The Firm as a Coordination System: Evidence from Software Services Offshoring

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Abstract

To examine what, if any, are the differences in how activities are coordinated within-firms vs. between-firms we conducted interviews with 32 project managers regarding 60 projects in the offshore software services industry. Uniquely, our projects were sampled along two dimensions: (1) co-location vs. spatial distribution and (2) were delivered by groups of individuals from a single firm vs. from multiple firms. Our evidence suggests that in co-located projects, the same broad categories of coordination mechanisms are used both within- and between-firms. However, there is a qualitative difference in how geographically (i.e. spatially) distributed projects are coordinated within- vs. between-firms. Distributed projects conducted within-firms rely extensively on tacit coordination mechanisms; such mechanisms are not readily available in between-firm projects that are spatially distributed. The difference may arise because of the lack of shared history and lack of enforcement through common authority in the between-firm context.

Key Words: Coordination, Common ground, Firm Boundaries, Knowledge Based View, Distributed Work
INTRODUCTION
Are interdependent activities coordinated differently when they lie within the boundaries of a firm rather than across the boundaries of firms? The answer to this question has vital implications for the lively theoretical debate around the “knowledge based perspective” – an approach that views the firm as an institution that offers safeguards against coordination problems (Conner and Prahalad, 1996; Demsetz, 1988; Grant, 1996; Kogut and Zander, 1992, 1996; Nahapiet and Ghoshal, 1998; Gulati, Lawrence and Puranam, 2005; Nickerson and Zenger, 2004). In this paper, we explore geographic (spatial) distribution or co-location of work as a contingency that influences the nature of coordination within- vs. between- firm boundaries.

Coordination as an outcome is achieved when interdependent individuals are able to act as if they can predict each other’s actions; coordination failures occur when interacting individuals are unable to anticipate each other’s actions and adjust their own accordingly (Schelling, 1960; Puranam, Raveendran and Knudsen, 2012). Ineffective communication and knowledge transfer, delays, misunderstandings and poor synchronization of activities are typical manifestations of coordination failure. In contrast, cooperation failures occur when interdependent individuals face conflicting incentives; these failures are manifested as hold-up, shirking and possibly other forms of opportunistic behavior (Alchian and Demsetz, 1972; Klein, Crawford and Alchian, 1978; Williamson, 1979). Scholars across a range of disciplines have noted that coordination failures can occur even when incentives are fully aligned (Simon, 1947; March and Simon, 1958; Schelling, 1960; Camerer, 2003; Heath and Staudenmayer, 2000; Grant, 1996; Holmstrom and Roberts, 1998).

While addressing the same central question as do theories of the firm based on economic incentives (i.e. why certain transactions are optimally conducted within rather than between firms – Coase, 1937; Williamson, 1975; 1985), proponents of the knowledge based view (KBV) have de-emphasized the various forms in which incentive conflict may arise, and instead have argued that firms are social structures that offer protection against coordination failures in unique ways that are not available in market transactions. Examples of mechanisms that are available only in within-firm transactions include higher levels of shared knowledge, common language and higher order organizing principles under the shadow of common authority (Kogut and Zander, 1992; 1996; Conner...
The firm as a coordination system

and Prahalad, 1996; Grant, 1996; Demsetz, 1988). Thus in the knowledge based perspective, the discriminating alignment between transactions and governance forms (Williamson, 1991) occurs not on the criteria of asset specificity and anticipated hold-up, but rather on the match between the coordination requirements of transactions and the distinctive coordination mechanisms that characterize within-firm vs. between-firm transactions (Nickerson and Zenger, 2004).

Incentive based theories such as transaction cost economics are able to offer a coherent account of the unique mechanisms by which incentive conflicts are mitigated or resolved within firms (e.g. through fiat and low power incentives). This is not true of the KBV as scholars have questioned the key premise that within-firm interactions can draw on unique coordinating mechanisms - arguing instead that such mechanisms are also available in between-firm transactions (Stinchcombe, 1985; Grandori, 1997; Grandori and Soda, 1995; Foss, 1996a; 1996b; Grandori and Kogut, 2002).

The empirical evidence available to date does not allow us to decide confidently between these viewpoints, with some studies offering (at least indirect) evidence of “differences” in within- and between-firm coordination mechanisms, and others showing “no differences”. For instance, consistent with the notion that shared organizing principles and common language confer unique advantages to within-firm knowledge transfer processes, Kogut and Zander (1993) found that multinational firms are more likely to transfer complex, tacit knowledge to their subsidiaries rather than to third parties. Almeida, Song and Grant (2002) found that multi-national firms cite their own foreign patents more frequently than the patents of alliance partners, or those of competitors. They suggest that firms have access to multiple formal and informal practices that facilitates transfer of both codified and tacit knowledge within their boundaries, and that fewer of these mechanisms are available between firms.

In contrast, other scholars who have studied the coordination mechanisms used between firms conclude that these are no different from those used within firms. Helper, McDuffie and Sabel (2000) document the use of “within-firm like” coordination practices such as co-location of engineers and the

Note that this critique is quite independent of the question of whether the knowledge based perspective, even if its premises were true, could claim to have provided an alternative sufficient explanation of firms as systems of asset ownership even if it does successfully explain the existence of employment contracts, as Foss (1996b) pointed out.
exchange of detailed information across assemblers and suppliers. Dyer (1996; 1997) and Dyer and Nobeoka (2000) observe that within-firm like coordination practices such as engineer co-location, co-specialization of human capital and strong identity and coordination rules are implemented in some buyer-supplier transactions in the automotive industry.

The stimulus for the current paper was an observation about the nature of the conflicting claims in the prior literature noted above: the empirical setting of the “no difference” camp (e.g., Helper et al, 2000) tends to be co-located buyer-supplier relationships, whereas the empirical setting of the “difference” camp (e.g. Almeida et al, 2002) consists of geographically dispersed subsidiaries of multinational firms. Our goal is therefore to understand co-location/distribution of work as a key contingency that the knowledge based perspective theorizing has perhaps neglected.

Theories of the firm, concerned as they are with the issue of discriminating alignment between transaction characteristics and governance modes offer no direct guidance on this question, as they are generally agnostic to the location of activity. Yet the spatial distribution of work is now widely recognized as an important contingency that should be reflected in our theories of organizations and organizing (e.g. Hinds and Kiesler, 2002; Zammuto et al, 2007). If we found that co-location vs. spatial distribution was indeed an important contingency that determined when the arguments of the knowledge-based perspective had force, we would see this as a useful refinement of the perspective. If we find no qualitative differences in the use of coordination mechanisms within-vs. between- firms, even after accounting for the contingency of co-location, our results would add to the evidence against the KBV.

The software services offshoring industry provides an interesting setting to examine our conjecture about the spatial distribution/co-location of work as a key contingency for the knowledge based perspective. Wage arbitrage between the “onshore” (typically Western) and “offshore” (e.g. India or China) locations is the principal economic driver of this industry (Farrell, 2005). Specifically, when offshoring is accompanied by outsourcing, the economics requires a reduction in the onshore headcount within the client and vendor firms with a corresponding (but less costly) increase in headcount offshore within the vendor firm. Despite this compelling incentive to offshore, projects
with *zero onshore presence* of vendor employees are exceedingly rare. The typical staffing pattern is such that 20-30% of the vendor employees in a project are onshore and 70-80% are offshore, with almost no client employees located offshore (Venkatesh and Krishna, 2005; Information Week, 2004). It appears that there is a strong preference to coordinate work across onshore and offshore locations between employees of the same firm (the vendor) rather than between onshore-client and offshore-vendor employees. Coordinating geographically distributed work is a widely recognized challenge in this industry (Cataldo et al, 2006; Mullick et al, 2006). This suggests some face validity for our conjecture that the advantages of within-firm coordination may be more salient for spatially distributed work rather than co-located work.

To investigate why and how this may be the case, we analyzed field interview data on 42 distributed and 18 co-located projects from the software services offshoring industry. Uniquely, these 60 projects were sampled along the dimensions of cross-location and cross-firm distribution of work allowing us to focus sharply on our conjecture. We chose a qualitative approach to be able to gain greater insight on the “how” questions that are at the center of our study: how are coordination mechanisms different across firm boundaries rather than within and how does co-location or spatial distribution of work influence the use of these mechanisms? Comparative case studies are useful precisely in these situations, where we are trying to understand process questions and boundary conditions for their applicability (Eisenhardt, 1989; Yin, 1994; Siggelkow, 2007).

