7-2014

Firm as a Coordination System: Evidence from Offshore Software Services

Kannan SRIKANTH
Singapore Management University, KSRIKANTH@smu.edu.sg

Phanish PURANAM
INSEAD

Published in Organization Science, July/August 2014, Volume 25, Issue 4, Pages 1253-1271.
http://doi.org/10.1287/orsc.2013.0886

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

Kannan Srikanth
Indian School of Business, Gachibowli, Hyderabad 500032, India, kannan_srikanth@isb.edu
Phanish Puranam
INSEAD, Singapore 138676, Singapore, phanish.puranam@insead.edu

To examine what, if any, are the differences in how activities are coordinated within versus 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) colocation versus spatial distribution and (2) delivery by groups of individuals from a single firm versus from multiple firms. Our evidence suggests that in colocated 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 versus 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. This difference may arise because of the lack of shared history and lack of enforcement through common authority in the between-firm context.

Keywords: coordination; common ground; firm boundaries; knowledge-based view (KBV) of the firm; distributed work; offshoring; offshore outsourcing; tacit coordination mechanisms
History: Published online in *Articles in Advance* January 9, 2014.

Introduction

Are interdependent activities coordinated differently when they lie *within* the boundaries of a firm rather than *across* them? 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; Gulati et al. 2005; Kogut and Zander 1992, 1996; Nahapiet and Ghoshal 1998; Nickerson and Zenger 2004). This paper explores geographic (spatial) distribution or colocation of work as a contingency that influences the nature of coordination within- versus 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 (Puranam et al. 2012, Schelling 1960). Ineffective communication and knowledge transfer, delays, misunderstandings, and poor synchronization of activity are typical manifestations of coordination failure. In contrast, cooperation failures occur when interdependent individuals face conflicting incentives; these failures are manifested as holdup, shirking, and possibly other forms of opportunistic behavior (Alchian and Demsetz 1972, Klein et al. 1978, Williamson 1979). Scholars across a range of disciplines note that coordination failures can occur even when incentives are fully aligned (Camerer 2003, Grant 1996, Heath and Staudenmayer 2000, Holmstrom and Roberts 1998, March and Simon 1958, Schelling 1960, Simon 1947).

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; see Coase 1937; Williamson 1975, 1985), proponents of the knowledge-based view (KBV) deemphasize the various forms in which incentive conflict may arise and instead argue 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 (Conner and Prahalad 1996; Demsetz 1988; Grant 1996; Kogut and Zander 1992, 1996). Thus in the KBV, the *discriminating alignment* between transactions and governance forms (Williamson 1991) occurs not on the criteria of asset specificity and anticipated holdup but rather on the match between the coordination requirements of transactions and the distinctive coordination mechanisms that characterize within-firm versus 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 (Foss 1996a, b; Grandori 1997; Grandori and Kogut 2002; Grandori and Soda 1995; Stinchcombe 1985).[1]

The available empirical evidence does not allow us to discriminate 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) find that multinational firms are more likely to transfer complex, tacit knowledge to their subsidiaries rather than to third parties. Almeida et al. (2002) find that multinational firms cite their own foreign patents more frequently than the patents of alliance partners or those of competitors. These authors suggest that firms have access to multiple formal and informal practices that facilitate 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 they do not differ from those used within firms. Helper et al. (2000) document the use of firm-like coordination practices such as colocation of engineers and 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 colocation, cospecialization of human capital, and strong identity and coordination rules are implemented in some buyer-supplier transactions in the automotive industry.

The stimulus behind the present paper is 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 colocated 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 whether colocation/spatial distribution of work is a key contingency that the KBV 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 find that colocation versus spatial distribution is indeed an important contingency that determines *when* the arguments of the KBV hold, we would see this as a useful refinement of the perspective. If we find no qualitative differences in the use of coordination mechanisms within versus between firms, even after accounting for the contingency of colocation, our results would add to the evidence against the KBV.

The software services offshoring industry provides an interesting setting in which to examine our conjecture about the spatial distribution/colocation of work as a key contingency for the KBV. Wage arbitrage between "onshore" (typically Western) and "offshore" (e.g., India, China) locations is the principal economic driver of this industry (Farrell 2005). Specifically, when offshoring is accompanied by outsourcing, the economics require a reduction in 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 vendor employees in a project are onshore and 70%–80% are offshore, with almost no client employees located offshore (*Information Week* 2004, Venkatesh and Krishna 2005). 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 surface validity for our conjecture that the advantages of within-firm coordination may be more salient for spatially distributed work rather than colocated work.

To investigate why and how this may be the case, we analyze field interview data on 42 distributed and 18 colocated projects from the software services offshoring industry. 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 gain greater insight on the "how" questions that are at the center of this study: *How are coordination mechanisms different across firm boundaries rather than within them, and how does colocation 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 in terms of their applicability (Eisenhardt 1989, Siggelkow 2007, Yin 1994). Our sample is unique in explicitly comparing within- and between-firm coordination for spatially distributed *and* colocated work.

Our analysis points to two main conclusions. First, we find that for *colocated 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 versus different firms. Consistent with general trends in the industry, in our sample, offshore outsourcing projects always include some onshore vendor employees. In this paper, apart from noting this distinction, we attempt to understand why this is the case.

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, and interpersonal and time orientations (Dougherty 1992, Heath and Staudenmayer 2000, Lawrence and Lorsch 1967, 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

To study differences in intra- and interfirm coordination mechanisms, it is useful to begin with a clear conception of the various categories of coordination mechanisms. 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 the usage in Argyres (1999), Takeishi (2002), and Helper et al. (2000) in their characterization of intra- and interorganizational 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 that 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 (Clark 1996, Schelling 1960).[2] Exactly how much common ground is required may, however, vary by situation and the nature of the coordination mechanisms employed. An extensive literature identifies several coordination mechanisms that help to create sufficient common ground for coordination; these can be usefully summarized into three generic categories: ongoing communication, modularity, and tacit coordinating mechanisms (TCMs). Rather than group mechanisms phenomenologically (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 successfully coordinate 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 so as to update common ground dynamically to achieve coordination.

