Stuart 2001). Our sample creation

[11] Prior benchmark studies of bargaining power in alliances (Yan and Gray 2001) have treated as instances of low criticality cases in which six or more alternatives for an alliance partner were available. In our sample, for all task resources there were at least as many resource providers, and usually many more. In robustness analyses we excluded from the sample those projects that involved resources for which there were no more than 12 suppliers, and we obtained the same patterns that we observe in the full sample. As to the preference for geographically proximate partners, regression results made it clear that distance is a strong deterrent of alliance formation.

procedure began by ascertaining the cases that fit our criteria. These were obtained by disaggregating each of the 474 contract-winning ATIs (whose membership ranges between two and eleven firms, with 3.01 being the mean) into dyads formed by their Lead firms and the other ATI members.[12] This step let us extract 749 dyads; however, only 316 of them, related to 189 projects, were useable on account of the others missing critical information.[13] While this loss of data is unfortunate, it applies equally to cases and controls (i.e., it leads to the deletion of all those non-cases that share Lead and Task with the 316 cases). This entails that the associations we estimate between the predictors and the outcome of interest are unbiased (Wacholder et al. 1992). This exclusion naturally limits the generalizability of findings from the study base (cases and non-cases) to the general population. However, an analysis of the causes of the missing data, and the results of t-tests of difference of means, indicate that this attrition does not seriously compromise the representativeness of our sample.[14] Sample creation went on with the selection of the control series, that is, of the non-observed ties. The function of controls is to represent the distribution of the focal variables in the same closed population that gave rise to the cases, and that is ensured by random sampling (Gerstman, 2013). However to help control for potential confounding factors, each case was matched by controls that share the same Lead Firm and Task (i.e., the elements j_1 and z). As potential partners we used the set of all 771 firms that, during the sample period, participated in at least one contract-winning ATI—thus demonstrating a willingness to engage in an inter-organizational relationship—provided that they possessed at least one of the capabilities required for the focal Task z—thus qualifying as credible partners. Following advice from Gail et al. (1976), we matched controls to cases on a 4:1 ratio. As a result our dataset is composed of 316 realized ties (cases) and 1,264 simulated ties (controls). The

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[12] If the same dyad was formed for two distinct projects, it gave rise to two distinct cases.

[13] Because almost all missing data are caused by it being impossible to identify the Lead, the Partner, or the task, for almost all such cases we are entirely missing one or more array of resource-related variables (each one comprising 47 variables), as well as information on other attributes of the missing element(s). Accordingly, the remaining observed case attributes were too narrow a base for performing a valid imputation of the item-missing values (Carpenter and Kenward 2013).

[14] The failures seem to depend on rather trivial reasons, such are carelessness in reporting (such information is publicly available from other sources, though difficult for researchers to retrieve retrospectively). Thus, the ensuing selection seems to depend on a host of small random disturbances rather than on a single systematic process. The t-tests of difference of means indicate that our core sample comprises more public tenders (66 percent) than the set of item-missing cases (47 percent). This is unsurprising, because for private tenders it is likely to be more difficult to ascertain the identity of the partners and the type of works involved. Tests results available from the authors upon request.

ensuing dependent variable, *Tie Formation*, is binary, taking the value 1 when a tie was realized (that is, an alliance was formed) and 0 when it was simulated. When performing the analyses, we used a conditional logit procedure, which is commonly employed with matched data (Hosmer et al. 2013). Conditional logistics is a fixed-effect method, which uses only within-stratum differences (i.e., differences within the set composed of an observed case and its matching controls) to compute the model parameters, essentially discarding any information about differences between strata (Allison 2005). This way, the effects of stable characteristics within each stratum are controlled for.[15] Conditional logistics also relaxes the assumption of independence of the errors within clusters, to deal with the fact that, in a matched case-control design, controls are selected in groups (Katz 2011).

MEASURES

Hypothesis-testing Variables

Our hypothesis-testing variables are based on task resource requirements and on firms' resource endowments. The former were extracted from the tender invitations, where, for each project, we found a particular set of task resources, which we called *I*. Overall, the law identifies 47 such resources that are relevant for construction projects.[16] Henceforth we indicate the count of the elements required for a particular project as $| I |$ and a particular resource in that set as *i*. We then use an integer scale from 0–8 to indicate the resource requirement, TRQ_i, that any given task poses on *i*.[17]

From the IASPC database, we collected firm-level information for the 47 categories, with R_{ji} indicating firm *j*'s endowments for resource *i*. R_{ji} is measured using the same 0–8 scale, where 0 indicates no endowment of the particular resource and 8 an endowment that is deep enough for performing work of any size requiring that resource. Among our realized ties, the number of task resources ranged from 1 to 18, with an average of 4.9. A Lead Firm possessed an average of 2.09 resources in amounts equal to or larger than required by the task (plus other resources in lesser

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[15] Specifically, our sample controls for the attributes of the task, the Lead Firm, and their match.
[16] These comprise things such as flooring, street furniture, dredging, and topographical surveying. Full list available from the authors.
[17] The scale of TRQ is established by the laws regulating bidding for public works contracts. The scale comprises nine categories, defined by a certain range of economic value assigned to the work a project requires. The upper limit of any given category is typically about twice as large as the upper limit of the previous category. Therefore, the scale is approximately log-linear.

amounts), while a Partner Firm averaged 1.00 resources. Simulated ties exhibited similar figures. To compare effect size across predictors, all variables except binary ones were standardized.