Our analysis points to two main conclusions. First, we find that for *co-located projects*, there is no evidence for coordination mechanisms that appear to be unique to projects that comprise individuals drawn from the same firm or from different firms. Second, for *spatially distributed* projects, we do find a sharp distinction in how work is coordinated between employees from the same firm vs. different firms. Consistent with the general trends in the industry, in our sample offshore outsourcing projects always included some onshore vendor employees. In this paper, apart from noting this distinction, we attempt to understand why this is the case. Our sample is unique in explicitly comparing within- and between-firm coordination for spatially distributed *and* collocated work.
Beyond the implications for understanding how coordination occurs within and between firms, our research has relevance to the broader organizational phenomenon of coordination under communication constraints. Both interdependence and communication constraints are well known joint consequences of specialization within organizations (Kretschmer and Puranam, 2008). In general, “as the specialization of tasks proceeds, the interdependency of the specialized parts increases” (Simon 1991, p. 42). Specialization inevitably leads to interdependence and the need for coordination in the sense that the specialized parts must eventually work together (March and Simon 1958). However, specialization, also creates communication constraints between individuals in specialized subunits within an organization because they belong to distinct “thought worlds” with mutually incompatible representations, language, interpersonal and time orientations (Lawrence and Lorsch 1967, Dougherty 1992; Heath and Staudenmeyer 2000; Sosa et al, 2012). Spatial distribution is but one source of communication constraint - time pressure, cultural differences, specialization and increasing scale may be others.

PRIOR THEORY: THREE GENERIC CATEGORIES OF COORDINATION MECHANISMS

In order to study differences in intra- and inter-firm coordination mechanisms, it is useful to start with a clear conception of the different categories of coordination mechanisms we will focus on. Since all coordination ultimately takes place between individuals (March and Simon, 1958), we use the term between-firm coordination to denote interactions involving employees from multiple firms and within-firm coordination to denote interactions between employees of a single firm. This is similar to usage in the work of Argyres (1999), Takeishi (2002) and Helper et al (2000) in their characterization of intra- and inter-organizational coordination. In our context, we treat organization as synonymous with firm (as do all theories of the firm- for instance see Williamson, 1991), though for other kinds of research questions, we do recognize it may be more appropriate to treat even a firm as comprising multiple organizations.
Some level of common ground – knowledge that is shared and known to be shared – is necessary for any conscious attempt at coordinated action (Schelling, 1960; Clark, 1996). Exactly how much common ground is required may however vary by situation and the nature of coordination mechanisms employed. An extensive prior literature has identified several coordination mechanisms that help to create sufficient common ground for coordination, and these can be usefully summarized into three generic categories: ongoing communication, modularity and tacit coordinating mechanisms (TCM). Rather than group mechanisms phenomenologically (e.g. into roles, routines etc.), we group them such that all the mechanisms grouped within a category work in roughly the same way to create the conditions under which individuals are able to successfully take coordinated actions, but the mechanisms listed across different categories work differently in achieving coordination.

**Ongoing communication** is the most intuitive and perhaps the most potent category of mechanisms for dynamically updating and maintaining the common ground necessary for coordinated action (Clark, 1996; Okhuysen and Bechky, 2009). Classical discussions of “feedback” (March and Simon, 1958) or “mutual adjustment” (Thompson, 1967) implicitly invoke the notion of ongoing communication in order to update common ground dynamically to achieve coordination.

Ongoing communication is more effective when it occurs between co-located individuals, since it provides the opportunity for face-to-face communication in a shared social context (Olson and Olson, 2000; Kraut et al, 2002). Prior work has shown that ongoing communication in virtual contexts using Information and Communication Technology (ICT) is inferior to face-to-face interaction in updating common ground (De Meyer, 1991; Kraut *et al.*, 1988; McGuire *et al.*, 1987). The consensus is that ICT media, even videoconferencing, remain limited in terms of bandwidth (Daft and Lengel, 1986; Doherty-Sneddon *et al.*, 1997; O’Conaill, Whittaker and Wilbur, 1993), and are relatively ineffective in coordinating complex ill-defined

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3 Actions may also be coordinated unconsciously as when each adapts individually to an environment that happens to include the other. Organisms coevolving in an ecology display such a property. The emergence of routines as a byproduct of individual adaptation by interdependent agents is another instance.
tasks with high interdependence between them (see Olson et al, 2002; Kraut et al., 2002; for reviews).

**Modularity** is a second category of approaches to coordination. It involves a designer who can partition activities into modules, design interfaces between modules and embed these interfaces into common ground across the individuals working in different modules (Simon, 1962). In general terms, an interface is a description of how the modules of a system interact with each other. In organizations, the modules are typically interdependent units (such as project teams, divisions or firms) and interfaces include standard operating procedures, design rules, plans and schedules that specify what each unit must do so that their actions are coordinated at the higher level (Galbraith, 1977; Tushman and Nadler, 1978). Interfaces economize on the need for ongoing communication as well as on the amount of knowledge held in common ground. If designed well, knowledge of the interface in common ground is sufficient to achieve coordinated action across sub-units (Simon, 1962; Baldwin and Clark, 2000; Ulrich and Eppinger, 1999), because across-module dependencies are primarily managed through interfaces, limiting the need for ongoing communication. Thus, while ongoing communication constantly updates common ground, modularity involves working with a minimal, constant level of common ground that is embedded in the interface.

When the pattern of interdependence between tasks is unknown or changing, as is typical in innovative work, modular approaches to coordination may be limited because well-specified interfaces cannot be designed *ex ante* (Thompson, 1967; Tushman and Nadler, 1978; Ethiraj and Levinthal, 2004; Okhuysen and Bechky, 2009). Under these conditions, coordination may require recourse to ongoing communication (March and Simon, 1958; Thompson, 1967; Tushman and Nadler, 1978; Scott, 2003). For example, Pentland and Reuter (1994) describe how ongoing communication was part of the routine for dealing with “exception” cases in a helpdesk system. Jarzabkowski, Lê, & Feldman (2011) discuss the role of intensive ongoing communication in coordinating when old routines were no longer adequate to coordinate in the changed circumstances.

Modularity and ongoing communication as two generic alternatives to coordinating work reflect the well-established distinctions between coordination by plan vs. feedback (March and Simon, 1958; Thompson, 1967; Tushman and Nadler, 1978; Galbraith, 1977), modular vs. integral designs
Recent work has also highlighted a third generic approach to coordination that relies primarily on **Tacit Coordination Mechanisms** (TCM’s). These help to achieve coordination in situations of high interdependence in a *tacit* manner – without recourse to explicit ongoing communication, or through the construction of modular interfaces. Instead, TCM’s work in two broad ways: a) by leveraging pre-existing common ground that may not be specific to the task at hand, and b) by building common ground through observing the work context, each other’s actions and outcomes rather than direct communication (Gutwin et al, 2004; Cramton, 2001; Clark, 1996). Leveraging shared experiences from having worked together on past projects is an instance of the former; it can often be built through rotating employees through the organization (Ghoshal, Korine and Szulanski, 1994; Nohria and Ghoshal, 1997). Observing the progress of work by working side-by-side is an instance of the latter.

Prior work has shown that TCM’s play an important role even in co-located work when ongoing communication is in theory feasible (Bechky, 2006; Faraj and Xiao, 2006). Mere proximity improves coordination because common ground is enhanced by being rooted in a shared social context such as a room and the use of shared artifacts (Olson et al, 2002; Kraut et al, 2002). Okhuysen and Bechky (2009) in their review of prior work on different coordination mechanisms emphasize that tacit coordination mechanisms such as the use of boundary objects, shared representations and task contexts improve the effectiveness of ongoing communication, and also help in achieving coordination even in situations where communication is constrained by enabling accountability, predictability and shared understanding among the interdependent actors. Srikanth and Puranam (2011) use survey data from a sample of offshore outsourced business processes to show that TCM can be distinguished empirically from the other two classes of coordination mechanisms, and that they mitigate the adverse impact on process performance arising from interdependence in spatially distributed work.