Ongoing communication is more effective when it occurs between colocated individuals, since it facilitates face-to-face communication in a shared social context (Kraut et al. 2002, Olson and Olson 2000). Prior work shows 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). There is consensus that ICT media, even videoconferencing, remain limited in terms of bandwidth (Daft and Lengel 1986, Doherty-Sneddon et al. 1997, O'Connail et al. 1993) and are relatively ineffective in coordinating complex, ill-defined tasks with high interdependence (for reviews, please see Kraut et al. 2002, Olson et al. 2002).

Modularity is a second category of approaches toward coordinating. It involves a designer who can partition activities into modules, design interfaces between modules, and embed these interfaces into common ground across 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 a 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 subunits (Baldwin and Clark 2000, Simon 1962, Ulrich and Eppinger 1999) because cross-module dependencies are primarily managed through interfaces, limiting the need for ongoing communication. Thus, whereas 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 (Ethiraj and Levinthal 2004, Okhuysen and Bechky 2009, Thompson 1967, Tushman and Nadler 1978). Under these conditions, coordination may require recourse to ongoing communication (March and Simon 1958, Scott 2003, Thompson 1967, Tushman and Nadler 1978). 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 et al. (2011) discuss the role of intensive ongoing communication in coordinating when old routines were no longer adequate to coordinate in changed circumstances.

Modularity and ongoing communication as two generic alternatives to coordinating work reflect well-established distinctions between coordination by plan versus feedback (Galbraith 1977, March and Simon 1958, Thompson 1967, Tushman and Nadler 1978), modular versus integral designs (Baldwin and Clark 2000, Sanchez and Mahoney 1996), and loose versus tight coupling (Orton and Weick 1990).

Recent work also highlights a third generic approach to coordination that relies primarily on ***tacit coordination***. TCMs help to achieve coordination in situations of high interdependence in a *tacit* manner—without recourse to explicit ongoing communication or through construction of modular interfaces. Instead, TCMs work in two broad ways: (a) by leveraging preexisting common ground that may not be specific to the task at hand and (b) by building common ground through observation of the work context, and actions and outcomes, rather than direct communication (Clark 1996, Cramton 2001, Gutwin et al. 2004). Leveraging shared experiences from having worked together on past projects is an instance of the former; this can often be built through rotating employees through the organization (Ghoshal et al. 1994, Nohria and Ghoshal 1997). Observing the progress of work by working side by side is an instance of the latter.

The literature shows that TCMs play an important role even in colocated work when ongoing communication is in theory feasible (Bechky 2006, Faraj and Xiao 2006). Mere proximity improves coordination because common ground is enhanced through being rooted in a shared social context, such as in the same room, and the use of shared artifacts (Kraut et al. 2002, Olson and Olson 2000, Olson et al. 2002). Okhuysen and Bechky (2009), in their review of prior work on different coordination mechanisms, emphasize that TCMs such as the use of boundary objects, shared representations, and task contexts improve the effectiveness of ongoing communication, and they help to achieve 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 TCMs can be distinguished empirically from the other two classes of coordination mechanisms (ongoing communication and modularity) 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 (Camerer 2003, Schelling 1960, Srikanth and Puranam 2011). For example, in Schelling's (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 or preexisting shared knowledge.

Although the three categories of coordination mechanisms described above are very well established in the literature, the present study examines how firm boundaries influence the usage (and existence) of these three generic categories of coordination mechanisms, with particular attention to whether (and why) differences (if any) are more salient for distributed rather than colocated work.

Methodology

We use data from field interviews to understand how and why within-firm coordination differs 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; this condition typically implies a 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 such settings, since the nature of prior theory development does not allow us to build robust hypotheses that the large sample data are 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 understanding whether there are differences in the usage of coordination mechanisms between and within firms, they are unlikely to shed as much light on questions of *why* these differences exist.

Our empirical strategy involves sampling cases in each cell in a 2×2 fully crossed design, where the cells identify projects crossing firm and/or geographic boundaries (see Figure 1). We choose this design because prior work tends to focus on projects that are colocated versus distributed or to compare projects conducted within versus 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 colocated and distributed settings.

Site Selection

Since we are interested in understanding how coordination mechanisms differ across both firm and geographic boundaries, we needed access to research sites conducting 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 United States and the other in India. The U.S. firm, which we call Integrator, is a large software services vendor well known for delivering globally distributed projects for its multinational clients. The Indian firm, which we call Process Master, is a pioneer in the offshore software services industry in India and has been very successful over 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 expect to observe differences in the way these firms manage projects, and by generating variety in the research sites, we hope to understand the boundary conditions of 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 2×2 sampling frame. This sampling strategy is particularly relevant for our research question, which calls for comparisons across cells. Based on these criteria, our prime contacts in both firms (at the level of country heads) nominated managers to meet with us.

The sample consists 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. These are susceptible to changing patterns of interdependence because of 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 preexisting systems. Maintenance projects may not require as much creative effort in design as development projects, but they do involve difficult coordination episodes around the need to quickly resolve problems across sites with information technology (IT) systems that are critical to the organization.

Figure 1 Project Sampling Strategy

	Developers belong to single firm: Yes	Developers belong to single firm: No
Project personnel **colocated** in one location	**Cell 1** Projects in which all developers (and analysts) work in the same location and all developers are employed by the vendor. 8 projects	**Cell 3** 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. 10 projects
Project personnel **distributed** among several locations	**Cell 2** Projects conducted by the vendor where all developers (and analysts) are employed by the vendor, but they work from several locations (both onshore and offshore). 22 projects	**Cell 4** 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, whereas others are employees of clients or other firms. 20 projects

Data Collection and Analysis

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 they are responsible for coordinating across geographic and firm boundaries. Project managers are better able than other participants to provide information on the entire life cycle of the project: the architecture phase, the development phase, and the change requests and delivery phase. Since cross-case comparison is essential to our design, we interviewed only managers who had experience in at least two of the four cells.

This 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 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 serve as a guide for the semistructured interviews in the main study (available in the appendix).

In the second phase of data collection, we interviewed project managers who could address their experiences in two specific (named) projects. Each project was in a different cell in our design. Our sponsors in the organizations identified the most appropriate managers with whom to speak. We contacted them with a short statement describing the purpose of our research and a short list of the types 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 to explain why various choices were made.