General Complementarity. We followed previous studies by operationalizing the resource non-overlap of a dyad's partners with the Euclidean distance between them in the space of 47 technical resources that are monitored by the IASPC, that is, with $[\Sigma_i(R_{Ai} - R_{Bi})^2]^{1/2}$. To make partnerships between small firms comparable with those among larger ones, we divided this figure by the average endowments of technical resources of the two actors in the dyad, A and B: $\frac{1}{2}[\Sigma R_{Ai} + \Sigma R_{Bi}]$. The theoretical value of this variable ranged from 0, corresponding to complete resource overlap, to 2, corresponding to no overlap. The observed range was 0 to 1.58.

General Imbalance. To capture the potential for asymmetic stores of resources to create a power imbalance as it is frequently measured—at the dyadic level—we used the expression $abs[\Sigma_i(R_{Ai} - R_{Bi})]$, calculated over the same set of resources as General Complementarity. Based on the degree to which these differences offset each other, this measure indicates the extent to which the resource endowments of the partners were in balance.

Depth Complementarity. To capture the degree to which two firms cover a particular task's resource needs, and fulfill the four criteria spelled out in the theoretical section, we set resource *i*'s depth complementarity, DC_i, to 0 if either (a) the task did not require the resource or (b) either of the partners could have singlehandedly fulfilled the need for *i*. DC_i was set to 1 when partners' joint resources exceeded the task requirements. And, finally, for values in-between we calculated to what degree the partners fulfilled the task requirement TRQ_i. Therefore, for two partner firms, A and B:

$DC_i = 0$	if $TRQ_i = 0$ or $R_{Ai} \geq TRQ_i$ or $R_{Bi} \geq TRQ_i$
$DC_i = 1$	if $(R_{Ai} + R_{Bi}) > TRQ_i$
$DC_i = (R_{Ai} + R_{Bi}) / TRQ_i$	otherwise

Finally, we computed an aggregate measure of Depth Complementarity using the mean value of the DC_i*'s* over *I*. Using an average is the same as using a unit weight, and this assumes that all resources are equally important, disregarding that task requirements vary. Therefore we performed robustness tests using *Weighted Depth Complementarity*, which weights the DCi's by the values of the task requirements, TRQ_i's—that is, more important resources receive a greater weight. Variables for robustness checks were created, on similar principles, for the remaining focal variables, as well.

Scope Complementarity. This variable captures the fit of different firms based on the different task resources they possess. This variable logically increases with the number of non-overlapping task resources the firms possess. To avoid overlap with Depth Complementarity, we excluded from the computation those resource categories that a partner did not possess in sufficient amounts to complete the project. Therefore, we first identified the subsets of task resources that either party possessed in sufficient amounts and we called them, respectively, *H* and *K*.[18] We next identified the set complements to *H* and *K*, that is, the resources in *H* and *K* that did not overlap (in set theory notation, $H\backslash K$, and $K\backslash H$ – read: "*H* not in *K*" and "*K* not in *H*"). Finally, we defined scope complementarity as the count of resources in the two set complements, as a proportion of the count of resources in *I*:

$$\textit{Scope Complementarity} = (|\, H\backslash K \,| + |\, K\backslash H \,|) \,/\, |\, I \,|$$

Depth Imbalance. We defined task resource-depth imbalance as the inequality in resource endowments of depth complementary resources held by two partners. Let *J* be the set of such resources, such that $J= \{i \,/\, DC_i>0\}$. Then, in line with Lawler and Yoon (1996), the depth imbalance DI_i of resource *i* can be defined as follows:

$$DI_i = 0 \qquad \text{if } i \notin J$$

$$DI_i = 1 - [\min(R_{Ai}, R_{Bi}) / \max(R_{Ai}, R_{Bi})] \qquad \text{otherwise}$$

By construction, DI_i ranges between 0 and 1, and increases with the difference between the parties' endowments of resource *i*. In line with exchange theory, we allowed for the possibility that an imbalance in favor of B in one resource might offset an imbalance in favor of A in another resource, thus preventing the emergence of a pattern of dominance. Accordingly, we averaged the DI_i's across the resources in *J,* but only after assessing their direction through the sign function, to take offsetting into account. Then we took the absolute value of the resulting indicator, as follows:[19]

[18] If the two parties are, respectively, A and B, in set theory notation *H* and *K* are defined as: $H = \{h \,/\, R_{Ah} \geq TRQ_h\}$, $K = \{k \,/\, R_{Bk} \geq TRQ_k\}$, with $H \subseteq I$, $K \subseteq I$.

[19] Averaging the DI_i's across the whole set of task resources would be perhaps more intuitive, though not consistent with our definition of task resource-depth imbalance. Besides, putting them in relation with a wider set of resources would 'water down' these imbalances. In any case, the choice of the denominator of Depth Imbalance has no practical consequence on our findings.

Depth Imbalance = abs [$\sum_i$ (sgn(R_{Ai} - R_{Bi}) · DI_i)]/ |*J* | $i \in J$

Scope Imbalance. We defined scope imbalance as the imbalance in scope of complementary task resources, and calculated it in two steps. First, we identified the subsets *H* and *K* of task resources that either party possessed in sufficient amounts, we identified their respective set complements H\K and K\H, and we counted the number of resources in those sets. We next calculated resource scope imbalance as follows:

Scope Imbalance = 0   if max (| *H**K* |, | *K**H* |) = 0

Scope Imbalance = 1 – [min (| *H**K* |, | *K**H* |) / max (| *H**K* |, | *K**H* |)]   otherwise

The case in which max (| *H**K* |, | *K**H* |) = 0 is a situation in which neither party possessed task resources in sufficient amounts, or when the parties' task resources overlapped perfectly.