Tacit coordination must not be confused with tacit knowledge, or indeed with unintended (emergent) coordination. Tacit coordination mechanisms leverage shared knowledge – knowledge that may be tacit or explicit – to achieve coordination without the need for ongoing communication.
The firm as a coordination system

(Schelling, 1960; Camerer, 2003; Srikanth and Puranam, 2011). For example, in Schellings’ (1960) experiments, focal points are explicit knowledge, but they allow tacit coordination – coordination without the need for communicating. The moniker “tacit” in tacit coordination signifies that “ongoing communication is not necessary”. Tacit knowledge, on the other hand, involves situations where ongoing communication is not sufficient for knowledge transfer. Tacit coordination may be quite deliberate, and may draw on deliberately created/pre-existing shared knowledge.

While the three categories of coordination mechanisms we have described above are very well established in prior literature, in this study, we examine how firm boundaries influence the usage (and existence) of these three generic categories of coordination mechanisms - with particular attention to whether (and why) the differences (if any) are more salient for distributed rather than collocated work.

METHODOLOGY

We chose a qualitative methodology based on field interviews to understand how and why within-firm coordination is different from between-firm coordination for two reasons. First, qualitative methodologies are useful when different theories attempt to explain the same question and empirical evidence is mixed, since these typically imply the need to uncover the contingencies or boundary conditions where the different arguments apply (Eisenhardt and Graebner, 2007; Siggelkow, 2007). Quantitative methods are less appropriate in these settings since the nature of prior theory development does not allows us to build robust hypotheses that the large sample data is meant to test (Miles and Huberman, 1994). Second, whereas quantitative methodologies (such as analysis of data from surveys, e.g. Srikanth and Puranam, 2011) may be useful to understand whether there are differences in the usage of coordination mechanisms between and within firms, they are unlikely to shed as much light on the questions of why these differences exist.

Our empirical strategy was to sample cases in each cell in a 2x2 fully crossed design, where the cells identify projects crossing firm and/or geographic boundaries (see Figure 1). We chose this design since prior work has tended to focus either on projects that are collocated vs. distributed or compare projects conducted within- vs. across firm boundaries, but not both (Dibbern et al, 2008;
Helper et al, 2000). Our sample uniquely includes both dimensions enabling us to contrast mechanisms used by firms to bridge coordination challenges within and across firm boundaries in both co-located and distributed settings.

Site Selection: Since we were interested in understanding how coordination mechanisms differ across both firm and geographic boundaries, we needed access to sites that conducted a broad variety of projects across the four cells in Figure 1. We interviewed 32 project managers from two large software services providers, one headquartered in the US and the other in India. The US firm, that we call “Integrator” is a large software services vendor well known for delivering globally distributed projects for its multinational clients. The Indian firm, that we call “Process Master” was a pioneer in the offshore software services industry in India, and has been very successful in the past decade in delivering large global solutions. Both firms increasingly work with partners in their projects, including with each other (though not in our sample). Also, both firms increasingly compete for similar projects, thus making comparisons between them potentially insightful. We expected to see differences in the way these firms manage projects, and by generating variety we hope to understand the boundary conditions to our findings (Yin, 1994). Each firm provided information on 30 projects.

Case Selection: We interviewed project managers for software development or maintenance projects who had experience in managing at least two of the modes of organizing projects in our 2x2 sampling frame. This sampling strategy is particularly relevant for our research question that calls for comparisons across cells. Based on these criteria, our prime contacts in both firms (who were at the level of country heads) nominated managers to meet with us.

The sample consisted of 48 development and 12 maintenance projects. Development projects are those where a client organization hires a vendor to create new software to provide some specified functionality. They are susceptible to changing patterns of interdependence due to changes in requirements, as well as unknown interactions between components that only come to light at a later stage. Maintenance projects on the other hand involve ongoing support and upkeep of pre-existing systems. Maintenance projects may not require as much creative effort in design as development
The firm as a coordination system

projects, but they do involve difficult coordination episodes around the need to quickly resolve problems across sites with IT systems that are critical to the organization.

Data Collection and Analysis: In this research, we gathered data primarily from field interviews of expert informants, similar to Uzzi (1997). To understand how software development and maintenance activities are coordinated, we believe that project managers are the most relevant expert informants. They are uniquely responsible for defining the formal coordination mechanisms to be used in a project and are also responsible for coordinating across geographic and firm boundaries. Project managers are more able than other participants to provide information on the entire lifecycle of the project: the architecture phase, the development phase and the change requests and delivery phase. Since cross-case comparison was essential to our design, we only interviewed managers who had experience in at least two of our four cells.

The study was conducted in three phases. In the first phase, as a pilot we interviewed managers from four projects who are not part of this sample in order to identify the issues and phases that we should focus on during data collection. Based on these pilot interviews, we prepared a list of questions to act as a guide to semi-structured interviews in the main study (available in appendix 1).

In the second phase of data collection, we interviewed project managers who could talk to us about their experiences in two specific (named) projects. Each project was in a different cell in our design. Our sponsors in the organizations identified the managers for us to speak with. We contacted them with a short statement of the purpose of our research and a short list of the type of questions we would ask to enable them to assemble secondary material. In essence, the managers were asked to describe and compare the coordination mechanisms used in the two projects across the two cells, and explain why different choices were made.

The interviews with project managers lasted between 60 and 180 minutes. 28 of the 32 interviews were recorded (with permission) and transcribed. We also took extensive notes during the interview, which were typed up the same day along with any field observations. In many instances the respondents drew diagrams and charts to explain concepts and also provided us with copies of documents, slides and templates that were used in their firm. Some managers were contacted again to clarify doubts.
In the third phase the analysis of the evidence proceeded by iteration, and in tandem with the second phase. Table 1 describes the process of case write up and analysis that we followed in this project. Both researchers read the interview transcripts and discussed emerging ideas and themes that were subsequently incorporated in the additional interviews to achieve greater understanding of these concepts. For example, we were unaware of a category of tools called “workflow” tools – after we encountered these tools in two projects, we specifically asked managers in subsequent interviews about these tools. Another was the phrase, “investing in process”. Once the major conceptual themes were identified from the content analysis, we read and reread interview transcripts to link the evidence to recurring themes and to understand the relationships between the themes. Finally, we compared our framework with prior theory to understand how our results added to further understanding of coordination within- and between-firms.

**FINDINGS**

Table 2 shows the use of the three generic categories of coordination mechanisms across the different types of projects in our sample. As a first stage in the analysis, we counted the number of projects in each cell that relied significantly on achieving modular solutions as evidence of attempts to use modularization as a coordination device. Similarly, we counted the number of projects that used rich communication technology such as videoconferencing (a handful of projects) and poor communication technology such as email and telephone (all projects) for ongoing communication. All co-located projects relied heavily on ongoing face-to-face communication. Distributed projects that invested heavily in travel between locations were also coded as using ongoing face-to-face communication. Finally, projects that emphasized leveraging tacit coordination mechanisms (TCM) such as leveraging shared coding procedures or tools that generated common ground across the project were coded as using TCM.

Our objective is to compare (a) whether different coordination mechanisms are used in within- vs. between-firm projects and (b) whether spatial co-location or distribution is a contingency that impacts
The firm as a coordination system

how within- vs. between-firm projects are coordinated. From table 2, the interesting patterns that require further explanation are these:

1. There appears to be no major difference in the coordination mechanisms used in co-located projects organized within-firms (cell 1) vs. between-firms (cell3).
   a. All the eight cell 1 and ten cell 3 projects relied heavily on ongoing face-to-face communication to achieve coordination. None of the projects relied on rich ICT such as videoconferencing and all of them relied on poor ICT such as email.
   b. Only one of eight cell 1 projects also uses TCM to coordinate, whereas none of these ten cell 3 projects use TCM to coordinate.
   c. None of the eight cell 1 projects relied on modular solutions to coordinate whereas only three of the ten cell 3 projects used modular solutions to coordinate.

2. In distributed projects, within-firm coordination (cell 2) appears to be achieved qualitatively differently from between-firm coordination (cell 4). Specifically,
   a. Only four of 22 (18%) of cell 2 projects rely on face-to-face communication, but 19 of 20 (95%) of cell 4 projects do so.
   b. As a mirror image to the above, coordination in 18 of 22 (82%) of cell 2 projects relies mainly on TCM whereas only one of 20 (5%) of between-firm (cell 4) coordination relies mainly on TCM.