The project manager interviews lasted between 60 and 180 minutes. Twenty-eight of the 32 interviews were recorded (with permission) and transcribed. We also took extensive notes during the interviews, 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 they provided us with copies of documents, slides, and templates used in their firms. Some managers were contacted again for any needed clarifications.

In the third phase, 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. Both researchers read the interview transcripts and discussed emerging ideas and themes, which 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 encountering 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 relationships between the themes. Finally, we compared our framework with published theory to understand how our results add to the understanding of coordination within and between firms.

Table 1 Description of Analysis Phases

Case write-up outputs	Application to case
Level 1 (descriptive case)	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.
Level 2 (diagnostic case)	The data were broken down into the following key dimensions: 1. Steps taken to achieve modular solutions across locations and any constraints to achieving such solutions 2. Steps taken to achieve rich communication across locations and any constraints to enabling such communication 3. Extent of communication using "poor" media across locations 4. Any other solutions to achieve coordination
Level 3 (theoretical case)	• In-depth content analysis of data in the three categories of coordination. • Multiple iterations through the "other" coordination mechanisms to identify common threads and noting differences. • Iteration through the cases to develop theoretical clarity. • Preparation of analytic displays, checklist matrices, etc., especially with respect to project descriptives (e.g., size, complexity, performance) to understand boundary conditions. • Iteration of comparison between colocated and distributed projects to understand similarities and differences. • Comparison of three coordination techniques (modularity, ongoing communication, and TCM) to understand micromechanisms and develop theoretical underpinnings. • Link to broader literature.

Findings

Table 2 shows the use of the three generic categories of coordination mechanisms across the different types of projects in our sample. In the first stage of 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 (in a handful of projects) and poor communication technology, such as email and telephone (in all projects), for ongoing communication. All colocated 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 TCMs, such as leveraging shared coding procedures or tools that generated common ground across the project, were coded as using TCMs.

Our objective is to compare whether (a) different coordination mechanisms are used in within- versus between-firm projects and (b) spatial colocation or distribution is a contingency that influences how within- versus between-firm projects are coordinated. From Table 2, there are several interesting patterns that require further explanation:

1. There appears to be no major difference in the coordination mechanisms used in ***colocated*** projects organized within firms (cell 1) versus between firms (cell 3).

a. All 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 relied on poor ICT, such as email.

b. Only one of eight cell 1 projects also used TCMs to coordinate, whereas none of these ten cell 3 projects used TCMs 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), as shown in bold in Table 2. Specifically,

a. Only 4 of 22 (18%) cell 2 projects rely on face-to-face communication, but 19 of 20 (95%) cell 4 projects do so.

b. As a mirror image to the above, coordination in 18 of 22 (82%) cell 2 projects relies mainly on TCMs, whereas only 1 of 20 (5%) between-firm (cell 4) projects relies mainly on TCMs.

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 use these projects as a stimulus to return 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.

Table 2 Coordination Mechanisms Used Across Geographic and Firm Boundaries

		Coordinating mechanisms (%)				
Cell	Total projects	Modularity	Face-to-face	Rich ICT	Poor ICT	TCM
Cell 1 (same firm, same location)	8	0	100	0	100	12.5
Cell 2 (same firm, different locations)	22	14	**18**	18	100	**82**
Cell 3 (different firms, same location)	10	30	100	0	100	0
Cell 4 (different firms, different locations)	20	35	**95**	0	100	**5**[a]

[a]In this project, most client personnel were former employees of the vendor, who already had much experience with the vendor's processes. Thus, from a common ground perspective, it may be dubious to treat this case as an example of tacit coordination between firms.

Finding 1: The Same Coordination Mechanisms Are Used Both in Within- and Between-Firm Projects That Are *Colocated*

In our data, we observe that both within- and between-firm colocated projects rely extensively on ongoing communication and copresence to achieve coordination, but not on other TCMs or on creating modular solutions.

Ongoing communication was the most important coordination mechanism used *within* firms. Respondents in cell 1 (see 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 colocated 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. (Integrator Manager 18, Project 34)

Ongoing communication was also an important coordination mechanism *between* firms in projects 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 of 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. (Integrator Manager 15, Project 28)

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 typically it 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 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, colocated 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 graphical user interface and server, 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 colocated between-firm projects (cell 3) invested in modularization. However, in none of these cases was coordination between the client and vendor firm 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 among themselves. 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 pattern of the limited use of modularity in our context is consistent with prior work. Several scholars have pointed out that in typical outsourcing projects, intermodule dependencies are irreducibly high and unstable through the life cycle of the project (Cataldo et al. 2006, Herbsleb and Mockus 2003, Kraut and Streeter 1995), and the up-front 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 to minimize hidden costs (Dibbern et al. 2008).

Tacit coordination mechanisms were used in all *colocated* (within- and between-firm) projects. These primarily involved taking advantage of shared physical copresence, which enabled project members to easily observe each other's actions and outcomes. For example, one manager told us how being colocated allowed

Figure 2 Mapping Interdependence Across Cells

	Developers belong to single firm: Yes	Developers belong to single firm: No
Project personnel **colocated** in one location	**Cell 1** (8 projects) Interdependence across locations: N/A Interdependence across firms: N/A	**Cell 3** (10 projects) Interdependence across locations: N/A Interdependence across firms: High: 7 Low: 3
Project personnel **distributed** among several locations	**Cell 2** (22 projects) Interdependence across locations: High: 19 Low: 3 Interdependence across firms: N/A	**Cell 4** (20 projects) Interdependence across locations: High: 19 Low: 1 Interdependence across firms: High: 13 Low: 7

for resolution of a problem through use of a mutually visible "demo" (demonstration), rather than attempting to explain the problem over email.

> 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 colocation there greatly helped because we demoed, straightaway we demoed . . . [the 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. (Process Master Manager 23, Project 43)

Similarly, within-firm, colocated projects also relied on copresence to coordinate, as documented in the literature (Olson and Olson 2000, Olson et al. 2002).

