Organizing the Usual Suspects: Structuring Temporary Organizations

Samuel S. Holloway
University of Portland

Mark. R. Meckler
University of Portland

Temporary vertical groups shift boundary decisions from a make, buy, or ally choice by a single firm acting alone to a collaborative decision influenced by the entire group. Using archival data on bridge construction project networks, we apply traditional theories of the firm at the group level of analysis. Using maximum likelihood estimation (Tobit) techniques, our findings on uncertain and complex construction projects support traditional organizational logics. However, contrary to orthodox Transaction Cost Economics (TCE) predictions, we found that longer and larger projects did not lead to more embedded vertical groups.

Keywords: structure design and boundaries, transaction cost economics, temporary organizations, tobit analysis, vertical groups

INTRODUCTION

Large, vertically integrated companies that arose during the first three-quarters of the 20th century were organized to deliver efficiently produced goods to a growing domestic market (Snow, Miles, & Coleman, 1992). The prevailing organizational structures gained significant economic efficiencies by optimizing both internal and external governance mechanisms and determining firm boundaries according to whether a transaction was governed more efficiently within the firm hierarchy or in the external market (Coase, 1937; Williamson, 1975). Core theories (like transaction cost economics or "TCE") both emerged from and adequately explained the well- functioning organizations from this time period. The last several decades have introduced material macro-environment changes. Pine and Gilmore (1998) note that economies have changed from primarily agrarian, to industrial, to services, to a contemporary transition toward an experiential economy. Collaboration has become commonplace and temporary organizations have become ubiquitous.

Temporary organizations are intriguing. They are formally impermanent, and yet many of them are also *informally persistent.* That is, it is not uncommon for temporary organizations to reconvene in the very same or quite similar form for subsequent ventures (Bellavitis, Rietveld, & Filatotchev, 2019; Ebers & Maurer, 2016). Examining vertical design choices within temporary forms deserves careful examination because it involves TCE, a core organization theory. It is unclear if TCE theory adequately deals with temporary organizations, like the temporary vertical groups involved in construction, film and entertainment. It is possible that the uncertainty around possible future re-forming/reconvening of an organization that was designed to be temporary alters the economic expectations or behaviors of past, current or potential participants. This temporary/persistent anomaly may alter the application or adequacy of classic TCE advice.

To preview our results, we found some consistency with traditional TCE, but some inconsistency as well. Consistent with TCE expectations in the case of temporary organizations, task *diversity* causes vertical groups to be designed with weaker tie strength, fewer repeated past partners and more varied partners, and that task *uncertainty* causes vertical groups to be designed with greater tie strength and more repeated partnerships. However, when it comes to large tasks of longer *duration* in temporary organizations, we found some inconsistency with TCE's forecasts. Orthodox TCE predictions suggest that firms would want to use deeper, established relationships for large long projects to incentivize and benefit from co-developed assets and routines (Dyer & Singh, 1998; Williamson, 1985). We found no such connection between task length and partner embeddedness in our robust sample of temporary organizations from the highway construction industry. It may be that for long projects the benefits from deeper relationships such as improved coordination and efficiency are offset by opportunistic behavior and the need for additional flexibility and resources. This suggests limits to the benefits of cooperation based upon the shadow of the future (Heide & Miner, 1992; Poppo, Zhou, & Ryu, 2008; Poppo, Zhou, & Zenger, 2008). These limitations are supported by Holloway and Parmigiani (2016) who found that persistent and repeated partnerships helped revenue but hurt profitability for the lead firm in their construction project networks.

THEORETICAL BACKGROUND

Temporary Organizational Forms

To learn how lead firms in vertical groups make decisions involving task and partner characteristics in temporary organizing situations, we investigated how lead firms design temporary inter-organizational networks. We use the name 'temporary inter-organizational networks' (TINs) to make the distinction from vertical groups that are designed to last a longer time. TINs are lead firm networks that constitute the typical organizational form found in project-based organizing (Lorenzoni & Lipparini, 1999). TIN project collaborations are established to accomplish pre-specified goals and last for a limited time period truncated by a pre-established end point. TINs have been observed in a wide range of industrial settings, including advertising (Grabher, 2002), construction (Eccles, 1981b; Winch, 1989), biotechnology (Powell, Koput, & Smith-Doerr, 1996), computers (Gomes-Casseres, 1994), financial services (Baker, 1990; Eccles & Crane, 1988; Podolny, 1993), computer software (Mayer & Nickerson, 2005), fashion (Uzzi, B., 1997; Uzzi, Brian, 1996), and the public sector (Altshuler & Luberoff, 2003; Hill & Lynn, 2005; Moynihan, 2005; Provan & Kenis, 2008).

Previous scholars have found that temporary organizations rely upon short-term, specialized workers with the capability to perform a small set of tasks repeatedly, and under high time pressure (Bechky, 2006; DeFillippi & Arthur, 1998; Faulkner & Anderson, 1987). This led to theorizing that firms in industries exhibiting temporary governance were coordinated more through cooperative relationships, aiming for collaborative stability (Jones, Candace, Hesterly, Fladmoe-Lindquist, & Borgatti, 1998). For example, Bechky (2006) studied the film industry and found that the tasks inherent to a given project provide sufficient structure to supplant traditional hierarchical controls. In industries like film, workers are highly specialized and generally perform only one function and are typically free market agents, not integrated into any one hierarchy. Additionally, these external specialists end up performing the same tasks over and over for the same film studios, so the expectation of future work promotes cooperative behavior on the current project. These contract-based specialists form strong identities that align their motivation with their job-specific tasks. Explicit contracts become extraneous for these relationships and cost more than using role-based coordination and relying upon social pressure and informal controls (Bechky, 2006). This role-based structure of relationships is characteristic of many industries that use temporary organizing and is especially prevalent in film production, fashion, and construction (Bechky, 2006; Faulkner & Anderson, 1987; Jones, Candace & DeFillippi, 1996; Uzzi, B., 1997).