These differences by themselves are not the key findings of this work. The projects we studied are not a representative sample and therefore we cannot use our data to make generalizable statements about how coordination is achieved in this industry. Rather, we used these as a stimulus to go back to the interviews in the subsequent rounds of coding to attempt to understand why these patterns may exist. Below we explain why we think we see these patterns in coordination mechanisms across the different types of projects.

**Finding 1: The same coordination mechanisms are used both in within- and between-firm projects that are co-located**
The firm as a coordination system

In our data, we observed that both within- and between-firm co-located projects relied extensively on ongoing communication and co-presence for achieving coordination, but not on other TCM or creating modular solutions.

*Ongoing communication* was the most important coordination mechanism used *within* firms. Respondents in cell 1 (Figure 1) typically pointed out that “we are all in the same location and developers communicate with each other all the time”. When speaking about coordination episodes, others described “walking over to the other cubicle” or “pulling together people in a room real quick”. All eight co-located projects conducted within a single firm (cell 1) emphasized the importance of communication. For example:

Loose interaction was sufficient for achieving coordination in this project; we did not have to invest much in processes. Here, one has the ability to walk over and interrupt another person over a question. In this project coordination mostly occurs by informal communication. (Manager 18, Project 34, Integrator)

Ongoing communication was also an important coordination mechanism *between* firms delivered from the same location (cell 3). For example:

There was a lot of ad-hoc communication between the developers; they were all located in the same floor. [When in need for clarification or coordination between developers] documentation or any information exchanged could either have been, emailed which I’d say is probably uncommon, the most common is probably just get up and talk to them because they’re all in the same area so it was very easy to communicate informally. (Manager 15, Project 28, Integrator)

Our interviews suggest that ongoing face-to-face communication was the most important coordination mechanism used in both within-firm and between-firm projects.

*Modularity* as a coordination device was attempted in every project but it typically was not sufficient for achieving coordination. The managers in our sample recognized that if they could divide work such that there were few interdependencies across modules, coordination would be easier. In all projects in our sample, managers made some effort to create code modules to the extent possible. However, changing requirements, unexpected interdependencies, idiosyncratic system features and “legacy” (old technology) issues prevented effective cross-location modularization in both development and maintenance projects. Figure 2 shows the level of interdependence between-firms and between-locations in our sample.
None of the eight within firm co-located projects (cell 1) relied extensively on modularization in the sense of using thin interfaces between modules. In other words, though the developers could be working on different kinds of code, such as GUI and server interface, there was enough unstructured interaction between them that for our analytical purposes they could be considered as working on a single module.

Modularity was not a very important mechanism to coordinate work between-firms either. Managers in all the 10 co-located between-firm projects (cell 3) invested in modularization. However, in none of these cases, coordination between the client and vendor firm was achieved by relying primarily on modularity. In some cases the client engaged more than one vendor in a project. These vendors in our sample typically had different competences and worked on different aspects of the project that were not highly interdependent with each other. In these cases, the different vendor firms had few interactions. In our sample, three of the ten cell 3 projects showed this pattern, which could be thought of as examples of modular coordination between the vendor firms, though these were the consequence of low interdependence ex ante, not structuring of interdependence into well-designed interfaces.

This result on the limited use of modularity in our context is consistent with prior work. Several scholars have pointed out that in typical outsourcing projects, inter-module dependencies are irreducibly high as well as unstable through the life cycle of the project (Kraut and Streeter, 1995; Cataldo et al., 2006; Herbsleb and Mockus, 2003), and the upfront investment in creating a modular structure may not be feasible. It is notable that recent empirical work in offshoring also does not advocate a modular approach in order to minimize hidden costs (Dibbern et al., 2008).

**Tacit Coordination Mechanisms** were used in all co-located within- and between-firm projects. These primarily involved taking advantage of shared physical co-presence, which enabled project members to easily observe each other’s actions and outcomes. For example, one manager told us how being co-located allowed for the resolution of a problem through the use of a mutually visible “demo” (demonstration), rather than attempt to explain it over e-mail.
“This project was done with bleeding edge technology, using NAS [technology name]. There were a lot of bugs in it [in NAS]. We were all sitting together in [location]. If it had been in India, and we go back and tell [the client] that the implementation is incorrect in NAS, it would have been extremely difficult for us to demonstrate it….there would be emails, and... they might have misinterpreted it. But the co-location there greatly helped because we demoed, straightaway we demoed... [client] asked why can’t you do a small example, and we wrote it. It was very interactive, [client] designers were sitting next to us, so in that way, we did not need to explain; it was self-obvious to the [client] person right there because they could see it as it was happening.” (Manager 23, Project 43, Process Master)

Similarly, within-firm co-located projects also relied on co-presence to coordinate, as documented in prior work (Olson and Olson, 2000; Olson et al, 2002).

In sum, we found no evidence in our sample for a coordination mechanism that was unique to the “within firm” or “between firms” context in co-located projects, which agrees with some of the prior findings (e.g. Helper et al, 2000).

**Finding 2: In distributed projects, within-firm coordination mainly relies on tacit coordination mechanisms (TCM), but between-firm coordination does not.**

In spatially distributed projects conducted within a single firm (cell 2), across-location coordination was achieved mainly by leveraging TCMs in 18 of the 22 projects (or in 82% of the cases). However, in projects that were spatially distributed and conducted across multiple firms (cell 4), coordination between-firms across locations was achieved mainly by leveraging TCM in only one out of the 20 projects (or in 5% of the cases). Even in this project, the client firm hired a lot of the vendor employees who now interacted with their former colleagues. Conversely, only 18% of the cell 2 projects relied on ongoing face-to-face communication whereas 95% of the cell 4 projects did so in order to coordinate between employees of different firms. This suggests that in distributed projects there is a significant difference in how coordination is achieved in within- vs. between-firm contexts. We examine the reasons below.

By definition, ongoing face-to-face communication is not possible in distributed projects, and ongoing travel between locations in order to maintain such communication is very expensive.

*Limited reliance on ongoing communication using ICT tools:* Ongoing communication with ICT tools appears to be distinctly less attractive compared to face to-face interaction, even within a
The firm as a coordination system

single firm. From table 2, we see that few distributed projects, within- or between-firms used rich ICT tools in our sample. These findings resonate with prior work that suggests that ICT tools are not very effective as communication channels in distributed work for two reasons. First, current ICT technologies, even video-conferencing, cannot match the benefits of co-location such as shared contextual information and frequent, rich interactions, which are necessary to transfer complex and hard to articulate information required for coordinating in software services (see Kraut et al, 2002 and Olson et al, 2002 for reviews). Second, the usefulness of rich ICT media such as videoconferencing is limited in distributed settings because they require co-presence – the need for all participants to simultaneously attend the meeting. In offshore software services, time zone differences make such co-presence very difficult to manage (for example, see Armstrong and Cole, 2002).

**TCM’s substitute for ICT based ongoing communication in within-firm projects:** In order to successfully coordinate projects across locations, distributed projects need an effective substitute for ongoing rich face-to-face communication. In our data it appears that within-firm distributed projects (in cell 2) leveraged TCM as an effective substitute for communicating. Specifically, in our sample, of the 22 projects organized in cell 2, fourteen leveraged pre-existing stocks of common ground and eighteen projects made an effort to generate common ground on an ongoing basis in a tacit manner. We observed two specific mechanisms: (a) leveraging pre-existing common ground by adhering to commonly agreed coding processes across different locations and (b) generating common ground on an on-going basis by using tools that made actions, contexts and outcomes visible across locations.

**Adherence to a commonly agreed work process** was one of the most important sources of pre-existing common ground in use in our intra-firm distributed projects. The Capability Maturity Model (CMM)

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4Adler (2005) provides a very good introduction to CMM for organizational scholars. Very briefly, CMM is a documentation centric process framework that regulates activities in software development. CMM provides best practices regarding what activities should be performed; the instantiation of CMM – how these activities are actually performed – is specific to each firm.
The firm as a coordination system

For example, due to the limitations of natural language, one coder cannot in general read code/documentation written by another coder without the need for disambiguation (Janicki et al, 1977). Adherence to commonly known standardized processes helps these interdependent coders to both generate the expected information, as well as understand that information as it was intended. As a manager put it, working to standardized processes ensure that in every activity:

“Do you understand what I am giving to you and how do you understand it, and it validates what is being created is in accordance to this understanding” (Manager 16, Project 30, Integrator).