In sum, we find no evidence in our sample for a coordination mechanism unique to the within-firm or between-firm context in colocated projects, which agrees with some published findings (e.g., Helper et al. 2000).

Finding 2: In Distributed Projects, Within-Firm Coordination Relies Mainly on TCMs, But Between-Firm Coordination Does Not

In spatially distributed projects conducted within a single firm (cell 2), cross-location coordination was achieved mainly by leveraging TCMs in 18 of the 22 projects (or in 82% of 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 TCMs in only 1 out of the 20 projects (or in 5% of the cases). Even in this project, the client firm hired many vendor employees, who now interacted with their former colleagues. Conversely, only 18% of cell 2 projects relied on ongoing face-to-face communication, whereas 95% of cell 4 projects did so 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- versus between-firm contexts; we examine the reasons for this below.

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

Limited Reliance on Ongoing Communication Using ICT Tools. Ongoing communication using ICT tools appears to be distinctly less attractive compared with face-to-face interaction, even within a single firm. From Table 2, we observe that few distributed projects, within or between firms, used rich ICT tools in our sample. These findings resonate with prior work, which suggests that ICT tools are not as effective as face-to-face communication for two reasons. First, current ICT technologies, even videoconferencing, cannot match the benefits of colocation, such as shared contextual information and frequent, rich interactions, which are necessary to transfer the complex and difficult-to-articulate information required for coordinating software services delivery (for reviews, please see Kraut et al. 2002, Olson et al. 2002). Second, the usefulness of rich ICT media such as videoconferencing is limited in distributed settings because they require copresence—the need for all participants to simultaneously attend the meeting. In offshore software services, time-zone differences make such copresence very difficult to manage (e.g., Armstrong and Cole 2002).

TCMs Substitute for ICT-Based Ongoing Communication in Within-Firm Projects. 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 (cell 2) leveraged TCMs as an effective substitute for communicating. Specifically, in our sample, of the 22 projects organized in cell 2, 14 leveraged preexisting stocks of common ground, and 18 projects made an effort to generate common ground on an ongoing basis in a tacit manner. We observed two specific mechanisms: (1) leveraging preexisting common ground by adhering to commonly agreed (standardized) coding processes across different locations and (2) generating common ground on an ongoing basis by using tools that made actions, contexts, and outcomes visible across locations.

1. *Working to standardized procedures*. Working to standardized procedures was one of the most important sources of preexisting common ground in our intrafirm distributed projects. The capability maturity model (CMM),[3] which firms follow in developing software, is one example of a standardized work process that we frequently encountered in our study. Our respondents explained that working to standardized processes mitigated coordination problems because they regulated what information was required to be transmitted, as well as provided guidelines on how this information would be interpreted and used. For example, because of 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 and understand that information as it was intended. As one manager put it, working to standardized processes ensures the following:

> 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. (Integrator Manager 16, Project 30)

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. (Integrator Manager 25, Project 47)

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 may be *anticipated* and accommodated. Interestingly, the process need not be optimally designed for a project to still be 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.[4]

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

> Developers do not code to adhere to a standard; they code to get the job done. [In this project] there were 60-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. (Integrator Manager 15, Project 29, emphasis added)

Analysis of coordination failures across locations in our sample pointed to the importance of common ground as embodied by a standardized set of processes across different development sites. In our sample, coordination problems occurred in all the nine distributed projects *without* uniform coding procedures across locations and high across location interdependence. 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 U.S. and Brazilian centers. Our programmers in the U.S. 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 U.S. to discuss and agree on processes that both the U.S. and Brazil would follow. Once the process was nailed down, I ensured that the U.S. employees followed them. This was the most important thing to bring the project back on track. (Integrator Manager 5, Project 10)

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

> This team is fully colocated, 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. (Integrator Manager 12, Project 22)

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

2. *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 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 coordinate by making actions transparent across locations and by quickly putting the latest developments across locations in common ground. These tools can be thought of as creating *trading zones* that enable developers across locations to coordinate (Kellogg et al. 2006). Eighteen of 22 projects organized in cell 2 made an effort to use common tools across locations to generate common ground across geographies.

Between-Firm Distributed Projects Did Not Use TCMs. In 19 out of the 20 cases organized in cell 4, between-firm coordination was achieved by ongoing face-to-face communication between employees of different firms. In these 19 projects, coordination *across*

locations happened within firms and relied on leveraging TCMs. 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 colocating their employees.

To illustrate this, consider a project involving a vendor firm from India providing software services to a client from the United States, where much of the coding work is done in India and some is done in New York. The pattern we found is one in which client employees in New York *rarely* interacted directly with the vendor employees in India, and vice versa. Rather, the client employees primarily interact with the vendor on-site team resident in New York by ongoing, face-to-face communication; i.e., between-firm coordination between client and vendor employees mainly happens face-to-face in New York. These on-site vendor employees located in New York in turn coordinate with their counterparts in India using TCMs. In other words, we find that interaction 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 cost savings, vendors in offshore software services projects never reduce their onshore employee presence to zero (*Information Week* 2004). 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

It appears to be much more difficult to rely on TCMs 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 preexisting common ground that they can leverage nor are they able to tacitly generate such common ground swiftly.

1. *Not working to standardized procedures.* As discussed above in the within-firm case, coordination is achieved partly 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) that 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.[5]

2. *Not using common tools to generate common ground.* 19 of the 20 projects organized in cell 4, different toolkits were used across firms.[6] A manager gave us an example of the coordination problems that occur when several 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. (Integrator Manager 10, Project 18)

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

The lack of TCMs in between-firm contexts results in coordination problems only in distributed projects. Such TCMs are also not present in between-firm, colocated 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 to 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.[7] However, this proved to be very expensive and time consuming. As one manager told us,

> In [this project] we had to spend four 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. (Process Master Manager 2, Project 4)

Another manager 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 our 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. (Process Master Manager 32, Project 60)

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 chief executive officer of the firm and her delegates). Authority denotes a superior's legitimate ability to demand obedient behavior from a group of subordinates within a specified realm of actions (Weber 1921/1978). This exists if subordinates accept the decision of their superior without independently examining the merits 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 find 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 firmwide standards because it is a cost to them to switch from their existing ad hoc practices to the firmwide ones.