The movement of highly specialized subcontractors among and between lead firms, as well as the repeated nature of project work, increases the structural embeddedness of networks within these industries. Structural embeddedness is the extent to which mutual contacts within a network are connected to one another (Granovetter, 1992: 35). Within these highly embedded industries, role-duration, expectation of future interactions, and the site-specific nature of work all increase structural embeddedness (Bechky, 2006; Eccles, 1981b).

AGGREGATE TIE STRENGTH

As industries and technologies mature, network partners become entrenched. Adner and Kapoor (2010) found that vertical integration significantly *improved* a lead firm's performance. Others found that vertical integration *reduces* the number of network ties (Hoetker, 2006; Lee, Hoetker, & Qualls, 2015). The trade-off between the flexibility of having multiple partners and the benefits of having fewer partners via vertical integration needs further study. Holloway and Parmigiani (2016) found that while some entrenchment of repeat partners is helpful, continued entrenchment over multiple iterations of temporary network organizations tended to lower lead firm profitability. This study is makes it clear that more familiarity is not necessarily better, at least when profit and on-time/on-budget goals are prioritized. The next question is: If too loose and too tight are sub-optimal, how tight or loose should inter-firm tie strength be?

We developed a new measure, *aggregate tie strength,* to represent the overall cohesiveness in terms of the strength of ties, and to account for network strength in terms of "girth." Aggregate network tie strength is a function of both the number of suppliers/key partners in the network and number of prior relationships with each of these suppliers. Aggregate tie strength is a function of network tie strength (NTS). Network tie strength is the ratio of overall ties to repeated ties. A multiple of less than one prior relationship per supplier would indicate (generally) a weakly tied temporary organizational network. We operationalized aggregate tie strength (ATS) below in Equation 1 and network tie strength (NTS) in Equation 2:

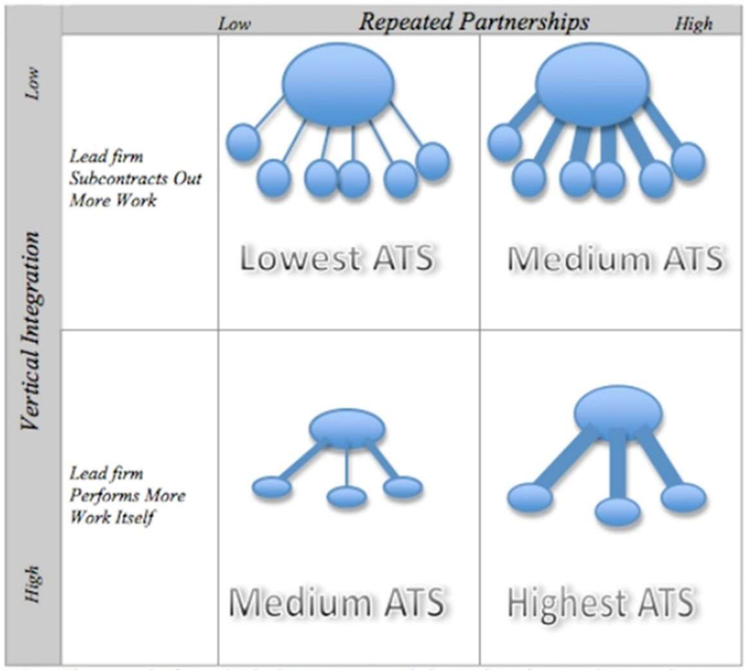
$$\text{ATS} = \text{NTS} * \log_e x \tag{1}$$

where x = number of partners

$$\text{NTS} = \text{Network Tie Strength} = \text{Number of partners/number of previous relationships} \tag{2}$$

For example, if the NTS was 1.5, and there are 10 members, then ATS of the entire network is 1.5 ln(10) = 3.45. If it were a larger network with 40 members and an NTS of 1.5, then the ATS is 1.5 ln(40) = 5.53. ATS give a scaled sense of both the importance of size of network and the strength of network ties. By including both hierarchical and relational governance mechanisms and by also including the aggregate impact of all project ties, ATS raises the level of analysis to the *group* or *network* level. Figure 1 depicts these relationships.

FIGURE 1
AGGREGATE TIE STRENGTH (ATS)



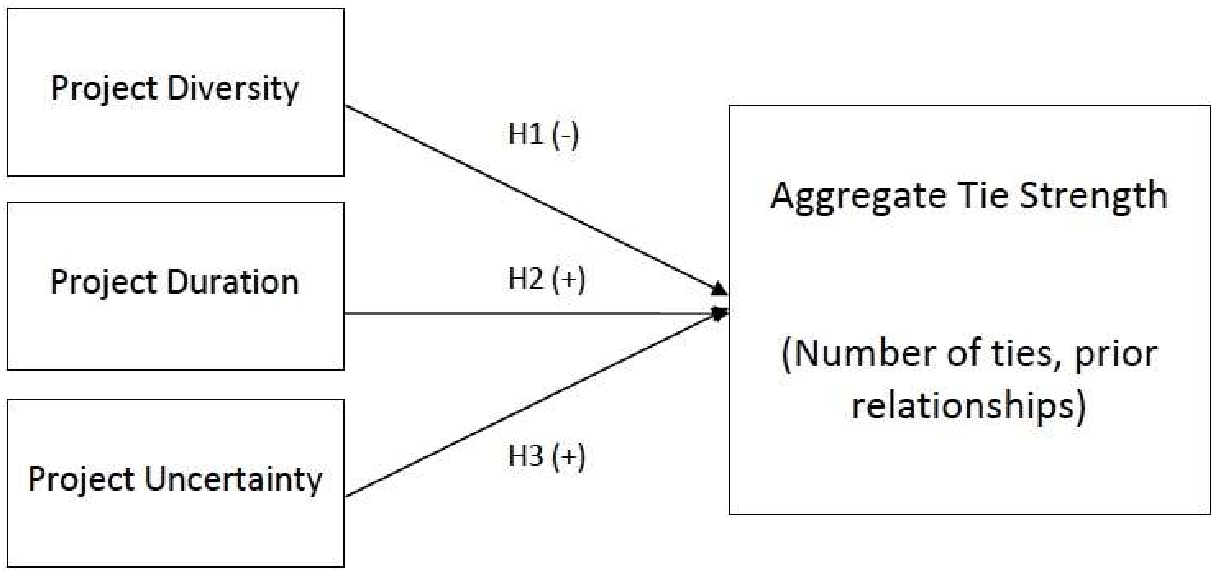
Note: The strength of an individual tie increases with the number of repeated partnerships. Strong ties indicated by thicker lines between lead firm and subcontractor