Control Variables

We controlled for six dyad-level partnership characteristics. *Sector Complementarity-F* ('F' being the section in the NACE classification indicating the entire construction industry) is a straightforward application of the reasoning based on resource dependence: that complementarity arises mainly from functional interdependence, and that this, in turn, arises principally between firms that transact different types of goods and services among them. Therefore, Sector Complementarity-F is constructed as a binary variable that takes a value of 0 for partnerships established between firms belonging to the same industry sector, at the two-digit level of the NACE classification, and 1 for partnerships across different sectors. As an exception to this rule, we assigned a 0 to any partnership established between firms in the construction industry, based on the conjecture that the three subsections into which the NACE classification subdivides the construction industry are unlikely to exhibit strong interdependence with one another (e.g., construction of buildings and construction of railways, pile-driving, construction of motorways, etc.). Nevertheless, in robustness checks we also coded dyads based on the aforesaid rule, without exceptions, and we obtained nearly identical results.

Sales Difference L-P is another proxy of dyadic power imbalance, that captures the economic sources of this construct (since asset-related ones are already captured by General Imbalance). This variable is the average difference between the sales of Lead Firm and Partner Firm (as reported in their respective financial statements), calculated over the five years prior to forming their partnership.

To control for the possibility that resource levels make partnerships less necessary or, conversely, facilitate the formation of partnerships (Eisenhardt and Schoonhoven 1996), we added the variable *Partner Firm's Asset Size,* calculated as the average of the Partner's total assets in the five years prior to the partnership. Previous studies have found that the likelihood of forming an inter-organizational tie declines as a function of the geographic distance between potential partners (Sorenson and Stuart 2008). Accordingly, we entered in our model the variable *Distance L-P*, the road distance between a Lead Firm and Partner Firm. Furthermore, it can happen that the task of the partnership is not co-located with one of the partners. We therefore controlled for *Distance P-S*, the road distance between a Partner Firm and the construction site. Further, we reasoned that partners that are locally embedded would enjoy several advantages: a better knowledge of the construction site, early notification that a certain project is likely to be tendered, and closer connections to the local government. In Italy’s construction industry, social and political embedding is strongly shaped by local identities. We determined that a Partner Firm located in the same province as the construction site would be more embedded than one located in a different province, and based the binary variable *Local Embeddedness P-S* on that indicator (0 = different province; 1= same province).

RESULTS

Table 1 presents descriptive statistics in four columns: one for the entire sample, one for realized ties (cases), one for simulated ties (controls), and one for the difference between cases and controls. As expected, all task resource complementarity measures had higher means in observed partnerships than in the randomly drawn ones. The descriptive statistics were in line with expectations also in the case of the imbalance measures, as task resource imbalance was lower in cases than in controls.

Bivariate correlations among the core predictors were generally small (see Table 2), with the exception of the 0.59 correlation between Sales Difference L-P and General Imbalance, which reflects the fact that firms with larger endowments of technical resources tended to have larger sales revenues, on average. The 0.59 correlation between Sales Difference L-P and Partner’s Asset Size also reflects this fact. Overall, multicollinearity was not an issue, and the maximum variance inflation factor (VIF) was 2.31, far below the conventional threshold of 10.

Table 3 relates conditional logit estimations for Tie Formation, and the results of two-tailed z-test for the predictors. In what follows, we report on the sign and the significance of the estimated coefficients. For the full model, Table 3 also reports the size of the coefficients in terms of "odds change," which should be understood as the change in the odds of tie formation for a one-unit increase of the corresponding independent variable, holding all other variables constant.[20]

Model 1 included dyadic and firm controls. As expected, the probability of tie formation decreased with geographical distance between partners ($p < 0.001$), and with the distance between the partner and the work site ($p < 0.001$). Also a locally embedded partner ($p < 0.001$) and Sectoral Complementarity-F ($p<0.01$) had a positive effect. Remaining predictors were insignificant. In Model 2, we introduced General Complementarity*,* which was positive and significant ($p < 0.01$). Therefore, our setting supports the baseline hypothesis about resource complementarity, which expected the classical dyadic measure of complementarity to have a positive influence on the likelihood of tie formation. Adding General Complementarity did not affect the control variables greatly. In Model 3 we added General Imbalance, which is negative and significant ($p < 0.01$). Therefore our setting also support the baseline hypothesis on resource imbalance.

In Model 4 we introduced Depth Complementarity and Scope Complementarity. Consistent with our Hypothesis 1a, when the potential partners exhibited task resource-depth complementarity, the chances of tie formation increased significantly ($p < 0.001$), as they did when potential partners exhibited scope complementarity ($p < 0.01$). Thus our Hypothesis 1b is also supported. Adding task complementarity variables did not influence the control variables.

Model 5 tested hypotheses 2a and 2b, which anticipated that an imbalanced depth of complementary resources, and an imbalanced scope of complementary resources, would have a negative effect on tie formation. Only the latter was supported ($p < 0.001$); the effect of Depth Imbalance had the expected negative sign but was not statistically significant (p=0.37). Further,

[20] Odds change are obtained by taking the exponential of the predictor's coefficient and subtracting one. Readers should bear in mind that since all our variables except binary indicators were standardized, their unit of measurement is one-standard-deviation of their unstandardized counterpart.