Another manager explained why the use of commonly agreed processes helps coordinate actions in distributed projects:

You have to follow something that is shared, and shared everywhere, in every component of the project, so you need absolutely to have this kind of backbone. Otherwise, you risk to be not understood by the other or misunderstood or not provide what is needed, anything can happen. (Manager 25, Project 47, Integrator)

In these projects, standardized processes are in common ground – they are known to everyone and because project managers ensure that they are followed, everyone also knows that everyone will follow them. The greatest advantage of this type of standardization comes from the ability to perform work (code in this case) in the certainty that the interdependent other will work in a known way – and hence their actions could be anticipated and accommodated. Interestingly, the process need not be optimally designed for a project to be still useful, as long as it is commonly used. As Schelling (1960) noted, a focal point that arises in one transaction can still be used as a coordination device in an unrelated transaction.

Several managers pointed to the lack of standardized processes as the main reason for coordination problems in their distributed projects. For example, a manager speaking about a poor coordination episode suggested:

“Developers do not code to adhere to a standard; they code to get the job done. [In this project] there were sixty somewhat developers and they tried to use as much of their skill as they could, and therefore there’s a lot of code that isn’t similar in nature that should be similar in nature. …This multiplicity of patterns leads to problems when one developer wants to leverage code by another developer… [next time] I would try and make sure there were better templates in place.” (Manager 15, Project 29, Integrator)

\[5\]We should note that standardized processes themselves such as CMM could be explicit knowledge. However, when such explicit knowledge is available in common ground, it enables tacit coordination.
The firm as a coordination system

Analyzing coordination failures across locations in our sample pointed to the importance of common ground as embodied by a uniform set of processes across different development sites. In our sample, all the nine distributed projects with high interdependence across locations, but without uniform coding procedures across different locations, suffered coordination problems. For instance, projects 10 and 17 suffered from coordination issues until uniform coding standards were imposed across the different locations of the same firm. As the manager of project 10, told us:

When I took over this project, the project was suffering delays from poor integration of work from our US and Brazilian centers. Our programmers in the US had worked in this industry and similar products for many years; they did not follow a mature process. This approach severely impacted interaction with the Brazilian employees. There were several episodes of miscommunication with “this is what I said” and “this is what I meant” and so on. The first thing I did when I took over was to bring some of the key Brazilians over to the US to discuss and agree on processes that both the US and Brazil would follow. Once the process was nailed down, I ensured that the US employees followed them. This was the most important thing to bring the project back on track. (Manager 5, Project 10, Integrator).

It is interesting to contrast within-firm distributed projects (cell 2) to within-firm co-located projects (cell 1). Co-located projects did not emphasize standardized processes or leverage TCM to the same extent. Several managers suggested that working to standardized processes was emphasized more in distributed projects but not in co-located projects, since in the latter ongoing communication can always resolve coordination issues. For example:

This team is fully co-located, so anybody could speak with anybody else at any time - and the weekly meetings happen in one room when everybody is present. Well within the last year we have started trying to follow the CMM code of practice and our centre is at level two, working on level three. Why do I have to follow that process, because, you know, we're all right together? It is more useful when you have a diverse team across locations. We are just starting to offshore part of our team, so having those processes in place makes that transition easier. (Manager 12, Project 22, Integrator)

In sum, achieving coordination by leveraging TCM is emphasized only when ongoing communication is ineffective (as it is in distributed projects).

*Using common tools to generate common ground:* We also found that distributed projects within firms take special measures to generate common ground across locations through tacit means—by directly improving the observability of actions and outcomes. Managers used tools such as code repositories, version control systems, and workflow tools in order to generate common ground regarding the work context, without the need for direct communication between individuals. Technical tools such as workflow management systems and configuration management tools help
developers from different locations to coordinate by making actions transparent across locations and quickly putting the latest developments across locations in common ground. These tools can be thought of as creating “trading zones” enabling developers across locations to coordinate (Kellogg, Yates and Orlikowski, 2006). 18 of 22 projects organized in cell 2 in our sample made an effort to use common tools across locations to generate common ground across geographies.

**Between-firm distributed projects did not use TCM:** In 19 out of the 20 cases organized in cell 4 in our sample, between-firm coordination was achieved by ongoing face-to-face communication between the employees of different firms. In these 19 projects, coordination *across locations happened within-firms* and relied on leveraging TCM. Put differently, in *every* case in Cell 4, at least one site in a distributed project featured a mixture of employees from different firms. Different firms might work together, but they did so by co-locating their employees.

To illustrate this, consider a project involving a vendor firm from India providing software services to a client from the USA. This is a distributed project, and much of the coding work is done from India, while some part is done in New York. The pattern we found is one in which client employees in New York *rarely* coordinate directly with the vendor employees in India, and vice versa. Rather the client employees primarily coordinate with the vendor on-site team that is resident in New York by on-going face-to-face communication; i.e., between firm coordination – between client and vendor employees mainly happens face-to-face in New York. These onsite vendor employees located in New York in turn coordinate with their counterparts in India using TCM. In other words, we find that coordination across locations typically happened *within* one firm (in this example within the vendor for New York – India). We should note that our sample of cell 4 projects reflects a pattern noted by industry observers- that despite obvious costs savings, vendors in offshore software services projects never reduce onshore employee presence to zero (Venkatesh and Krishna, 2005). The key question here is *why* between-firm distributed projects rely on face-to-face communication when within-firm distributed projects rely much more on TCMs.

**Finding 3. Between-firm coordination in distributed projects relies on face-to-face communication because TCMs are not available.**
The firm as a coordination system

It appears to be much more difficult to rely on TCM to achieve coordination between firms across locations, rather than within-firms. As pointed out earlier, in our sample of 20 cell 4 projects, effectively none used TCM. This is because individuals in different firms typically neither have any pre-existing common ground that they can leverage, nor are they able to tacitly generate such common ground swiftly.

Working to standardized procedures: As discussed above in the within-firm case, coordination is partly achieved by relying on working to standardized procedures that already exist in common ground within the firm. However, common procedures typically do not exist between firms. For example, a manager described a project (project 19) she worked on that had integration problems – which she attributed to the fact that the vendor (integrator) had one set of processes from another vendor who had a different set of processes, both of which were different from the client’s set of processes. In our sample of 20 projects in cell 4, only one involved different firms with common standardized work procedures\(^6\).

Using common tools to generate common ground: In 19 of the 20 projects organized in cell 4, different tool-kits were used across firms\(^7\). A manager gave us an example of the coordination problems that occur when many vendors are involved and they do not use a standardized toolkit:

[An] important headache is the mismatch in the technical development tool sets that are not shared by multiple vendors on a single project and the key one that I'll always come back to is configuration management. The more different development groups that you have operating, the greater the risk that you have that your configuration management is not going to be effective. And rarely if ever is there a single consolidated configuration management tool that ensures when a particular module is checked in by one person and changes are made, that somebody else isn't making changes to the same code sets that will conflict with those when the application is merged together. (Manager 10, Project 18, Integrator)

In other words, our data suggests that tacit coordinating mechanisms (TCMs) used in the within-firm case such as working to standard processes and using common toolkits are not available in between-firm projects.

\(^6\) The exception was a project where the client hired a large number of developers from the vendor, who in turn now coordinated with the vendor from the client side.

\(^7\) The exception was a very ambitious project, and the project manager lobbied to specially get resources to implement a standardized global tool kit across all locations.
The firm as a coordination system

The lack of TCM in between-firm contexts results in coordination problems only in distributed projects. Such TCMs are also not present in between-firm co-located projects (in cell 3). However, similar to cell 1 projects, cell 3 projects also draw on rich ongoing face-to-face communication that can swiftly resolve any coordination problems.

Why between-firm projects cannot develop TCMs? Our evidence suggests that it is not easy to create common procedures or force the adoption of common toolkits across firms. In our sample, several projects involving multiple firms made an attempt to develop new joint processes across firms. However, this proved to be very expensive and time consuming. As a manager told us:

In [project] we had to spend 4 months creating a joint methodology and training clients and our employees in this methodology. This caused a lot of heartburn among the employees who were more used to doing things in their own way. Redesigning all the templates, communicating it to the teams, and ensuring they were followed was very difficult. (Manager 2, Project 4, Process Master)

Another manger nicely summed up the various issues:

“[when working with client developers] the processes are the same, we will share our templates with them...We have to discuss with them, they are not aware of our processes, we have to educate them, this is how it is, this is how we do things...it is a bit of a burden to do this... we have to carry them along and educate them, and buffers must be built in the project to accommodate this. If the project is aggressive, we suggest that we don’t take them [client developers].