As represented in Figure 1, higher values of ATS (aggregate tie strength) indicate a TIN using fewer and better-known partners. Higher ATS values indicate a tight network with strong ties – high relational embeddedness. The highest levels of ATS indicate a temporary vertical group where the lead firm is performing a large majority of the work (high vertical integration) and, for the work that is subcontracted out, the lead firm chooses to use a small number of known and trusted partners (high repeated partnerships). Lower values of ATS indicate lower tie strength, which is indicative of a wider network consisting of more network partners, fewer repeated partners, and partners with more disparate and more specialized skills (Capaldo, 2007; Provan & Kenis, 2008). This is depicted in the upper left quadrant of Figure 1 (low vertical integration and low number of repeated partnerships). In between these extremes, ATS can vary by a lead firm choosing to vertically integrate to a high degree while subcontracting to relatively unknown partners (low repeated partnerships). Conversely, lead firms can have moderate levels of ATS by choosing to subcontract out a majority of the work (low vertical integration) but use known and trusted partners (high repeated partnerships).

HYPOTHESIS DEVELOPMENT

In this section, we develop a series of hypotheses linking project characteristics of diversity, duration, and uncertainty to aggregate tie strength. The TCE and capabilities literatures dictate that a firm should internally produce goods that are close to its area of expertise, core to its business, and related to items it already produces (Barney, Jay B., 1986; Prahalad & Hamel, 1990; Wernerfelt, 1984). The alliance and network literatures inform us that firms should seek to exert higher levels of hierarchical control when forming alliances with these same properties (Eccles, 1981b; Gulati & Singh, 1998). The degree of vertical integration, the number of partners and partner embeddedness all affect aggregate tie strength, our key indicator of temporary vertical group design. Figure 2 outlines hypotheses 1-3 that describe these relationships.

FIGURE 1
CONCEPTUAL MODEL - HOW DO EXCHANGE CONDITIONS AFFECT AGGREGATE TIE STRENGTH?



We define *project diversity* as the number of specialized tasks required to complete a project (Jones, C., Hesterly, & Borgatti, 1997). To undertake a highly diverse project, partners must employ a wide assortment of production equipment, process a diverse array of material inputs, and complete a large number of specialized tasks. In temporary organizatons, lead firms are likely to outsource many of the specialized tasks, taking advantage of the knowledge and skills found among their wider network of partners (Argyres, 1996; Grant, 1996; Kogut & Zander, 1992; Rubin, 1973). Diverse projects may also benefit from leveraging the flexibility of the network form of governance to integrate these multiple autonomous, differently skilled parties to complete a project (Brusoni, Prencipe, & Pavitt, 2001). The resulting, differentiated network will be adaptable as more diverse partners may engage in a wider search for new solutions when organizational environments change (Cohen & Levinthal, 1990; Ethiraj & Levinthal, 2004; Lawrence & Lorsch, 1967; Rivkin & Siggelkow, 2003). Gulati and colleagues (2005) found that integration significantly reduced the adaptive capability and scope of work that interfirm collaborations could perform. Thus, the vertical integration literature suggests projects of greater diversity are best governed with diverse, differentiated vertical relationships. The reduced use of vertical integration suggests that more diverse partners will complete a greater portion of the work, reducing relational embeddedness and resulting in a lower value of aggregate tie strength.

As a result of greater outsourcing, lead firms will use a greater number of partners in cases of high project diversity. Capaldo (2007) researched lead firm-networks in the Italian furniture industry and found the number of ties that a lead firm has in its network correctly models the overall diversity of that network. The resulting diverse networks are akin to modular organizations, in which firms conduct transactions through loosely-coupled networks with well-identified interfaces (Baldwin, 2008; Hoetker, 2006; Sanchez & Mahoney, 1996). In modular organizations, "a tightly integrated hierarchy is supplanted by a loosely-coupled network of organizational actors" (Schilling & Steensma, 2001). Within these loosely-coupled networks, transactions are not technologically determined, rather, they arise through the interplay of cooperating firms' knowledge and resources and in alignment with a specific opportunity (Baldwin, 2008). Collectively, this literature on modular organizations suggests that as project diversity increases, organizational characteristics will mirror those of the project and increase in diversity as well. These arguments provide the logic for our first hypothesis:

Hypothesis 1: *Higher levels of project diversity will be associated with lower levels of aggregate tie strength (ATS) within temporary vertical groups.*

Project duration affects temporary vertical group design as longer projects promote integrated vertical relationships to stem opportunism and improve cooperation. Longer projects involve more labor, materials, and other resources. In longer-term projects, all firms involved dedicate a considerable amount of resources and thus cannot pursue other opportunities. Due to the temporal nature of projects, this essentially locks in the partners, which can lead to hold up problems due to opportunistic partners (Williamson, 1975). Through vertically integrating and controlling a greater proportion of the project, lead firms can mitigate the potential of subcontractors to engage in hold up behavior.

Perhaps more importantly, cooperation and collaboration are paramount in longer projects, as the extended duration indicates a higher likelihood of scheduling alterations and other changes. Longer time horizons increase the coordination costs of vertical relationships, as firms must not only decompose a larger number of future tasks but also assess future task interdependence and associated coordination costs (Gulati & Singh, 1998). Provan and Kenis (2008) propose that longer project durations favor network stability over flexibility, with stable networks increasing their use of hierarchical controls to facilitate coordination. Network stability is enhanced within lead firm networks, because the strong central figure can coordinate activities more efficiently (Provan & Kenis, 2008). To summarize, coordination in temporary vertical relationships in enhanced by using lead firm integration, which reduces the number of partners and increases the collaboration demands among them (Gulati et al., 2005).