Model 6 estimated the effects of all our predictors jointly. The results of prior models remained generally very robust, thus confirming that the statistical significance we found was not a simple reflection of common variance. The only exception is Sectoral Complementarity-F, which became insignificant. These effects are nonnegligible. Among the variables measured on ratio scales, Depth complementarity and Scope complementarity display the largest effects, their odds changes (oc) being respectively 126 percent and 73 percent, while the effect of General complementarity is comparatively gentler (oc: 28 percent). In contrast, the effect of the dyadic measure of imbalance is on a par with that of Scope imbalance (oc: -31 percent), and it is somewhat larger than that of Scale imbalance (oc: -16 percent). Unreported Wald tests indicated that the difference $\beta_{\textit{Depth complem.}}$ - $\beta_{\textit{General complem.}}$ is statistically significant ($\Delta = .568$, $p < 0.05$, two sided), while the other differences between task-level and the corresponding dyadic level variables are not. This suggest that in our research setting, other things being equal, forming ties that are well matched along the dimension of Depth complementarity is a more pressing concern than matching them on General complementarity.

Overall, these results, and the Wald tests reported at the bottom of Table 3, indicate that taking Model 1 as a reference, a significant improvement of model fit is gained by adding each of our focal constructs (resource complementarity and resource imbalance) at each level of analysis (task level and dyadic level). Conversely, in unreported analyses we found that deleting either of these constructs, at each level of analysis, significantly reduces model fit.[21]

Robustness checks

We also performed robustness analyses to check how sensitive our results were to underlying assumptions in the measurements. Table 4 report the estimated coefficients for models that replaced our task complementarity and task imbalance variables with their weighted alternatives. This change caused no variation in the sign or significance of any variable, and only minor changes in the size of the coefficients. In a second battery of robustness analyses, we matched each case with a different number of matching alliances: one, two, four, six and eight (Table 5). Thes sign of all the predictors, and the significance of most of them is the same across all the samples. With larger samples several

[21] Similar results were obtained with likelihood ratio tests (under the assumption of unclustered data).

coefficients are supported at more stringent levels of significance. Accordingly, it is not very surprising that *Depth complementarity* and *General imbalance* are not supported with one and two matching controls respectively, and that they are supported with the other four samples. Conversely, with eight matching controls, *Depth imbalance* becomes significant ($p < 0.05$), which suggests that the rejection of Hypothesis 2b in the main analyses might have depended on the power of our tests being insufficient for the small size of the effect involved. Overall, Table 5 indicates that the results are remarkably robust to the number of matching controls.

In a third set of robustness analyses we checked whether the process of decomposing multi-firm alliances into dyads might have caused residuals autocorrelation, thereby lowering standard errors estimates and inflating the test statistics. To that purpose, we first controlled for project fixed-effects, by running conditional logistic regressions on strata comprising all the dyads related to a given project. Second, when running the original analyses, we calculated sandwich standard errors clustered by project, rather than by Lead. Third, we ran analyses on a subsample obtained by randomly choosing for each project only one case and its accompanying controls. Overall, all the variables that are significant in Table 3, had the same sign, and were also significant in each of these analyses. This is noteworthy, especially in the light of the fact that the first and the third of these robustness checks could only rely on 189 strata. Altogether, these findings suggest that our results are unlikely to have been driven by autocorrelation.[22]

Concluding this section, we comment on the design of our empirical study and on its adequacy for testing the theory we developed. As mentioned earlier, our observed ties are from contract-winning coalitions, because in our setting data about realized-but-unsuccessful ties are unavailable. Therefore, one may doubt whether the observed effects of the factor variables depends on these factors impinging on the selection of contract winners, rather than on the process of tie formation. However, in this setting ties are only formed for the purpose of winning a contract, and are immediately disbanded in case of failure. Therefore, anything that appeared to significantly affect the chances of winning, would certainly affect the partnering decision as well. Stated differently, our

[22] Data available from the authors. We thank an anonymous reviewer for suggesting these tests.

predictors drive the formation of both, successful- and realized-but-unsuccessful ties.[23]

DISCUSSION AND CONCLUSION

In this study we advance the theory of alliance formation with three important contributions: First , we demonstrate that the quality of interorganizational matches is determined by the way resources combine not only at the dyadic level of the relationship – as it is commonly acknowledged – but also at the level of the task that an alliance forms to address. Second, at both levels, those resources that "play well" together and give rise to incentives to alliance formation – complementary resources – may also deter alliance formation: through the prospect of negotiating alliance terms with a powerful partner. Third, the quality of interorganizational matches may also depend on the possession by the actors of resources of the same kind.

These contributions were primarily driven by our interest in the question of how firms select one another as alliance partners—a central but underinvestigated question in alliance research (Oxley and Silverman 2008)—its findings However, the development of task-related constructs for both complementarity and resource imbalance, has much broader theoretical implications. First, it advances a contingent view of resource complementarity that has been foreshadowed by contributions in different fields (Cassiman and Veugelers 2006; Matsuyama 1995; Soda and Furlotti 2017) and squares well with practitioners' understanding of the concept. Indeed, we show that resource complementarity is not exclusively determined by the resource endowments of the partners, but is also contingent on the task that the partners envision.