To me, what matters is the whole methodology, which is used in that context is agreed upon by both the client personnel and our personnel, that is a critical issue. I cannot have the client personnel participating if they cannot follow. There were some instances where somebody [from client] would not be following the template and write their own code, but in those instances we need a clear protocol, like who do you report to and how to get it done, who has authority.” (Manager 32, Project 60, Process Master)

The main reason why common processes and technologies are difficult to create and use between firms appears to be the absence of a unified authority in such contexts (e.g. ultimately the CEO of the firm and her delegates). Authority denotes a superior’s legitimate ability to demand obedient behavior by a group of subordinates within a specified realm of actions (Weber, 1921). It exists if subordinates accept the decision of their superior without independently examining the merits

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8 Attempts were also made in co-located projects, as the vendor managers suggested “at the insistence of the clients”. This was typically seen as an opportunity by the client to upgrade their processes, but they did not adopt the vendor processes whole-sale, but attempted to fine-tune them to what they regarded as their unique needs.
The firm as a coordination system

of that decision (Barnard, 1938; Simon, 1947). There are multiple possible sources of authority; the
employment contract is a salient one within firms (Simon, 1947; Williamson, 1975).

We found instances in our data of the role of authority in a) selecting a standard operating
procedure for inclusion in common ground from among competing alternatives- thus guaranteeing a
speedy and widely agreed choice rather than a necessarily optimal one, b) maintaining and protecting
it against the usual organizational changes arising from turnover, local adaptation or growth- for
instance, through an emphasis on documentation and dissemination of standards, and c) enforcing it
by ensuring compliance to it when individual incentives may conflict – such as when developers do
not wish to adhere to firm wide standards since it is a cost to them to switch from their existing ad-hoc
practices to the firm-wide standard.

The role of authority in enforcing a process or adoption of a technology is most obvious:

“When someone is not following the processes, we need the ability to remedy the situation.
Also, [vendor] on-site team will “hear” [vendor] offshore team better. For example, if
[vendor] offshore has some particular requirement that eases its work, [vendor] onsite will
provide it that way – the offshore and onsite leads will ensure it, but the client employee
will not.” (Manager 4, Project 8, Process Master)

Adler (2005) discusses this aspect in his analysis of CMM adoption by developers. Similarly,
different firms have different technology profiles, having made extensive investments in software
licenses, training etc. – and authority is required to enforce a shift.

Authority may also be useful in agreeing on a common work process. Another manager
provided us an example:

“One example was how we were doing data warehousing, and there were two different
models and there was a lot of fighting on these two different models [within the vendor] and
I ended up intervening and doing a pros and cons assessment, to weigh the two alternatives,
and I ended up having to say, based on this analysis, this is the direction we’re going, and at
this point, I don’t care if it is technically the right solution, no more arguing about it.”
(Manager 28, Project 53, Integrator)

This suggests that there exist circumstances when coordination on a (possibly inferior) choice
may be better than continued search for an optimal choice or uncoordinated adoption of different
choices. In these situations, authority is useful even if it does nothing but enable a (perhaps arbitrary)
common choice (Conner and Prahalad, 1996).
While it is possible to conceive giving managers in one firm authority over employees in another (e.g. Stinchcombe, 1985), in practice this seemed problematic in our context. One manager from Process Master spoke about how she had (in principle) authority over project matters even over client developers, but the client manager has authority on other matters. She however admitted that she rarely approached client personnel with criticism of their work, but always raised it with the client manager, who “hopefully took some action” (Manager 2, Project 4, Process Master).

In our context, as well as more generally, there are typically asymmetric costs to firms to adopting the same standards or technologies, such as CMM processes or a new set of software licenses and the required training. Typically, the vendors have more advanced processes than the clients, but the clients have bargaining power to try and minimize disruption to their organization. This is precisely the situation of “coordinated adaptation” Williamson (1991) discusses – where each party has the incentive to create and interpret standards that are advantageous to itself. While the problem of asymmetric costs of adoption may exist even within a firm, a source of common authority makes it easier to enforce adoption (Williamson, 1991).

In sum, in spatially distributed settings TCM’s are important to achieving coordination since ICT based ongoing communication is usually ineffective. Within-firms projects are more likely to use TCM’s than between-firm projects because the availability of shared authority within-firms makes it is easier to leverage pre-existing common ground and to generate de novo common ground tacitly. This explains the need for costly onsite presence in offshore outsourcing. Together, these findings suggest a potential explanation for why some prior studies have found within-firm coordination to be distinct and advantageous (in distributed settings) but others did not find any difference in between- vs. within-firm coordination (in co-located settings).

**Alternative explanations:** These take the form of possible unobserved differences in the nature of projects across cells in Figure 1 that might have led us to erroneously attribute differences in coordination mechanisms observed to the organizational forms involved. While we are unable to offer statistical evidence for or against such alternative explanations, we do believe that our data still allow us some confidence in our conclusions. Our sample included projects of different sizes and
complexity in each of the cells. This helped us to address questions such as whether it is possible that between-firm projects are less likely to rely on TCM because they are larger or more complex on average than within-firm projects.

Our data suggest that distributed projects are not smaller or simpler – from a technical and business perspective – than co-located projects, nor are between-firm projects smaller or simpler than within-firm projects. Table 3 shows the distribution of projects by size and complexity. In our sample heterogeneity in size and complexity do not account for the difference in coordination mechanisms used or the nature of interdependence observed in between- and within-firm projects. In distributed projects, within-firm coordination occurred by leveraging TCM, while between-firm coordination mainly happened face-to-face at the firm interface, regardless of the size or complexity of the projects (though we had no instances of small projects in cell 4 in our sample).

**DISCUSSION**

In perfectly competitive markets, prices serve as signals that obviate the need for individual actors to consciously coordinate their activities with each other. As long as each actor responds to price, the system as a whole is coordinated (Williamson, 1975; Hayek, 1945). In contrast, activities are coordinated under a unified source of authority within the firm (Coase 1937). However, to the extent that a large quantity of economic activity lies in the “swollen middle” between markets and

9 Complexity was rated on technical and business dimensions by the project managers.
The firm as a coordination system

hierarchies (Hennart, 1993; Bradach and Eccles. 1989), it is important to understand how coordination mechanisms work within- vs. between-firms. In this paper, we use qualitative data to explore a simple question about these coordination mechanisms: (when) do within-firm transactions rely on unique coordination mechanisms that are not available in between-firm transactions?

Our findings can be summarized as follows. First, for co-located projects, the same coordination mechanisms are used within firms and between firms. Second, for spatially distributed projects, tacit coordination mechanisms (TCM) are used within firms but not between firms. And third, the reason that TCMs are not used between firms on distributed projects even though they would be helpful is because of the lack of history of shared experience and lack of enforcement through authority.

Implications for theory: Our findings indicate that it may be difficult to rely on TCM’s to achieve coordination in between-firm settings, because there is typically little pre-existing common ground between firms and it may not be as easy to build without ongoing communication. In contrast, within-firm projects can draw on such pre-existing common ground as well as use technologies that enable the rapid build-up of common ground even under communication constraints. This suggests that organizing activities within one firm rather than across the boundaries of firms may perhaps be advantageous in situations where there are significant constraints on both ongoing communication and modularization.

The information processing theory of organizations suggests that highly interdependent activities be organized in semi-autonomous units; this is the guiding principle underlying grouping and linking in firms (Thompson, 1967; Galbraith, 1977; Tushman and Nadler, 1978) as well as using modularity as an organizing principle (Simon, 1962; Sanchez and Mahoney, 1996). This is because ‘grouping’ has the advantage of coordinating tight interdependence by recourse to ‘feedback’ or ongoing communication. However, this work does not deal with the problem of coordinating when ongoing communication is ineffective. Our argument is that interdependence alone may not suffice to give within-firm coordination the advantage; indeed the voluminous work on buyer-supplier relationships in numerous industries including aircraft, automobiles, engineering services and IT shows clearly that highly interdependent work is performed quite often across firm boundaries (Kotha
The firm as a coordination system

and Srikanth, 2013; Nishiguchi, 1994; Helper et al, 2000; Dyer, 2000; Argyres, 1999; Kraut and Streeter, 1995). In our own sample, we find high interdependencies in inter-firm as well as intra-firm projects (see Figure 2), and no differences in how interdependent work is coordinated between or within firms when the actors are co-located (i.e. face no communication constraints).