Longer projects also benefit from a smaller number of vertical group partners as these firms can gain efficiencies from developing superior interorganizational routines (Nelson & Winter, 1982) and derive benefits from dedicated resources (Kale, Dyer, & Singh, 2002). Greater information sharing and accompanying coordination benefits will result as a small number of partners interacts over time (Dyer, 2000; Hayes, Wheelwright, & Clark, 1988). Longer interactions with fewer partners also enhances incentives for greater cooperation, which increases the cost-effectiveness of trust as a contractual safeguard (Poppo et al., 2008). Longer projects increase expectations of continuity, trust, and enhance the transfer of private or tacit knowledge (Dyer & Singh, 1998; Ring & Van de Ven, Andrew H, 1992; Tesler, 1980). This suggests that longer projects will encourage stronger networks with a dense cluster of strong ties so that firms can capitalize on these benefits.

Long-term projects also promote the greater use of repeated partnerships in network relationships. Eccles (1981a) noted that in the construction industry relations between subcontractors and general contractors are generally stable and over long periods of time. Greater trust can develop between partners over time, and these repeated interactions facilitate information sharing and learning between partners, which increase the likelihood of these partners working together in the future (Gulati, 1995b, 1995a, 1998). Repeated interactions increase relational embeddedness, which facilitates coordination as partners know and understand each other's preferences (Grabher, 2002; Levinthal & Fichman, 1988; Uzzi, Brian, 1996). Efficiency gains from network stability are improved by partners' past history and by partners' shared expectation for the project's future (Ariño & Reuer, 2004). Greater coordination attenuates transaction uncertainty, increases efficiency of exchanges, and improves performance. Collectively, these arguments provide the logic for hypothesis 2:

Hypothesis 2: *Higher levels of project duration will be associated with higher levels of aggregate tie strength (ATS) within temporary vertical groups.*

Project uncertainty, as used in this study, fits Williamson's (1985) definition of primary uncertainty, such that it involves unpredictability and volatility in demand, technology, and other aspects of the task environment. In combination with asset specificity, greater uncertainty promotes the need for greater adaptation and coordination, thus favoring vertical integration (Walker & Weber, 1984; Williamson, 1979; Williamson, 1975). Project uncertainty makes contracting with partners more difficult as it can be difficult to include sufficient contingencies in a formal agreement (Argyres & Mayer, 2007; Hart, 1995;

Williamson, 1985). This contracting difficulty therefore favors greater vertical integration by the lead firm.

Working with a smaller number of partners is also desirable for projects with greater uncertainty. In these situations, partners will need to mutually adjust and coordinate activities and this is more tenable with fewer partners. This is particularly true as the network is formed ex ante, such that firms understand that uncertainty will occur but will not know how it will impact each partner specifically but that all will need to work together to address it ex post. This leads to reciprocal interdependence among the firms such that they will need to jointly problem solve and mutually adjust as the project unfolds (Thompson, 1967; Gulati et al., 2005). This heightens the need for continuous adaptation and communication, which is facilitated with fewer partners.

Prior relationships with partners will also facilitate adaptation and coordination required by uncertainty. Upon designing the vertical group, lead firms must assess the resources a potential partner brings to the vertical group and assess how the value derived from that partner's resources may change in the face of changes in the external environment (Ariño & Reuer, 2004). Because future changes in value are unknown at the time a temporary vertical group is formed, Reuer, Zollo and Singh (2002) suggest the initial governance decision is only one component of a much broader series of challenges that cooperating firms must adjust to in the face of uncertainty. The increasing reliance on adaptation under high uncertainty favors vertical groups higher in relational embeddedness, because prior experience with a partner increases flexibility and allows for lower cost adaptations (Luo, 2002). Interorganizational trust, developed over time through repeated partnerships, reduces the costs of contract renegotiation and subsequent conflict (Zaheer, McEvily, & Perrone, 1998). Collectively, these arguments support hypothesis 3:

Hypothesis 3: *Higher levels of project uncertainty will be associated with higher levels of aggregate tie strength (ATS) within temporary vertical groups*

In summary, we propose that lead firms design their temporary vertical groups to match project characteristics. Diverse projects that require varied and specialized skills will motivate lead firms to outsource to a broad array of partners, reducing aggregate tie strength. Long and uncertain projects, with their potential for greater opportunism as well as their requirements for greater coordination and adaptation, will motivate lead firms to engage in more activities internally, use fewer partners, and select well-known partners.

METHODOLOGY

We follow Eccles (1981a; 1981b) and study *bridge construction firms*, which Eccles noted are particularly salient examples of persistent interfirm relationships on multiple projects. In bridge construction, lead firms actively contribute to production, and design temporary organizations within their persistent vertical groups by first considering the degree of vertical integration and then selecting the number and identity of partners with whom to subcontract Eccles (1981a; 1981b).

We constructed our sample from a list of all department of transportation (DOT) bridge projects (and their associated vertical groups) constructed in the state of Oregon from 2000 – 2007. Conveniently, the DOT has required a *Subcontractor Disclosure Form* (SDF) since February 2000. The SDF is a written list of all vertical group participants that perform greater than 5% of the work. The SDF includes the names of each general contractor and subcontractor in every vertical group and is the source of all partner identities.

To further refine our sample, we selected only those bridge projects that required on-site construction from raw materials, noted by prior scholars as ideal project requirements to elucidate strategic choices among vertical groups (Eccles, 1981a; Hampson & Tatum, 1997). Our analysis began by reviewing every Request for Proposal (RFP) issued by ODOT from 2000 – 2007. This initial list included complete data on 330 projects, eliciting 1380 proposed vertical groups. Within this initial sample, we then screened projects to include only those that contained data needed to model our exchange conditions in each hypothesis. The final sample included 166 bridge projects eliciting 584 proposed vertical groups.