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

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

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 with the following 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. (Integrator Manager 28, Project 53)

This suggests that there exist circumstances in which coordination on a (possibly inferior) choice may be better than a continued search for an optimal choice or uncoordinated adoption of different choices. In these situations, authority is useful even if it merely enables a (perhaps arbitrary) common choice (Conner and Prahalad 1996).

Although it is possible to conceive giving managers in one firm authority over employees in another (e.g., Stinchcombe 1985), in practice this seems 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" (Process Master Manager 2, Project 4).

In our context, as well as more generally, there are typically asymmetric costs to firms in adopting the same standards or technologies, such as CMM processes or a new set of software licenses and the required training. Vendors typically have more advanced processes than clients (because of specialization), but clients have bargaining power to attempt to minimize disruption to their organizations. This is precisely the situation of "coordinated adaptation" that Williamson (1991) discusses, where each party has an incentive to create and interpret standards that are advantageous to itself. Although 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, TCMs are important to achieving coordination, since ICT-based ongoing communication is usually ineffective. Within-firm projects are more likely to use TCMs than are between-firm projects, because the availability of shared authority within firms makes it easier to leverage preexisting common ground and to tacitly generate de novo common ground. This explains the need for a costly on-site presence in offshore outsourcing. Together, these findings suggest a potential explanation for why some prior studies find within-firm coordination to be distinct and advantageous (in distributed settings),

but others find no difference in between- versus within-firm coordination (in colocated settings).

Alternative Explanations. Alternative explanations take the form of possible unobserved differences in the nature of projects across cells in Figure 1 that may have led us to erroneously attribute differences in observed coordination mechanisms to the organizational forms involved. Although 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 includes projects of different sizes and complexity in each of the cells. This helps us to address such questions as whether it is possible that between-firm projects are less likely to rely on TCMs 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 colocated 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 does not account for the difference in coordination mechanisms used or in the nature of interdependence observed in between- and within-firm projects. In distributed projects, within-firm coordination occurs by leveraging TCM, and between-firm coordination mainly happens face-to-face at the firm interface, regardless of size or complexity of the projects (though we had no instances of small projects in cell 4 in our sample).

In our sample, project complexity does not appear to materially change the nature of coordination mechanisms used.[8] We have data on 19 complex and 11 less complex projects in the within-firm organization and 24 complex and 6 less complex projects in the between-firm organization. However, both less complex and complex projects emphasize ongoing communication in the colocated case and TCMs in the distributed settings for within-firm projects and ongoing communication for coordinating between firms in distributed projects. Reading Table 2 in conjunction with Table 3, the overwhelming pattern suggests that the choice of coordination mechanisms is not driven primarily by size or complexity.

Table 3 Distribution of Project Size and Complexity

	Project size			
Location model	Small	Medium	Large	Total
Multiple (42)				
High complexity	0	7	26	33
Low complexity	3	6	0	9
Single (18)				
High complexity	2	4	4	10
Low complexity	2	3	3	8
Total	7	20	33	60

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 (Hayek 1945, Williamson 1975). 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 hierarchies (Bradach and Eccles 1989, Hennart 1993), it is important to understand how coordination mechanisms work within versus 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 colocated projects, the same coordination mechanisms are used within firms and between firms. Second, for spatially distributed projects, tacit coordination mechanisms are used within firms but not between firms. 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 TCMs to achieve coordination in between-firm settings because there is typically little preexisting 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 preexisting common ground as well as use technologies that enable rapid buildup 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 semiautonomous units; this is the guiding principle underlying grouping and linking in firms (Galbraith 1977, Thompson 1967, Tushman and Nadler 1978), as well as the use of modularity as an organizing principle (Sanchez and Mahoney 1996, Simon 1962). This is because grouping has the advantage of coordinating tight interdependence by recourse to feedback or ongoing communication. However, this work does not address 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 (Argyres 1999, Dyer 2000, Helper et al. 2000, Kotha and Srikanth 2013, Kraut and Streeter 1995, Nishiguchi 1994). In our sample, we find high interdependencies in interfirm as well as intrafirm projects (see Figure 2), and no differences in how interdependent work is coordinated between or within firms when the actors are colocated (i.e., when they face no communication constraints).

However, when high interdependence is coupled with communication constraints, intrafirm coordination may indeed hold some advantages. Our finding is that within-firm work can be coordinated using TCMs by relying on the preexisting 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 provides several possible explanations for why we might observe a qualitative change in the stock of preexisting common ground at the boundaries of the firm. Common ground refers to shared knowledge of first and higher orders (i.e., knowledge that is shared, known to be shared, known to be known to be shared; Clark 1996). Such knowledge is more likely to be available within firms than between them 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, everyone knows that any violation will be corrected through application of authority, and therefore common adherence can be reliably expected. 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 preservation of common ground, including common ground generated by shared experience. To the extent that the 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 that these insights about authority and coordination are a valuable complement to those of Adler and Borys (1996) and Adler (2005), who point to conditions under which employees view authority as enabling or coercive. These insights also complement the findings of Kotha and Srikanth (2013), who suggest that authority may be important to providing the incentives required to generate common ground and may be an impetus for vertically integrating previously outsourced activities. In contrast, tacit coordination across firms may be possible without the presence of common authority when investments are made in generating common ground across them, such as investments in common IT systems that can serve as a "technical grammar" (see Argyres 1999) or systems that increase observability of actions across firms (see Kotha and Srikanth 2013).

If the common ground available to employees within a firm is shaped by its history and exercise of a common source of authority, this would 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 (e.g., science, law, 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 becomes codified in their contracts. This does not, however, imply that this condition 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 investment in and enforcement of common ground (Monteverde 1995, Williamson 1985).

Limitations and Suggestions for Future Research

First, we note the inherent limitations of our method, which lends itself to inductive insight but not generalization. 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. Although we do present some comparative data and examine 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 colocated in at least one location.

Our data on past projects may 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 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. We emphasize that our conclusions are not based on the responses of one manager but based on the responses of 32 managers from two different firms, with respect to 60 different projects. The findings of this paper represent the common thread among all responses and therefore are likely less prone to individual biases.