However, when high interdependence is coupled with communication constraints, then intra-firm coordination may indeed have some advantages. Our finding is that within-firm work can be coordinated using TCM by relying on pre-existing stock of common ground when both modularity and ongoing communication are constrained, but this is typically not feasible in the between-firm case.

Our research also provides some possible explanations for why we might see a qualitative change in the stock of pre-existing common ground at the boundaries of the firm. Common ground refers to shared knowledge of first and higher orders (i.e. it is shared, known to be shared, known to be known to be shared etc. – Clark ,1996). Such knowledge is more likely to be available within firms than between, because there is likely to be greater history of shared experience within the firm, as well as greater likelihood that common ground is actively managed and enforced through authority. For example, in our setting, coordination based on standardized procedures appears to be effective only because everyone in the firm knows about these procedures and adheres to them in their work, and everyone knows that everyone knows these procedures and so on. In addition, they know that any violation will be corrected by the use of authority, and therefore can reliably expect common adherence. Put differently, common ground arises in part from shared experience – but authority is another important source for the de novo generation as well as for the preservation of common ground, including the common ground generated by shared experience. To the extent that authority to select, maintain and enforce common ground is more likely within a firm rather than between firms, this provides a possible explanation as to why the level of common ground may be qualitatively different within rather than between firms. We believe these insights about authority and coordination are a valuable complement to those of Adler and Borys (1996) and Adler (2005), who point to the conditions under which employees view authority as enabling or coercive. These insights also complement the findings by Kotha and Srikanth (2013) who suggest that authority may be important
The firm as a coordination system

to provide the incentives required to generate common ground and may be an impetus for vertical integrating previously outsourced activities.

If the common ground available to employees within a firm is shaped by its history and the exercise of a common source of authority, this would also explain why two firms with no prior history of working together or without shared authority structures are unlikely to have significant levels of common ground, beyond what is available through hiring of employees from common professions (eg. science, law or engineering). On the other hand, a series of repeated interactions should help to build common ground between firms. For example, Mayer and Argyres (2004) show that over repeated interactions, firms develop a stock of common ground, which gets codified in their contracts. That does not however imply that this will ever be equivalent, let alone superior, to the stock of common ground created within a firm, for a similar period of repeated interaction. This is because of the presence of authority in the latter but not the former case which facilitates the investment in as well as enforcement of common ground (Williamson, 1985; Monteverde, 1995).

Limitations and suggestions for future research: First, we should note the inherent limitations of our method, which lends itself to inductive insights but not generalizations. We chose our industry, software services offshoring, for reasons of appropriateness rather than representativeness (Yin, 1994). Similarly, both the firms that we chose to study and the cases for interviews were selected based on our sampling criteria (Yin, 1994) rather than because they were representative of the industry. While we do present some comparative data and looked at a large number of cases, they may not be representative of all projects. We can state, however, that our data reproduces a well-known pattern in the industry - that projects distributed across multiple firms and multiple locations are organized such that some employees from both the client and vendor firms are co-located at least in one location.

Our data on past projects could also be subject to hindsight bias on the part of our informants. However, we tried to mitigate this risk by asking specific questions relating to specific projects rather than asking the managers to make general statements based on their experience. Our reliance on single interviewer responses regarding the project may suggest bias on the part of the respondent. However, we believe our conclusions are very likely robust to such bias since we see a convergent
pattern across different kinds of projects performed by two different organizations – a pattern that is less likely to emerge if there is significant bias. To emphasize, our conclusions are not based on the responses of one manager, but based on the responses of 32 managers from two different firms, talking about 60 different projects. The findings in the paper are the common thread among all these responses – and therefore is likely less prone to individual biases.

Finally, this research does not present evidence of causation – from our respondent’s views, we have distilled an explanation for why vendors never reduce onshore presence to zero (because of the need for TCM and the availability of TCM’s internally but not between firms). We also provide some evidence to explain why we prefer our explanation to alternatives, but this is not necessarily conclusive; statistical analysis of large sample data is needed to test the mechanisms that we highlight from this study.

While acknowledging these limitations, we also wish to point to some of the strengths of this study. First, this is one of very few studies that examine coordination both within and across firms together and address the important contingency of whether the projects are co-located or distributed; in our setting, we are able to observe firms making near simultaneous choices of coordination mechanisms, within vs. between firm boundaries, and are able to address why these choices are different. The difficulty in coordinating across multiple locations makes this choice important even within firms, thus making comparisons within vs. across firm and location boundaries meaningful rather than trivial. This comparison makes explicit the co-location-distribution contingency that can explain the apparent contradiction in prior empirical work regarding the core claim of the KBV that within-firm transactions can draw on unique coordination mechanisms not available in between-firm transactions. Second, this study points both to the conditions under which within-firm exchange uses unique coordination mechanisms relative to between-firm exchange, as well as why this difference may exist.

CONCLUSIONS

For the knowledge based view to offer a distinctive yet viable perspective on firms, it is necessary to explain under what conditions firms may possess advantages at coordinating activities
within their boundaries, and what these advantages may be. This study is one of the few to systematically compare the different coordination mechanisms used in within- and between-firm projects directly, rather than compare outcomes such as knowledge transfer (Kogut and Zander, 1993) or the quality of integration (Gulati et al, 2005). Our findings suggest that differences in within- vs. between-firm coordination are most visible under conditions of high interdependence and significant communication constraints. Under such circumstances- and the offshoring of software services is merely one instance- it may be easier to build or leverage pre-existing common ground within the firm. This advantage may be traceable ultimately to the existence of shared experience and shared authority within the boundaries of a firm. Recognizing and further understanding the role of authority in generating and maintaining common ground is likely to be a fruitful avenue for further research into understanding the firm as a coordination system.

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The firm as a coordination system


The firm as a coordination system


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FIGURE 1 PROJECT SAMPLING STRATEGY

<table>
<thead>
<tr>
<th>Developers belong to Single firm</th>
<th>YES</th>
<th>NO</th>
</tr>
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<tbody>
<tr>
<td><strong>CELL 1</strong></td>
<td>Projects in which all developers (and analysts) work in the same location and all developers are employed by the vendor.</td>
<td>8 Projects</td>
</tr>
<tr>
<td><strong>CELL 2</strong></td>
<td>Projects conducted by vendor where all developers (and analysts) are employed by the vendor, but they work from several locations (both onshore and offshore)</td>
<td>22 Projects</td>
</tr>
<tr>
<td><strong>CELL 3</strong></td>
<td>Projects in which all developers (and analysts) work in the same location, but some members are employees of the vendor and others employees of the client or other firms.</td>
<td></td>
</tr>
<tr>
<td><strong>CELL 4</strong></td>
<td>Projects in which developers and analysts work in different locations (project has both onshore and offshore components) and some staff members are employees of vendor, while others are employees of clients or other firms.</td>
<td></td>
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Total

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<td>30</td>
<td>30</td>
</tr>
<tr>
<td>60</td>
<td>60</td>
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TABLE 1 – Description of Analysis Phases