Measures

The Oregon DOT keeps immaculate records of each bridge project and all proposed costs submitted by contractors. These records, known as "Bid Tabulations" in the industry, allowed us to construct continuous measures for most variables. For each of the 584 proposals that passed our screening process, a complete bid tabulation was available.

Within each bid tabulation is a work schedule that influences both vertical group structure and costs. This work schedule, called the "bid schedule" by ODOT, describes each component of the project that must be completed. As mentioned before, there is no product variation within the bid schedule, so each vertical group must submit a price to do all of the exact same bridge components, roadside improvements, landscaping, traffic control, paving, earthwork, etc.

Dependent Variable

Aggregate Tie Strength is constructed as previously described as: ATS = NTS * $\log_e x$ Where x = number of partners, NTS= Network Tie Strength = Number of partners/number of previous relationships

Gulati (1995) found that only the four most recent interactions positively affected current alliance performance. Therefore, only the five most recent ties between a lead firm and a subcontractor were included in counting values of repeated ties. The values for *Aggregate Tie Strength* ranged from 0 – 4.16 with a standard deviation of 0.77.

Independent Variables

Project Diversity measures the number of specialized tasks needed to complete a project and is a key determinant of organizational form in the construction industry (Eccles, 1981b). We counted the number of different tasks delineated in the bid tabulation for each job Tasks may include things such as pile driving, drilling shafts, furnishing and placing reinforcing steel, furnishing and placing concrete, demolition, jet grouting, painting, temporary traffic control devices, landscaping, irrigation, and excavation, among others. We then normalize the number of tasks by dividing by the total project cost in dollars. Last, to ease interpretation of the results, the normalized measure of diversity is then multiplied by 10,000.

Project Duration is operationalized by the project cost (US Dollars). Large projects are associated with longer time durations and construction project duration is often measured by total project receipts in dollars (Eccles, 1981a).

Project Uncertainty is operationalized as the number of pages contained within Section 00290 – Environmental Uncertainty of the Project Special Provisions. Section 00290 calls a prospective bidder's attention to potential issues regarding the physical environment, such as environmental hazards in existing and proposed structures (e.g., lead-based paint, creosote treated timbers), the approximate location of cultural sites (e.g., Native American burial grounds, parks), and wildlife behavior (e.g., nesting sites of endangered species, spawning beds and other protected fish habitat). Section 00290 is a salient source of uncertainty for prospective bidders. Across the sample of projects, section 00290 ranges from one paragraph (1/4 page) to 25 pages. The mean number of pages is 6.86 with a standard deviation of 4.37 pages.

Control variables were operationalized as follows. *Lead firm Size* was operationalized as the number of employees at the lead firm's headquarters (Eccles 1981a; Seldin and Bloom 1961). *Lead firm Age* is a count of the number of years since the lead firm was founded. We use *Lead Firm Size* and *Age* as proxies for firm capabilities across all projects. We believe size and age influence strategic decision-making and similarly influence the selection of subcontractors in a vertical group. *Project Frequency* is a count variable for the total number of bridge projects in Oregon in a given year. Accounting for frequency matches Eccles (1981a) and his measure for "market variability," which he included to refute evidence of vertical group structures previously discussed in Stinchcombe (1959) *Environmental Munificence* is measured by the total dollar volume of bridge projects in Oregon in a given year. Similar to controlling for project frequency, Eccles (1981a) suggests controlling for munificence gives scholars greater ability to discern the role of subcontracting on the performance of construction projects.

RESULTS

Aggregate Tie Strength is censored at a lower limit, and also has a limited range of values – suggesting Tobit regression is the preferred modeling technique (Greene, 2003). Furthermore, for each bridge proposal in the sample, observations take on values at the limit, which is another strong indicator that Tobit regression is the appropriate choice in this case (Kennedy, 2003). To control for the presence of multiple vertical groups for a lead firm and to more robustly control for lead firm capabilities that may inform vertical group design decisions, we use robust standard errors and clustering Tobit regressions by lead firm.

As Table 1 shows, none of the correlations are statistically significant at the 5% level and none of the correlations are extraordinarily high. To ensure collinearity was not a problem, we ran OLS regression to estimate vertical group structure (Model 5) and with the full range of variables in Table 1. We used econometric techniques to reduce biases associated with ordinary least squares (OLS) regression. By their very nature of being 'temporary,' observations of these organizational forms suggest variables of limited range, missing data issues, and error terms that violate the assumptions of OLS (Kennedy, 2003). We employed maximum likelihood estimation to assuage these issues and allow us more accurate interpretation of the results.

Following regression, we calculated the variable inflation factor (VIF), an indicator of collinearity if its value is greater that 10.0 (Meyers, 2006). The largest VIF value in Model 5 was 1.68. Thus, we conclude that collinearity did not degrade the results from the Tobit regression procedures.

Table 2 presents the results from the Tobit regression that tests the effects of project characteristics on vertical group design. Environmental Munificence, captured on an annual basis, also serves as a control for contemporaneous correlation. Contemporaneous correlation exists when the error terms of observations in each time period are correlated (Certo & Semadeni, 2006). As an additional robustness check, we replaced munificence with year dummies and found no adverse effects from contemporaneous correlation. Model 1 includes only the control variables and provides baseline estimates. Models 2, 3, and 4 begin introducing the key independent variables, with Model 5 being the full or unrestricted model. To test the goodness-of-fit of the models, we used a chi-squared likelihood ratio (LR) test. The results from LR testing indicate Model 5, the full model, is the best fit for these data ($p < .05$).

Hypothesis 1 predicted that as project diversity increases, temporary vertical groups will be designed with a greater number of less embedded network partners. The negative and significant coefficients obtained for project diversity in Models 2 and 5 indicate that as project diversity increases, *Aggregate Tie Strength* decreases. This supports Hypothesis 1.

Hypothesis 2 predicted that as project duration increases, temporary vertical groups will be designed to include a set of more familiar network partners, which increases relational embeddedness. The negative but not significant coefficient obtained for project size in Model 5 indicates that longer projects may be associated with lower values of *Aggregate Tie Strength*, which contradicts the hypothesized relationship. Therefore, Hypothesis 2 is not supported.