Second, the contextuality of resource complementarity introduces a new mechanism of network dynamics (Ahuja et al. 2012; Hite 2008). The mechanisms of tie formation that are currently acknowledged in network research, such as homophily, reciprocity, transitivity and repeated ties, overwhelmingly favor the perpetuation of existing relationships and the formation of dense clusters of

[23] The factors that we highlight only bear a loose relationship with the legal requirement that the bidding coalitions collectively possess certain minimum resource endowments. Obviously, this criterion must be met for a coalition to be eligible for contract award. However, as a criterion for partner selection this requirement is largely unconstraining. For example, it does not tell apart dyads with resource overlaps from non-overlapping dyads, dyads that fulfill the requirements in different degrees, and dyads with resource imbalances from balanced ones. Therefore, the factors that we highlight, are to be understood as criteria for tie formation, not for selecting the winner from the bidding coalitions.

similar actors (Powell et al. 2005; Sorenson and Stuart 2008), and so does complementarity understood as a dyadic construct based on the actors' resource profiles (Dierickx and Cool 1989). If instead resource complementarity is contingent on the task at hand, we've identified a source of dyadic variation (Hite 2008) that explains why alliances with new partners also occur.

Third, our study advances the literature on inter-organizational power by confirming that power is an important factor in boundary decisions, in line with Santos and Eisenhardt (2009). Moreover, by positing and testing that the importance of resource asymmetries for the partner selection partly depends on task characteristics, we established a contingency whose relevance may well exceed its application to strategic alliances, since the underlying logic plausibly applies to all those situations in which different actors pool resources for the performance of a joint task.

Our study highlights that interorganizational resource complementarity also has a components that is invariant to the task of the alliance. The fact that the quality of resource match is determined at both levels suggests that resource endowments impinge simultaneously on multiple objectives that the parties seek to further through their alliance. Previous literature has not elaborated much on the complexity and the contextuality of those objectives, as it has usually assumed that they consisted in a single, strategic, motive of developing and rounding out an existing resource base. Instead, we proposed, and our study supports, that an additional, important objective of many interorganizational collaborations is that of performing a specific task, because valorizing a set of resources usually requires a plan to harness them for a specific purpose.

It is interesting to ask whether such motive is only salient for tactical or operational ties, or conversely, if it also has relevance for strategic alliances. Arguably, in strategic alliances that are created to accommodate host government policy (Contractor et al. 1988), or to reduce competition (Glaister and Buckley 1996), the motive to get things done well through the pooling of the right combination of resources may take a backseat. However, alliances that are created for other reasons —e.g., to enable faster entry to the market (Mariti and Smiley 1983), to enable product diversification (Porter and Fuller 1986), etc.— also require that partners perform some sort of task. Therefore, firms driven by such motives would still be well advised to search for partners whose endowments of resources and capabilities fit with those of the focal firm and with the task requirements. Many alliance investigations assume that learning is one of the main reasons for establishing a strategic alliance (Khanna et al. 1998). To the extent that absorbing some of a partner's knowledge and routines is the main driver of an alliance, it may be that firms are attracted to potential partners that possess a lot of the target capability, irrespective of the inducements provided by task resource complementarity. However, even in such cases, observing a partner's skills actively deployed in a particular task will facilitate the absorption of skills in general (Huber 1991; Nadler et al. 2003), and particularly of their tacit components. This makes it reasonable to expect that even these alliances would more often be established for the purpose of absorbing task-related capabilities than unrelated ones. Even in joint R&D alliances, in which learning motives are particularly salient, tasks appear to be important. Such alliances are often organized as interorganizational projects, i.e., assigned with an approximate task and a time bracket (Lundin and Soderholm 1995). The focus of projects on tasks raises the salience of resources as a critical enabling factor. Not surprisingly, some studies have found that task resource requirements were carefully delineated in joint R&D alliance agreements (Grandori and Furlotti 2010; Lerner and Merges 1998). Overall, tasks are a prominent concern in a large variety of strategic alliances. As such, it's plausible that task resource requirements regularly and significantly affect the choice of alliance partner(s).

If task resource complementarity captures how well potential partners match each other from the viewpoint of the alliance task, then what mechanism underlie the dyadic attribute of general resource complementarity in alliances that are project-based — as those in our research setting clearly are? Given the rather routine nature of the tasks involved, we think it unlikely that in our setting this mechanism consist of the greater opportunities for learning that large, non-overlapping resource bases afford. Rather, it may have to do with the fact that partners that have wider and deeper resource endowments, not overlapping with that of the focal actor, are seen by this as potentially useful to cope with still unknown task requirements. Moreover, the cooptation of firms by an actor who could have performed a project alone or in collaboration with different partners, creates indebtedness on the part of the coopted firm (Soda and Usai 1999). If projects are recurring events, and a norm of reciprocity prevails in the industry, the obliging partner can reasonably expect it will be on the receiving end of a similar favor in the future. Under such conditions, exending the invitation to a firm endowed with a large and not overlapping resource set, holds promise for the focal firm of accessing a future stream of projects that would otherwise be beyond its reach. Indeed, qualitative studies have observed that in the Italian contruction industry there are many more cooperative ties (in the form of participation in consortia of firms), than would be justified by the need to source technological and managerial capacities, and have interpreted such phenomenon in terms of indebtedness and reliance on future pay-offs (Soda and Usai 1999).