<table>
<thead>
<tr>
<th>Case write up Outputs</th>
<th>Application to Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 (Descriptive Case)</td>
<td>Based on the interviews, each project was written up into a case study, describing the characteristics of the project, the architectural decisions to determine modularity, and the coordination episodes involving development and change management.</td>
</tr>
<tr>
<td>Level 2 (Diagnostic Case)</td>
<td>The data was broken down into the following key dimensions(^\text{10}):</td>
</tr>
<tr>
<td></td>
<td>1. Steps taken to achieve modular solutions across locations, and any constraints to achieve such solutions.</td>
</tr>
<tr>
<td></td>
<td>2. Steps taken to achieve rich communication across locations, and any constraints to enable such communication.</td>
</tr>
<tr>
<td></td>
<td>3. Extent of communication using “poor” media across locations</td>
</tr>
<tr>
<td></td>
<td>4. Any other solutions to achieve coordination</td>
</tr>
<tr>
<td>Level 3 (Theoretical Case)</td>
<td>• In-depth content analysis of data in the three categories of coordination</td>
</tr>
<tr>
<td></td>
<td>• Multiple iterations through the “other” coordination mechanisms to identify common threads and note differences</td>
</tr>
<tr>
<td></td>
<td>• Iteration through the cases to develop theoretical clarity</td>
</tr>
<tr>
<td></td>
<td>• Preparation of analytic displays, check list matrices etc., especially with respect to project descriptives (such as size, complexity, performance) to understand boundary conditions</td>
</tr>
<tr>
<td></td>
<td>• Iteration of comparison between co-located and distributed projects to understand similarities and differences</td>
</tr>
<tr>
<td></td>
<td>• Comparison of three coordination techniques (Modularity, communication and common ground) to understand micro-mechanisms and develop theoretical underpinnings</td>
</tr>
<tr>
<td></td>
<td>• Link to broader literature</td>
</tr>
</tbody>
</table>

\(^{10}\) Details regarding how each construct was coded from the interviews are available in the appendix.
Figure 2: Mapping Interdependence Across Cells

Developers belong to Single Firm

<table>
<thead>
<tr>
<th>Cell</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cell 1</strong></td>
<td>(8 Projects)</td>
<td></td>
</tr>
<tr>
<td>Interdep. Across Locations:</td>
<td>N/A</td>
<td>Interdep. Across Firms:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cell 2</strong></td>
<td>(22 Projects)</td>
<td></td>
</tr>
<tr>
<td>Interdep. Across Locations:</td>
<td>High: 19 Low: 3</td>
<td>Interdep. Across Firms:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cell 3</strong></td>
<td>(10 Projects)</td>
<td></td>
</tr>
<tr>
<td>Interdep. Across Locations:</td>
<td>N/A</td>
<td>Interdep. Across Firms:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cell 4</strong></td>
<td>(20 Projects)</td>
<td></td>
</tr>
<tr>
<td>Interdep. Across Locations:</td>
<td>High: 19 Low: 1</td>
<td>Interdep. Across Firms:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>
TABLE 2: Coordination Mechanisms Used Across Geographic and Firm Boundaries

<table>
<thead>
<tr>
<th>Location</th>
<th>Cell 1</th>
<th>Cell 3</th>
<th>Cell 2</th>
<th>Cell 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>(same firm, same location)</td>
<td>(different firm, same location)</td>
<td>Same firm, different locations</td>
<td>Different firms, different locations</td>
<td></td>
</tr>
<tr>
<td>Total Projects</td>
<td>8</td>
<td>10</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>Coordination mechanisms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modularity</td>
<td>0</td>
<td>30%</td>
<td>14%</td>
<td>35%</td>
</tr>
<tr>
<td>Face-to-face</td>
<td>100%</td>
<td>100%</td>
<td>18%</td>
<td>95%</td>
</tr>
<tr>
<td>Rich ICT</td>
<td>0</td>
<td>0</td>
<td>18%</td>
<td>0</td>
</tr>
<tr>
<td>Poor ICT</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>TCM</td>
<td>12.5%</td>
<td>0</td>
<td>82%</td>
<td>5%*</td>
</tr>
</tbody>
</table>

*: In this project, most of the client personnel were former employees of the vendor, who already had a lot of experience with the vendor’s processes. Thus from a common ground perspective, it may be dubious to treat this case as an example of across firm coordination.

TABLE 3 - Distribution of Project size and complexity

<table>
<thead>
<tr>
<th>LOCATION MODEL</th>
<th>PROJECT SIZE</th>
<th>SMALL</th>
<th>MEDIUM</th>
<th>LARGE</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>MULTIPLE (42)</td>
<td>High Complexity</td>
<td>0</td>
<td>7</td>
<td>26</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Low Complexity</td>
<td>3</td>
<td>6</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>SINGLE (18)</td>
<td>High Complexity</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Low Complexity</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>7</td>
<td>20</td>
<td>33</td>
<td>60</td>
</tr>
</tbody>
</table>
Appendix - 1: Interview Guide

The sampling strategy involved software development/maintenance projects that fall into each of the four cells identified below to enable comparisons across them:

<table>
<thead>
<tr>
<th>Developers belong to same firm</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developers</td>
<td>Projects in which all developers (and analysts) work in the same location and all developers are employed by the vendor.</td>
<td>Projects in which all developers (and analysts) work in the same location, but some members are employees of the vendors and others employees of the client or other firms.</td>
</tr>
<tr>
<td>Co-located</td>
<td>Projects conducted by vendor or client where all developers (and analysts) are employed by the vendor, but they work from several locations (both onshore and offshore)</td>
<td>Projects in which developers (and analysts) work in different locations (project has both onshore and offshore components) and some staff members are employees of vendors, while others are employees of clients or other firms.</td>
</tr>
</tbody>
</table>

We began interviews by telling our respondents:

“Please think of two specific projects you managed – they should be in two different cells in the above figure.” We then led them through a series of questions listed below, for project 1 and project 2. The questions centre on key “coordination episodes” in the life of a project:

1. Deciding on the appropriate architecture for this project.
2. The development phase of the project when the main functionalities were developed.
3. Change management and resolution, especially those episodes that led to significant departures from prior designs and work plans (including bug-fixing, service disruptions).

Project Characteristics:
1. Size and complexity of project, number of stakeholders
2. Distribution of project staff among locations and by function.
3. Experience of client and vendor teams with projects of this type, with the technology and business requirements, (some measure of how novel the project is)
4. Project organization chart (reporting relations as well as affiliations).
5. Brief stick diagram of the principal components of the project, the main systems and the interfaces
6. The above is the engagement model. How was this chosen? What were the rules, handbooks, etc. that were taken into account in making this decision?

Coordination Mechanisms – Modularization:
1. How is the decision regarding the architecture made? Who are the participants?
2. What are the principal concerns that go into this decision?
3. Any tools and techniques, rules of thumb etc. that are utilized in deciding the architecture?
4. How did the architecture chosen impact the resources available for the project (in terms of location, training, technologies etc)?
5. To what extent is the architecture decision constrained by non-technical considerations (such as political, economies of re-use, contractual etc.)? If there exists several equally valid architectures, how do you choose between them?
6. How much effort goes into deciding the architecture as against on-going coordination? In hindsight, how would you change the architecture?
Ongoing Coordination
1. Coordination mechanisms employed in the development phase of the project – how does a developer ensure that her component will fit in well with the overall system?
2. How does the developer ensure that her code does not “break” someone else’s code?
3. How are the major functionalities split across teams or locations? How do the developers normally interact, within teams and across teams?
4. What are the project communication mechanisms – examples, project wide meetings, weekly staff meetings, etc?

Tools and Artefacts
1. What are the processes and procedures in place to ensure coordination – such as roles, designated members with expertise/ ownership, rules of engagement, rules of escalation, processes to get commitment, conventions on standards, interfaces, programming guidelines etc.
2. What are the tools and artefacts used in coordination – including automated software tools like code checkers, version control, data managers, workflow tools etc?
3. In your opinion how do tools help in developing software on budget and on schedule?
4. Could you describe projects where access to tools vs. lack of them made a difference in project performance?

Change Management
1. Coordination mechanisms employed in change management - Process of change identification and incorporation in project plan
2. Process of coordination between analysts and developers impacted by change.
3. Specifically, what tools and artefacts are specific to such change management episodes than for initial development?
4. How was it accomplished (buffering, slack, negotiation etc?)

Changes in Engagement Model
1. How exactly do you think co-location of the teams helps? In your judgement, what are the advantages of having all developers for this project work in a single site?
2. How would you change the coordination mechanisms above if the project were distributed (co-located)?
3. What is the advantage of having everyone from a single firm? How would you change the project if everyone was from your firm (or some from another firm?)

Performance
1. Was the project on budget? If not, how much overage or underage?
2. Was the project on schedule? If not how much over or under target?
3. How satisfied was the client firm with the project?
4. How satisfied was your (vendor) firm with the project?

Misc.
1. How are processes used in the project? How are they updated?
2. Any details on interesting coordination mishaps or mishap avoidance from respondents experience.