Hypothesis 3 predicted that as project uncertainty increases, temporary vertical groups will be designed with a tighter set of network partners, which increases relational embeddedness. The coefficient on the *Project Uncertainty* variable is positive and significant in Models 4 and 5. This means that project uncertainty is associated with increased relational embeddedness among vertical group partners, which supports Hypothesis 3.

TABLE 1
DESCRIPTIVE STATISTICS AND CORRELATIONS

		Mean	S.D.	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	Aggregate Tie Strength	0.46	0.77	0.00	4.16	1.00							
(2)	Project Diversity	0.43	0.75	0.02	8.49	-0.05	1.00						
						(0.19)							
(3)	Project Duration[a]	517.17	314.01	45.00	1688.00	0.06	-0.25	1.00					
						(0.16)	(0.00)						
(4)	Environmental Uncertainty	6.86	4.37	0.25	25.00	0.10	-0.23	0.39	1.00				
						(0.01)	(0.00)	(0.00)					
(5)	Lead Firm Size[b]	67.43	102.61	1.00	650.00	-0.14	-0.06	0.03	0.04	1.00			
						(0.00)	(0.14)	(0.48)	(0.37)				
(6)	Lead Firm Age[c]	38.32	23.62	0.00	130.00	0.01	-0.10	0.20	0.08	0.36	1.00		
						(0.84)	(0.01)	(0.00)	(0.04)	(0.00)			
(7)	Log Munificence[a]	19.41	0.19	19.10	19.74	0.03	-0.13	-0.14	0.09	0.09	0.04	1.00	
						(0.47)	(0.00)	(0.00)	(0.02)	(0.03)	(0.29)		
(8)	Project Frequency[d]	41.47	8.29	28.00	52.00	-0.02	0.10	-0.24	-0.37	0.04	0.05	0.30	1.00
						(0.64)	(0.01)	(0.00)	(0.00)	(0.30)	(0.19)	(0.00)	

Sample n=584
a Log, Millions of US Dollars
b Number of HQ Employees
c Years
d Projects Per Year

TABLE 2
TOBIT ESTIMATION

	Model 1	Model 2	Model 3	Model 4	Model 5
Lead Firm Size	-0.002	-0.002	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Lead Firm Age	0.005	0.004	0.003	0.004	0.003
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Log Munificence	0.769	0.598	0.790	0.552	0.468
	(0.713)	(0.699)	(0.678)	(0.722)	(0.654)
Project Frequency	-0.010	-0.006	-0.007	-0.000	0.002
	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
Project Diversity		-0.338*			-0.220*
		(0.178)			(0.114)
Project Duration			0.000**		0.000
			(0.000)		(0.000)
Enviro Uncertainty				0.043***	0.034**
				(0.012)	(0.014)
N	580	580	580	580	580
Log Pseudo Likelihood	-663.52	-660.50	-655.38	-660.07	-651.60
Pseudo R-Squared	0.01	0.01	0.01	0.01	0.02

Robust standard errors, clustered by lead firm, in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%, one-tailed tests

To summarize, the results in Model 5 (the full model) are consistent with the interpretation that project characteristics significantly affect how lead firms design temporary vertical groups. The negative and significant coefficient for *Project Diversity* indicates that lead firms design vertical groups for diverse projects with lower values of relational embeddedness. The positive and significant coefficient for *Project Uncertainty* in Model 5 indicates that vertical groups exhibit higher relational embeddedness for more uncertain projects. Turning to the control variables, we see that large lead firms tend to experiment with a more diverse array of subcontractors and that environmental munificence, which measures the total volume of work for a given year, is related to higher values of *Aggregate Tie Strength*.

CONTRIBUTIONS

This study extends our knowledge of how firms design groups or clans to complete temporary projects and who they include in the partner network. Prior studies ignored how antecedent task requirements affect these design choices, which in turn limited our understanding of how vertical integration decisions interact with network structures. Second, observing vertical groups raised the level of analysis to the whole network level, extending our understanding of governance beyond dyadic relations to a (more) holistic understanding of how partner networks configure and reconfigure over time. We found that vertical groups are strategically designed according to temporary project characteristics. This extends theories of governance design beyond a single firm acting alone to include how multiple firms organize and compete as value chains (Hult, Ketchen, & Arrfelt, 2007) within cooperative industries (Adner & Kapoor, 2010; Helper, MacDuffie, & Sabel, 2000). Last, while Brusoni and Prencipe (2001) suggested that these lead firms behave as "systems integrators," our study adds specifics. We found that duration of the assembled network organization is a variable that affects temporary vertical groups differently than more permanent networks or alliances.

CONCLUSION

The empirical findings of this study suggest that project characteristics and relational embeddedness interact to affect organizing in temporary vertical groups. Lead firms should consider project characteristics strategically to inform their integration decision, what is outsourced, to whom, and how loose or tight the structure of the entire network needs to be.Once an estimate of the in-house work is determined, the choice of including certain potential partners and withholding inclusion of others should not be solely informed by successful previous partnering. Our findings indicate that considering complexity and duration of the next project may strategically optimize a particular iteration of a temporary vertical group, by sometimes excluding previous partners with a longer co-history of successful collaboration. While higher project uncertainty should be considered a vote for the inclusion of historical partners, consideration of project complexity and project duration could indicate excluding these potential partners. Avoiding a bias for reflectively including all the "usual suspects" should enhance the efficiency of the ultimate network design. Perhaps this is why some collaborative groups are so persistent and successful over time: Proper vertical group design per project is difficult to get right and critical to success. Judging by resource-based VRIO (Barney, Jay, 1991) standards, lead firms and vertical group members that have this joint capability have a clear source of sustainable competitive advantage.

Managers in the construction industry and other settings can derive value from this study. Managers are increasingly being asked to design radically different business models that access new forms of capital, technology and skills that simply were not available previously (Prahalad & Oosterveld, 1999). This may require bringing together more and different partners to create novel products or access new markets. Faced with this daunting challenge, perhaps these managers can look at the design of vertical groups as a place to start and consider how various subsets of partners over time can help them accomplish different tasks.