Finally, this research does not present evidence of causation; from our respondents' views, we distill an explanation for why vendors never reduce onshore presence to zero (because of the need for TCMs and the availability of TCMs 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 in 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 and that address the important contingency of whether projects are colocated or spatially distributed; in our setting, we are able to observe firms making near-simultaneous choices of coordination mechanisms, within versus between-firm boundaries, and we 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 versus across firm and location boundaries meaningful rather than trivial. This comparison makes explicit the colocation–distribution contingency, which 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 to 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 in coordinating activities within their boundaries, as well as what these advantages may be. This study is one of the few to systematically compare the various coordination mechanisms used in within- and between-firm projects directly, rather than compare outcomes such as knowledge transfer (Kogut and Zander 1993) or quality of integration (Gulati et al. 2005). Our findings suggest that differences in within- versus 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 preexisting 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.

Acknowledgments

The second author acknowledges funding from the European Research Council under [Grant 241132] for "The Foundations of Organization Design" project. The first author acknowledges funding from the Leverhulme Trust Digital Transformations Programme at the London Business School and support from the Strategic Organization Design Unit, University of Southern Denmark. The authors also thank Huggy Rao, Markus Becker, Gerry George, Michael Jacobides, Reddi Kotha, Thorbjorn Knudsen, Nandini Rajagopalan, Mari Sako, and Aks Zaheer for helpful comments on earlier versions.

Appendix. Interview Guide

The sampling strategy involved software development/maintenance projects that fall into each of the four cells identified in Figure 1 to enable comparisons across them.

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 Projects 1 and 2. The questions center 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 and 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 (modular) 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 nontechnical considerations (political, economies of reuse, 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 ongoing 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, projectwide meetings, weekly staff meetings, etc.?

Tools and Artifacts

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 artifacts used in coordination—including automated software tools such as 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 versus a 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 artifacts 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 colocation of the teams helps? In your judgment, 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 (colocated)?

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?

Miscellaneous

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.

Endnotes

[1]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 provide an alternative, sufficient explanation of firms as systems of asset ownership, even if this perspective does successfully explain the existence of employment contracts, as Foss (1996b) points out.

[2]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 by-product of individual adaptation by interdependent agents is another instance.

[3]Adler (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.

[4]We note that standardized processes themselves, such as CMM, may be explicit knowledge. However, when such explicit knowledge is available in common ground, this enables tacit coordination.

[5]The exception is a project where the client hired a large number of developers from the vendor, who in turn then coordinated with the vendor from the client side.

[6]The exception was a very ambitious project, and the project manager lobbied to specially obtain resources to implement a standardized global tool kit across all locations.

[7]Attempts were also made in colocated 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 wholesale; they attempted to fine-tune them to what they regarded as their unique needs.

[8]Complexity was rated on technical and business dimensions by the project managers.

References

Adler PS (2005) Beyond hacker idiocy: The changing nature of software community and identity. Heckscher C, Adler PS, eds. *The Firm as a Collaborative Community: Reconstructing Trust in the Knowledge Economy* (Oxford University Press, Oxford, UK), 61–89.

Adler PS, Borys B (1996) Two types of bureaucracy: Enabling and coercive. *Admin. Sci. Quart.* 41(1):61–89.

Alchian A, Demsetz H (1972) Production, information costs and economic organization. *Amer. Econom. Rev.* 65(5):777–795.

Almeida P, Song J, Grant RM (2002) Are firms superior to alliances and markets? An empirical test of cross-border knowledge building. *Organ. Sci.* 13(2):147–161.

Argyres NS (1999) The impact of information technology on coordination: Evidence from the B-2 "Stealth" Bomber. *Organ. Sci.* 10(2):162–180.

Armstrong DJ, Cole P (2002) Managing distances and differences in geographically distributed work groups. Hinds PJ, Kiesler S, eds. *Distributed Work* (MIT Press, Cambridge, MA), 167–190.

Baldwin CY, Clark KB (2000) *Design Rules: The Power of Modularity* (Harvard Business School Press, Boston).

Barnard C (1938) *The Functions of the Executive* (Harvard University Press, Cambridge, MA).

Bechky BA (2006) Gaffers, gofers, and grips: Role-based coordination in temporary organizations. *Organ. Sci.* 17(1):3–21.

Bradach JL, Eccles RG (1989) Price, authority, and trust—From ideal types to plural forms. *Annual Rev. Sociol.* 15:97–118.

Camerer C (2003) *Behavioral Game Theory* (Princeton University Press, Princeton, NJ).

Cataldo M, Wagstrom P, Herbsleb JD, Carley K (2006) Identification of coordination requirements: Implications for the design of collaboration and awareness tools. *Proc. Comput.-Supported Cooperative Work* (ACM, New York), 353–362.

Clark H (1996) *Using Language* (Cambridge University Press, Cambridge, UK).

Coase RH (1937) The nature of the firm. *Economica* 4(16):386–405.

Conner KR, Prahalad CK (1996) A resource based theory of the firm: Knowledge vs. opportunism. *Organ. Sci.* 7(5):477–501.

Cramton CD (2001) The mutual knowledge problem and its consequences for dispersed collaboration. *Organ. Sci.* 12(3):346–371.

Daft RL, Lengel RH (1986) Organizational information requirements, media richness and structural design. *Management Sci.* 32(5):554–571.

De Meyer A (1991) Tech talk: How managers are stimulating global R&D communication. *Sloan Management Rev.* 37(January):49–58.

Demsetz H (1988) The theory of the firm revisited. *J. Law Econom. Organ.* 4(1):141–161.

Dibbern J, Winkler J, Heinzl A (2008) Explaining variation in client extra costs between software projects offshored to India. *MIS Quart.* 32(2):332–366.

Doherty-Sneddon G, Anderson A, O'Malley C, Langton S, Garrod S, Bruce V (1997) Face-to-face and video mediated communication: A comparison of dialog structure and task performance. *J. Experiment. Psych.* 3(2):105–125.

Dougherty D (1992) Interpretive barriers to successful product innovation in large firms. *Organ. Sci.* 3(2):179–203.