A corollary of the fact that the formation of an alliance simultaneously furthers strategic objectives and project-related ones, is that when assessing the quality of the match with a potential partner, firms may need to trade-off the task-specific advantages of the focal collaboration with the strategic ones, and may find that a partner that is desirable in one respect is not necessarily equally good in the other. The size of the effects that we found suggest that in our research setting, when facing such choice, firms will on average attend more to the need to fulfill task-resource requirements. Of course, there may be settings in which priorities are reversed, as when interorganizational resources give rise to network effects. For example, in global liner shipping (as well as in other communication or transportation systems), the value of the network can be expected to increase with the number of nodes (Stabell and Fjeldstad 1998), thereby creating incentives to add network partners who contribute a large set of non-overlapping routes (Mitsuhashi and Greve 2009).

Discussing complementarity and resource imbalance as closely related constructs also highlights that firms face a second trade-off, which involves these two constructs. To illustrate, consider a firm that needs to fill a substantial gap in the depth of its endowment of a particular resource. Such firm will be attracted, up to a point, by the potential complementarity of partners with a large endowment of that resource. However, when the endowment is too large, the prospective resource imbalance between the two firms acts as an obstacle to alliance formation. As a result, the firm may opt for a less complementary partner. While this trade-off was implicit in revised resource dependence models (Casciaro and Piskorski 2005), our model gives it explicit recognition and points at ways in which the trade-off can be managed, such as giving up complementarity for the sake of more balanced relations, filling resource gaps by entering multi-partner alliances, or by establishing relations in which a resource imbalance in one or more resources is compensated by symmetrical resource imbalances in other task resources.

Further research could build and improve on our paper in several directions. First, in our model the decision to form a partnership is conditionally independent. In reality, the resource complementarity of any dyad in a multiparty alliance will be influenced to some degree by the resources contributed by coalition partners outside the dyad. Arguably, the resulting bias works in our favor, since our measures of complementarity should be a weaker predictor of relationship formation than a hypothetical operationalization that properly accounts for all resource interdependencies.[24] This notwithstanding, future research could devise analytical methods that would enable a researcher to address simultaneous partner choices. Second, available data do not allow us to observe alliances whose bids for projects were unsuccessful. We've argued that this data limitation doesn't undermine our basic findings. However, future research can search for settings in which it is empirically possible to examine if these constructs have differential effects on alliance formation and alliance performance. Third, to ensure the availability and reliability of data, our study focused only on large- and medium-sized projects. Moreover, deleting cases with missing items entails that ties formed for private tenders are underrepresented in our sample. While the methodology of case-control design allows for a correct estimation of parameters for the study base, our results do not generalize to the source population. Therefore, future studies could investigate whether these constructs are similarly relevant for smaller projects, for alliances for private tenders, and for the alliance population at large.

In conclusion, we have brought the concept of task to bear on the decision of with whom to partner. Testing these ideas in a context of inter-organizational construction projects made it possible to map our constructs to observable variables. However, the idea that resource complementarity and resource imbalances are shaped by contextual factors in general, and by tasks in particular, is a meta-theoretical concept that is likely to matter for relationships beyond the inter-organizational alliances we studied here. Indeed, our findings suggest that continuing to apply the conceptual lens of the task is likely to disclose new and interesting insights into inter-organizational collaboration.

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[24] The robustness analyses reported above also provide reasons for being confident about our findings. In yet other analyses we included the interaction between the task resource complementarity variables and the number of members in the ATI to which observed dyads belonged. It could be expected that as the number of members of the ATI increased, interdependences would become more complex, and the predictive power of our task resource complementarity variables would decrease. However, no such interaction was significant.

Table 1 - Descriptive Statistics: Means and Standard Deviations*

	All	**Cases (Tie formation=1)**	**Controls (Tie formation=0)**	**Delta (2) – (3)**
	mean/sd	mean/sd	mean/sd	
	(1)	(2)	(3)	
Tie formation	0.20	1.00	0.00	1.00
	(0.40)	(0.00)	(0.00)	
Sectoral complementarity-F	0.34	0.37	0.34	0.04
	(0.48)	(0.48)	(0.47)	
Sales difference L-P	0.00	-0.10	0.03	-0.13*
	(1.00)	(0.90)	(1.02)	
Partner's asset size	0.00	-0.16	0.04	-0.20**
	(1.00)	(0.85)	(1.03)	
Distance L-P	-0.00	-0.57	0.14	-0.71**
	(1.00)	(0.87)	(0.98)	
Distance P-S	-0.00	-0.68	0.17	-0.85**
	(1.00)	(0.81)	(0.97)	
Local embedding P-S	0.09	0.33	0.03	0.30**
	(0.29)	(0.47)	(0.17)	
General complementarity	0.00	0.19	-0.05	0.23**
	(1.00)	(1.32)	(0.90)	
General imbalance	-0.00	-0.15	0.04	-0.19**
	(1.00)	(0.98)	(1.00)	
Depth complementarity	0.00	0.16	-0.04	0.20**
	(1.00)	(1.16)	(0.95)	
Scope complementarity	-0.00	0.07	-0.02	0.09
	(1.00)	(1.02)	(0.99)	
Depth imbalance	-0.00	-0.01	0.00	-0.01
	(1.00)	(0.99)	(1.00)	
Scope imbalance	0.00	-0.12	0.03	-0.14*
	(1.00)	(1.01)	(1.00)	
Weighted depth complem.	-0.00	0.17	-0.04	0.21**
	(1.00)	(1.17)	(0.95)	
Weighted scope complem.	0.00	0.08	-0.02	0.11
	(1.00)	(1.02)	(0.99)	
Weighted depth imbalance	0.00	-0.01	0.00	-0.02
	(1.00)	(0.99)	(1.00)	
Weighted scope imbalance	0.00	-0.14	0.04	-0.18**
	(1.00)	(1.02)	(0.99)	
Observations	1580	316	1264	

* Standard deviations are reported in parentheses. Significance levels of t-test of difference of means: * 0.05; ** 0.01.