REFERENCES

Adner, R., & Kapoor, R. (2010). Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal*, *31*, 306-333.

Altshuler, A., & Luberoff, D. (2003). *Mega-projects: The changing politics of urban public investment*. Washington: Brookings Institution Press.

Argyres, N. (1996). Evidence on the role of firm capabilities in vertical integration decisions. *Strategic Management Journal*, *17*, 129-150.

Argyres, N., & Mayer, K.J. (2007). Contract design as a firm capability: An integration of learning and transaction cost perspectives. *The Academy of Management Review*, *32*, 1060-1077.

Ariño, A., & Reuer, J.J. (2004). Designing and renegotiating strategic alliance contracts. *Academy of Management Perspective*, *18*, 37-48.

Baker, W.E. (1990). Market networks and corporate behavior. *American Journal of Sociology*, *96*, 589-625.

Baldwin, C.Y. (2008). Where do transactions come from? modularity, transactions, and the boundaries of firms. *Industrial and Corporate Change*, *17*(1), 155-195. doi:10.1093/icc/dtm036

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*, 99-121.

Barney, J.B. (1986). Strategic factor markets: Expectations, luck, and business strategy. *Management Science*, *32*, 1231-1241.

Bechky, B. (2006). Gaffers, gofers, and grips: Role-based coordination in temporary organizations. *Organizational Science*, *17*, 3-22.

Bellavitis, C., Rietveld, J., & Filatotchev, I. (2019). The effects of prior co-investments on the performance of VC syndicates: A relational agency perspective. *Strategic Entrepreneurship Journal*, (Forthcoming).

Brusoni, S., Prencipe, A., & Pavitt, K. (2001). Knowledge specialization, organizational coupling, and the boundaries of the firm: Why do firms know more than they make? *Administrative Science Quarterly*, *46*, 597-621.
Capaldo, A. (2007). Network structure and innovation: The leveraging of a dual network as a distinctive relational capability. *Strategic Management Journal*, *28*, 585-608.
Certo, S.T., & Semadeni, M. (2006). Strategy research and panel data: Evidence and implications. *Journal of Management*, *32*, 449-471.
Coase, R.H. (1937). *The nature of the firm*. New York: Oxford University Press.
Cohen, W.M., & Levinthal, D.A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*, 128-152.
DeFillippi, R., & Arthur, M. (1998). Paradox in project-based enterprise:The case of film making. *California Management Review*, *40*, 1-15.
Dyer, J.H. (2000). *Collaborative advantage: Winning through extended expertise supplier networks*. New York: Oxford University Press.
Dyer, J.H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *The Academy of Management Review*, *23*, 660-679.
Ebers, M., & Maurer, I. (2016). To continue or not to continue? drivers of recurrent partnering in temporary organizations. *Organization Studies*, *37*(12), 1861-1895.
Eccles, R.G. (1981a). Bureaucratic versus craft administration: The relationship of market structure to the construction firm. *Administrative Science Quarterly*, *26*, 449-469.
Eccles, R.G. (1981b). The quasifirm in the construction industry. *Journal of Economic Behavior & Organization*, *2*, 335-357.
Eccles, R.G., & Crane, D.B. (1988). *Doing deals: Investment banks at work*. Boston, MA: Harvard Business School Press.
Ethiraj, S.K., & Levinthal, D. (2004). Modularity and innovation in complex systems. *Management Science*, *50*, 159-173.
Faulkner, R.R., & Anderson, A.B. (1987). Short-term projects and emergent careers: Evidence from hollywood. *American Journal of Sociology*, *92*, 879-909.
Gomes-Casseres, B. (1994). Group versus group: How alliance networks compete. *Harvard Business Review*, *72*, 62.
Grabher, G. (2002). The project ecology of advertising: Tasks, talents, and teams. *Regional Studies*, *36*, 205-214.
Granovetter, M. (1992). Problems of explanation in economic sociology. In N. Nohria & R.G. Eccles (Eds.), *Networks and organizations: Structure, form and action* (pp. 25-56). Boston: Harvard Business School Press.
Grant, R.M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, *17*, 109-122.
Gulati, R., Lawrence, P.R., & Puranam, P. (2005). Adaptation in vertical relationships beyond incentive conflict. *Strategic Management Journal*, *26*, 415-440.
Gulati, R., & Singh, H. (1998). The architecture of cooperation: Managing coordination costs and appropriation concerns in strategic alliances. *Administrative Science Quarterly*, *43*, 781-814.
Hart, O. (1995). *Firms, contracts, and financial structure*. Oxford, UK: Clarendon Press.
Hayes, R.H., Wheelwright, S.C., & Clark, K. (1988). *Dynamic manufacturing*. New York: The Free Press.
Heide, J.B., & Miner, A.S. (1992). The shadow of the future: Effects of anticipated interaction and frequency of contact on buy-seller cooperation. *Academy of Management Journal*, *35*, 265-291.
Helper, S., MacDuffie, J.P., & Sabel, C. (2000). Pragmatic collaborations: Advancing knowledge while controlling opportunism. *Industrial and Corporate Change*, *9*, 443.
Hill, C.J., & Lynn, L.E. (2005). Is hierarchical governance in decline? evidence from empirical work. *Journal of Public Administration Research and Theory*, *15*, 173-195.

Hoetker, G. (2006). Do modular products lead to modular organizations? *Strategic Management Journal*, *27*, 501-518.

Holloway, S.S., & Parmigiani, A. (2016). Friends and profits don't mix: The performance implications of repeated partnerships. *Academy of Management Journal*, *59*(2), 460-478.

Hult, G.T., Ketchen, D.J., & Arrfelt, M. (2007). Strategic supply chain management: Improving performance through a culture of competitiveness and knowledge development. *Strategic Management Journal*, *28*, 1035-1052.

Jones, C., Hesterly, W.S., & Borgatti, S.P. (1997). A general theory of network governance: Exchange conditions and social mechanisms. *Academy of Management Review*, *22*(4), 911-945.