Dyer JH (1996) Specialized supplier networks as a source of competitive advantage: Evidence from the auto industry. *Strategic Management J.* 17(4):271–291.

Dyer JH (1997) Effective inter-firm collaboration: How firms minimize transaction costs and maximize transaction value. *Strategic Management J.* 18(7):535–556.

Dyer JH (2000) *Collaborative Advantage: Winning Through Extended Enterprise Supplier Networks* (Oxford University Press, New York).

Dyer JH, Nobeoka K (2000) Creating and managing a high performance knowledge-sharing network: The Toyota case. *Strategic Management J.* 21(3):345–368.

Eisenhardt KM (1989) Building theories from case study research. *Acad. Management Rev.* 14(4):488–511.

Eisenhardt KE, Graebner ME (2007) Theory building from cases: Opportunities and challenges. *Acad. Management J.* 50(1):25–32.

Ethiraj SK, Levinthal DA (2004) Modularity and innovation in complex systems. *Management Sci.* 50(2):159–173.

Faraj S, Xiao Y (2006) Coordination in fast-response organizations. *Management Sci.* 52(8):1155–1169.

Farrell D (2005) Offshoring: Value creation through economic change. *J. Management Stud.* 42(3):675–683.

Foss NJ (1996a) Knowledge-based approaches to the theory of the firm: Some critical comments. *Organ. Sci.* 7(5):470–476.

Foss NJ (1996b) More critical comments on knowledge-based theories of the firm. *Organ. Sci.* 7(5):519–523.

Galbraith J (1977) *Organization Design* (Addison-Wesley, Boston).

Ghoshal S, Korine H, Szulanski G (1994) Interunit communication in multinational corporations. *Management Sci.* 40(1):96–110.

Grandori A (1997) Governance structures, coordination mechanisms and cognitive models. *J. Management Governance* 1(1):29–47.

Grandori A, Kogut B (2002) Dialog on organization and knowledge. *Organ. Sci.* 13(3):224–231.

Grandori A, Soda G (1995) Inter-firm networks: Antecedents, mechanisms and forms. *Organ. Stud.* 16(2):183–215.

Grant RM (1996) Toward a knowledge-based theory of the firm. *Strategic Management J.* 17(Special issue):109–122.

Gulati R, Lawrence P, Puranam P (2005) Adaptation in vertical relationships: Beyond incentive conflict. *Strategic Management J.* 26(5):415–440.

Gutwin C, Penner R, Schneider K (2004) Group awareness in distributed software development. *Proc. 2004 ACM Conf. Comput.-Supported Cooperative Work* (ACM, New York), 72–81.

Hayek F (1945) The use of knowledge in society. *Amer. Econom. Rev.* 35(4):519–530.

Heath C, Staudenmayer N (2000) Coordination neglect: How lay theories of organizing complicate coordination in organizations. Sutton RI, Staw B, eds. *Research in Organization Behavior*, Vol. 22 (JAI Press, Greenwich, CT), 153–193.

Helper S, MacDuffie J, Sabel C (2000) Pragmatic collaborations: Advancing knowledge while controlling opportunism. *Indust. Corporate Change* 9(3):443–488.

Hennart J-F (1993) Explaining the swollen middle: Why most transactions are a mix of "market" and "hierarchy." *Organ. Sci.* 4(4):529–547.

Herbsleb JD, Mockus A (2003) Formulation and preliminary test of an empirical theory of coordination in software engineering. *Proc. Foundations Software Engrg.* (ACM, New York), 112–121.

Hinds PJ, Kiesler S (2002) *Distributed Work* (MIT Press, Cambridge, MA).

Holmstrom B, Roberts J (1998) Boundaries of the firm revisited. *J. Econom. Perspect.* 12(4):73–94.

Information Week (2004) SmartAdvice: Getting the right onsite mix with offshore suppliers. (March 17) http://www.informationweek.com/smartadvice-getting-the-right-onsite-mix-with-offshore-supplies/d/d-id/1023890.

Janicki R, Parnas DL, Zucker J (1977) Tabular representations in relational documents. Brink C, Schmidt G, eds. *Relational Methods in Computer Science* (Springer-Verlag, Düsseldorf, Germany), 184–196.

Jarzabkowski PA, Lê JK, Feldman MS (2011) Toward a theory of coordinating: Creating coordinating mechanisms in practice. *Organ. Sci.* 23(4):907–927.

Kellogg KC, Orlikowski WJ, Yates J (2006) Life in the trading zone: Structuring coordination across boundaries in post-bureaucratic organizations. *Organ. Sci.* 17(1):22–44.

Klein B, Crawford RG, Alchian A (1978) Vertical integration, appropriable rents and the competitive contracting process. *J. Law Econom.* 21(2):297–326.

Kogut B, Zander U (1992) Knowledge of the firm, combinative capabilities, and the replication of technology. *Organ. Sci.* 3(3):383–397.

Kogut B, Zander U (1993) Knowledge of the firm and the evolutionary theory of the multinational corporation. *J. Internat. Bus. Stud.* 24(4):625–645.

Kogut B, Zander U (1996) What firms do? Coordination, identity, and learning. *Organ. Sci.* 7(5):502–518.

Kotha S, Srikanth K (2013) Managing a global partnership model: Lessons from the Boeing 787 "Dreamliner" program. *Global Strategy J.* 3(1):41–66.

Kraut R, Fussell S, Brennan S, Siegel J (2002) Understanding effects of proximity on collaboration: Implications for technologies to support remote collaborative work. Hinds PJ, Kiesler S, eds. *Distributed Work* (MIT Press, Cambridge, MA), 137–162.

Kraut RE, Streeter L (1995) Coordination in large scale software development. *Comm. ACM* 38(3):69–81.

Kraut RE, Galegher J, Egido C (1988) Relationships and tasks in scientific research collaborations. *Human-Comput. Interaction* 3(1):31–58.

Kretschmer T, Puranam P (2008) Integration through incentives in differentiated organizations. *Organ. Sci.* 19(6):860–875.

Lawrence PR, Lorsch JW (1967) *Organizations and Environment: Managing Differentiation and Integration* (Harvard University Press, Cambridge, MA).