Table 2 - Correlation Matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	Tie formation	1							
(2)	Sectoral complementarity-F	0.03	1						
(3)	Sales difference L-P	-0.05	0.10	1					
(4)	Partner's asset size	-0.08	0.11	0.59	1				
(5)	Distance L-P	-0.29	-0.01	-0.09	-0.05	1			
(6)	Distance P-S	-0.34	0.00	-0.04	0.02	0.67	1		
(7)	Local embedding P-S	0.42	-0.02	-0.02	-0.03	-0.28	-0.42	1	
(8)	General complem.	0.09	0.15	-0.25	-0.17	0.01	-0.02	0.04	1
(9)	General resource imbalance	-0.08	-0.03	0.59	0.25	-0.07	-0.05	-0.01	-0.34
(10)	Depth complementarity	0.08	0.01	-0.14	-0.08	0.02	0.02	-0.04	0.00
(11)	Weighted scale complem.	0.09	0.00	-0.15	-0.09	0.01	0.02	-0.04	0.01
(12)	Scope complementarity	0.04	0.10	0.09	-0.02	0.00	-0.05	0.01	0.04
(13)	Weighted scope complem.	0.04	0.10	0.07	-0.05	0.00	-0.05	0.01	0.07
(14)	Depth imbalance	0.00	0.06	-0.10	-0.10	0.06	0.05	-0.01	0.09
(15)	Weighted scale imbalance	-0.01	0.07	-0.10	-0.10	0.06	0.06	-0.01	0.10
(16)	Scope imbalance	-0.06	0.03	0.05	-0.08	0.03	0.00	0.04	-0.01
(17)	Weighted scope imbalance	-0.07	0.02	0.04	-0.09	0.05	0.01	0.04	0.02

		(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(9)	General resource imbalance	1							
(10)	Depth complementarity	-0.19	1						
(11)	Weighted scale complem.	-0.20	0.99	1					
(12)	Scope complementarity	0.20	-0.40	-0.41	1				
(13)	Weighted scope complem.	0.18	-0.42	-0.45	0.97	1			
(14)	Depth imbalance	-0.09	0.29	0.30	-0.25	-0.24	1		
(15)	Weighted scale imbalance	-0.09	0.29	0.30	-0.25	-0.25	0.99	1	
(16)	Scope imbalance	0.18	-0.28	-0.27	0.39	0.40	-0.01	-0.01	1
(17)	Weighted scope imbalance	0.16	-0.31	-0.30	0.42	0.44	0.01	0.01	0.94

N = 1580

Table 3 - Conditional Logit Models of Tie Formation

	(1)	(2)	(3)	(4)	(5)	(6)	(6) (Odds change)
Sectoral compl.-F	0.542**	0.416*	0.499*	0.422*	0.571**	0.311	36%
	(0.204)	(0.202)	(0.206)	(0.203)	(0.201)	(0.203)	
Sales difference L-P	-0.045	-0.063	0.164	-0.055	-0.043	0.042	4%
	(0.211)	(0.211)	(0.223)	(0.219)	(0.206)	(0.217)	
Partner's asset size	-0.351	-0.254	-0.413*	-0.227	-0.391	-0.240	-21%
	(0.228)	(0.210)	(0.202)	(0.173)	(0.236)	(0.190)	
Distance L-P	-0.539***	-0.553***	-0.528***	-0.569***	-0.529***	-0.572***	-44%
	(0.146)	(0.152)	(0.142)	(0.146)	(0.148)	(0.147)	
Distance P-S	-0.773***	-0.780***	-0.766***	-0.705***	-0.781***	-0.719***	-51%
	(0.167)	(0.170)	(0.166)	(0.166)	(0.166)	(0.164)	
Local embedding P-S	1.919***	1.905***	1.957***	2.071***	1.956***	2.148***	757%
	(0.343)	(0.341)	(0.354)	(0.338)	(0.347)	(0.350)	
General complem.		0.321**				0.248*	28%
		(0.112)				(0.117)	
General imbalance			-0.451**			-0.371*	-31%
			(0.146)			(0.162)	
Depth complementarity				0.782***		0.816***	126%
				(0.190)		(0.225)	
Scope complementarity				0.482**		0.549***	73%
				(0.151)		(0.148)	
Depth imbalance					-0.094	-0.177	-16%
					(0.105)	(0.113)	
Scope imbalance					-0.237**	-0.375***	-31%
					(0.082)	(0.109)	
Dependent variable	*Tie formation*	*Tie formation*	*Tie formation*	*Tie formation*	*Tie formation*	*Tie formation*	
Observations	1580	1580	1580	1580	1580	1580	
Pseudo-R-squared	0.347	0.358	0.357	0.379	0.356	0.410	
Log-likelihood	-332.079***	-326.666***	-326.885***	-315.731***	-327.505***	-300.121***	
Chi-squared of the step†		8.192**	9.483**	18.376***	8.892**	34.069***	

Notes: * 0.05, ** 0.01, *** 0.001. Two-tailed tests. Estimates corrected for case-control design. Errors adjusted for clusters in Lead firm. Models based on matched sample analysis of 316 realized alliances. †: Change from control-variables-only model.