Jones, C., & DeFillippi, R. (1996). Back to the future in film: Combining industry and self-knowledge to meet career challenges of the 21st century. *Academy of Management Perspectives*, *10*, 89-104.

Jones, C., Hesterly, W.S., Fladmoe-Lindquist, K., & Borgatti, S.P. (1998). Professional service constellations: How strategies and capabilities influence collaborative stability and change. *Organization Science*, *9*, 396-410.

Kale, P., Dyer, J.H., & Singh, H. (2002). Alliance capability, stock market response, and long term alliance success: The role of the alliance function. *Strategic Management Journal*, *23*, 747-768.

Kennedy, P. (2003). *A guide to econometrics* (5th ed.). Cambridge: MIT Press.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, *3*, 383-397.

Lawrence, P.R., & Lorsch, J.W. (1967). In J.W. Lorsch (Ed.), *Organization and environment; managing differentiation and integration.* Boston: Division of Research, Graduate School of Business Administration, Harvard University.

Lee, J., Hoetker, G., & Qualls, W. (2015). Alliance experience and governance flexibility. *Organization Science*, *26*(5), 1536-1551.

Levinthal, D., & Fichman, M. (1988). Dynamics of interorganizational attachments: Auditor-client relationships. *Administrative Science Quarterly*, *33*, 345-369.

Lorenzoni, G., & Lipparini, A. (1999). The leveraging of interfirm relationships as a distinctive organizational capability: A longitudinal study. *Strategic Management Journal*, *20*, 317-338.

Lundin, R.A., & Soderholm, A. (1995). A theory of the temporary organization. *Scandinavian Journal of Management*, *11*, 437-455.

Luo, Y. (2002). Contract, cooperation, and performance in international joint ventures. *Strategic Management Journal*, *23*, 903-920.

Mayer, K.J., & Nickerson, J.A. (2005). Antecedents and performance implications of contracting for knowledge workers: Evidence from information technology services. *Organization Science*, *16*(3), 225-242.

Meyers, L.S. (2006). *Applied multivariate research: Design and interpretation*. Thousand Oaks, CA: Sage.

Moynihan, D. (2005). *Leveraging collaborative networks in infrequent emergency situations.* Washington, DC: Retrieved from Leveraging Collaborative Networks in Infrequent Emergency Situations

Nelson, R.R., & Winter, S.G. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Belknap Press of Harvard University Press.

Pine, B.J., & Gilmore, J.H. (1998). Welcome to the experience economy. *Harvard Business Review*, *76*, 97-105.

Podolny, J.M. (1993). A status-based model of market competition. *American Journal of Sociology*, *98*, 829-872.

Poppo, L., Zhou, K.Z., & Ryu, S. (2008). Alternative origins to interorganizational trust: An interdependence perspective on the shadow of the past and the shadow of the future. *Organization Science*, *19*, 39-55.

Poppo, L., Zhou, K.Z., & Zenger, T.R. (2008). Examining the conditional limits of relational governance: Specialized assets, performance ambiguity, and long-standing ties. *Journal of Management Studies*, *45*, 1195-1216.
Powell, W.W., Koput, K.W., & Smith-Doerr, L. (1996). Interorganizational collaborations and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly*, *41*, 116-145.
Prahalad, C.K., & Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review*, *68*, 79.
Provan, K.G., & Kenis, P. (2008). Modes of network governance: Structure, management, and effectiveness. *Journal of Public Administration Research and Theory*, *18*, 229-252.
Reuer, J.J., Zollo, M., & Singh, H. (2002). Post-formation dynamics in strategic alliances. *Strategic Management Journal*, *23*, 135-152.
Ring, P.S., & Van de Ven, A.H. (1992). Structuring cooperative relationships between organizations. *Strategic Management Journal*, *13*(7), 483-498.
Rivkin, J.W., & Siggelkow, N. (2003). Balancing search and stability: Interdependencies among elements of organizational design. *Management Science*, *49*, 290-311.
Rubin, P.H. (1973). The expansion of firms. J*ournal of Political Economy*, *81*, 936-949.
Sanchez, R., & Mahoney, J.T. (1996). Modularity, flexibility, and knowledge management in product and organization design. *Strategic Management Journal*, *17*, 63-76.
Schilling, M.A., & Steensma, H.K. (2001). The use of modular organizational forms: An industry-level analysis. *The Academy of Management Journal*, *44*, 1149-1168.
Shanley, M., & Peteraf, M.A. (2004). Vertical group formation: A social process perspective. *Managerial and Decision Economics*, *25*, 473-488.
Snow, C.C., Miles, R.E., & Coleman, H.J. (1992). Managing 21st century network organizations. *Organizational Dynamics*, *20*, 5-21.
Tesler, L.G. (1980). A theory of self-enforcing agreements. *The Journal of Business*, *52*, 27-44.
Uzzi, B. (1997). Social structure and competition in interfirm networks: The paradox of embeddedness. *Administrative Science Quarterly*, *42*(1), 35.
Uzzi, B. (1996). The sources and consequences of embeddedness for the economic performances of organizations: The network effect. *American Sociological Review*, *61*, 674-698.
Walker, G., & Weber, D. (1984). A transaction cost approach to make-or-buy decisions. Science Quarterly, *29*, 373-391.
Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*(2), 171.
Williamson, O.E. (1979). Transaction-cost economics: The governance of contractual relations. *The Journal of Law and Economics*, *22*(2), 233-261.
Williamson, O.E. (1975). *Markets and hierarchies: Analysis and antitrust implications*. New York: Free Press.
Williamson, O.E. (1985). *The economic institutions of capitalism: Firms, markets, relational contracting*. New York: Free Press.
Winch, G. (1989). The construction FIrm and the construction project: A transaction cost approach. *Construction Management and Economics*, *7*, 331-345.
Zaheer, A., McEvily, B., & Perrone, V. (1998). Does trust matter? exploring the effects of interorganizational and interpersonal trust on performance. *Organization Science*, *9*, 141-159.