March JG, Simon HA (1958) *Organizations* (John Wiley & Sons, New York).

Mayer KJ, Argyres NS (2004) Learning to contract: Evidence from the personal computer industry. *Organ. Sci.* 15(4):394–410.

McGuire TW, Kiesler S, Siegel J (1987) Group and computer mediated discussion effects in risk decision making. *J. Personality Soc. Psych.* 52(5):917–930.

Miles MB, Huberman AM (1994) *Qualitative Data Analysis: An Expanded Sourcebook* (Sage, Beverly Hills, CA).

Monteverde K (1995) Technical dialog as an incentive for vertical integration in the semiconductor industry. *Management Sci.* 41(10):1624–1638.

Mullick N, Bass M, Houda Z, Sangwan R, Paulish D, Cataldo M, Herbsleb JD, Bass L (2006) Siemens Global Studio Project: Experiences adopting an integrated GSD infrastructure. *Internat. Conf. Global Software Engrg. (ICGSE'06)* (IEEE, Piscataway, NJ), 203–212.

Nahapiet J, Ghoshal S (1998) Social capital, intellectual capital, and organizational advantage. *Acad. Management Rev.* 23(2):242–266.

Nickerson JA, Zenger TR (2004) A knowledge-based theory of the firm—The problem-solving perspective. *Organ. Sci.* 15(6):617–632.

Nishiguchi T (1994) *Strategic Industrial Sourcing: The Japanese Advantage* (Oxford University Press, Oxford, UK).

Nohria N, Ghoshal S (1997) *The Differentiated Network: Organizing Multi-National Corporations for Value Creation* (Jossey-Bass, San Francisco).

O'Connail B, Whittaker S, Wilbur S (1993) Conversations over videoconferences: An evaluation of the spoken aspects of video mediated interaction. *Human-Comput. Interaction* 8(4):389–428.

Okhuysen G, Bechky B (2009) Coordination in organizations: An integrative perspective. *Acad. Management Ann.* 3(1):463–502.

Olson GM, Olson JS (2000) Distance matters. *Human-Comput. Interaction* 15(2):139–178.

Olson JS, Teasley S, Covi L, Olson G (2002) The (currently) unique advantages of co-located work. Hinds PJ, Kiesler S, eds. *Distributed Work* (MIT Press, Cambridge, MA), 113–135.

Orton JD, Weick KE (1990) Loosely coupled systems: A reconceptualization. *Acad. Management Rev.* 15(2):203–223.

Pentland BT, Reuter HH (1994) Organizational routines as grammars of action. *Admin. Sci. Quart.* 39(3):484–510.

Puranam P, Raveendran M, Knudsen T (2012) Organization design: The epistemic interdependence perspective. *Acad. Management Rev.* 37(3):419–440.

Sanchez R, Mahoney J (1996) Modularity, flexibility and knowledge management in product and organization design. *Strategic Management J.* 17(Special issue):63–76.

Schelling TC (1960) *The Strategy of Conflict* (Harvard University Press, Cambridge, MA).

Scott WR (2003) *Organizations: Rational, Natural and Open Systems* (Prentice Hall, Upper Saddle River, NJ).

Siggelkow N (2007) Persuasion with case studies. *Acad. Management J.* 50(1):20–42.

Simon HA (1991) Organizations and markets. *J. Econom. Perspect.* 5(2):25–44.

Simon HA (1947) *Administrative Behavior* (Free Press, New York).

Simon HA (1962) *The Sciences of the Artificial* (MIT Press, Cambridge, MA).

Sosa M, Gargiulo M, Rowles C (2012) Inter-team communication in complex new product development. Working Paper 2012/65/TOM/OB, INSEAD, Fontainebleau, France.

Srikanth K, Puranam P (2011) Integrating distributed work: Comparing task design, communication and tacit coordination mechanisms. *Strategic Management J.* 32(8):849–875.

Stinchcombe AL (1985) Contracts as hierarchical documents. Stinchcombe AL, Heimer CA, eds. *Organization Theory and Project Management* (Norwegian University Press, Bergen, Norway), 121–171.

Takeishi A (2002) Knowledge partitioning in the inter-firm division of labor: The case of automotive product development. *Organ. Sci.* 13(3):321–338.

Thompson JD (1967) *Organizations in Action* (McGraw-Hill, New York).

Tushman M, Nadler D (1978) Information processing as an integrating concept in organization design. *Acad. Management Rev.* 3(3):613–624.

Ulrich K, Eppinger S (1999) *Product Design and Development* (McGraw-Hill, New York).

Uzzi B (1997) Social structure and competition in inter-firm networks: The paradox of embeddedness. *Admin. Sci. Quart.* 42(1):35–67.

Venkatesh G, Krishna S (2005) Economics of offshoring software projects: The influence of multistaging on onsite-offshore mix. *Proc. Pacific Asia Conf. Inform. Systems, Bangkok*, 1554–1560.

Weber M (1921/1978) *Economy and Society* (University of California Press, Berkeley).

Williamson OE (1975) *Markets and Hierarchies* (Free Press, New York).

Williamson OE (1979) Transaction-cost economics: The governance of contractual relations. *J. Law Econom.* 22(2):233–261.

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

Williamson OE (1991) Comparative economic organization: The analysis of discrete structural alternatives. *Admin. Sci. Quart.* 36(2):269–296.

Yin R (1994) *Case Study Research: Design and Methods* (Sage, Beverly Hills, CA).

Zammuto RF, Griffith TL, Majchrzak A, Dougherty DJ, Faraj S (2007) Information technology and the changing fabric of organization. *Organ. Sci.* 18(5):749–762.

Kannan Srikanth is an assistant professor of strategy in the Indian School of Business. He received his Ph.D. from the London Business School. His research focuses on learning and coordination aspects of organizational adaptation and innovation.

Phanish Puranam is the Roland Berger Professor of Strategy and Organization Design at INSEAD. He received his Ph.D. in management from the Wharton School and served for over a decade on the faculty of London Business School, including as the chair of the school's Ph.D. program. His research focuses on understanding how organizations work and how to make them work better. He is particularly interested in the use of experiments and formal models to study the microstructure of organizations.