Table 4 - Robustness checks: task-contingent predictors weighted by resources task requirements

	(1)	(2)	(3)	(4)	(5)	(6)
Sectoral compl.-F	0.542**	0.416*	0.499*	0.402*	0.572**	0.290
	(0.204)	(0.202)	(0.206)	(0.203)	(0.203)	(0.205)
Sales difference L-P	-0.045	-0.063	0.164	-0.042	-0.048	0.037
	(0.211)	(0.211)	(0.223)	(0.217)	(0.209)	(0.218)
Partner's asset size	-0.351	-0.254	-0.413*	-0.213	-0.394	-0.233
	(0.228)	(0.210)	(0.202)	(0.173)	(0.241)	(0.192)
Distance L-P	-0.539***	-0.553***	-0.528***	-0.568***	-0.522***	-0.567***
	(0.146)	(0.152)	(0.142)	(0.146)	(0.148)	(0.148)
Distance P-S	-0.773***	-0.780***	-0.766***	-0.704***	-0.778***	-0.705***
	(0.167)	(0.170)	(0.166)	(0.167)	(0.165)	(0.163)
Local embedding P-S	1.919***	1.905***	1.957***	2.067***	1.973***	2.210***
	(0.343)	(0.341)	(0.354)	(0.333)	(0.348)	(0.354)
General complem.		0.321**				0.234*
		(0.112)				(0.117)
General imbalance			-0.451**			-0.373*
			(0.146)			(0.163)
Weighted depth complem.				0.818***		0.881***
				(0.191)		(0.244)
Weighted scope complem.				0.483**		0.606***
				(0.152)		(0.149)
Weighted depth imbal.					-0.103	-0.160
					(0.104)	(0.111)
Weighted scope imbal.					-0.271**	-0.490***
					(0.084)	(0.123)
Dependent variable	*Tie formation*	*Tie formation*	*Tie formation*	*Tie formation*	*Tie formation*	*Tie formation*
Observations	1580	1580	1580	1580	1580	1580
Pseudo-R-squared	0.347	0.358	0.357	0.381	0.359	0.419
Log-likelihood	-332.079***	-326.666***	-326.885***	-314.730***	-326.009***	-295.578***
Chi-squared of the step†		8.192**	9.483**	19.318***	11.257**	37.123***

Notes: * 0.05, ** 0.01, *** 0.001. Two-tailed tests. Estimates corrected for case-control design. Errors adjusted for clusters in Lead firm. Models based on matched sample analysis of 316 realized alliances. †: Change from control-variables-only model

Table 5 - Robustness to number of matching controls

	# controls = 1	# controls = 2	# controls = 4	# controls = 6	# controls = 8
	(1)	(2)	(3)	(4)	(5)
Sectoral compl.-F	0.133	0.539	0.311	0.254	0.235
	(0.355)	(0.280)	(0.203)	(0.180)	(0.183)
Sales difference L-P	0.035	0.013	0.042	-0.012	-0.169
	(0.279)	(0.191)	(0.217)	(0.206)	(0.222)
Partner's asset size	-0.187	-0.177	-0.240	-0.210	-0.078
	(0.250)	(0.158)	(0.190)	(0.169)	(0.179)
Distance L-P	-0.487*	-0.592**	-0.572***	-0.619***	-0.587***
	(0.200)	(0.202)	(0.147)	(0.138)	(0.134)
Distance P-S	-0.627**	-0.666**	-0.719***	-0.659***	-0.648***
	(0.204)	(0.206)	(0.164)	(0.151)	(0.150)
Local embedding P-S	2.307***	2.375***	2.148***	1.870***	1.820***
	(0.567)	(0.456)	(0.350)	(0.305)	(0.305)
General complem.	0.496**	0.253	0.248*	0.322**	0.318**
	(0.185)	(0.130)	(0.117)	(0.115)	(0.107)
General imbalance	-0.545*	-0.491*	-0.371*	-0.408**	-0.360*
	(0.227)	(0.217)	(0.162)	(0.154)	(0.154)
Depth complementarity	0.293	0.468*	0.816***	0.624***	0.622***
	(0.250)	(0.213)	(0.225)	(0.186)	(0.170)
Scope complementarity	0.608**	0.500**	0.549***	0.520***	0.532***
	(0.198)	(0.153)	(0.148)	(0.149)	(0.141)
Depth imbalance	-0.208	-0.157	-0.177	-0.194	-0.206*
	(0.199)	(0.127)	(0.113)	(0.106)	(0.104)
Scope imbalance	-0.634***	-0.403***	-0.375***	-0.334**	-0.286**
	(0.184)	(0.119)	(0.109)	(0.106)	(0.100)
Dependent variable	*Tie formation*	*Tie formation*	*Tie formation*	*Tie formation*	*Tie formation*
Observations	632	948	1580	2132	2685
Pseudo-R-squared	0.497	0.452	0.410	0.375	0.344
Log-likelihood	-110.174***	-190.313***	-300.121***	-376.237***	-441.896***

Notes: * 0.05, ** 0.01, *** 0.001. Two-tailed tests. Estimates corrected for case-control design. Errors adjusted for clusters in multi-firm alliance membership. Models based on matched sample analysis of 316 realized alliances.

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