

***Understanding Knowledge Acquisition, Integration and Transfer  
by Global Development, Engineering and Construction Firms***

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Amy Javernick Will, Stanford University  
Raymond E. Levitt, Stanford University  
W. Richard Scott, Stanford University

Collaboratory for Research on Global Projects / CIFE  
416 Escondido Mall  
Building 550  
Stanford, California, 94305-4020  
Phone: (650) 305-0109  
email [ajwill@stanford.edu](mailto:ajwill@stanford.edu)

This is a working paper developed from a research proposal to the National Science Foundation. ***Please do not reproduce or cite this paper without the author's permission.*** The intent is to revise and shape this paper to best serve the Construction Engineering and Management community's research and industry needs in the area of institutional learning and knowledge acquisition and transfer on global projects and across global firms. Your comments are welcome and appreciated. Correspondence concerning this paper should be addressed to Amy Javernick Will, Collaboratory for Research on Global Projects, 416 Escondido Mall, Building 550, Stanford, California 94305-4020. Email: [ajwill@stanford.edu](mailto:ajwill@stanford.edu).

**ABSTRACT**

Studies of global projects in construction and other industry sectors have focused on the cross-cultural conflicts and resulting costs that can arise from the assembly of participants with vastly different and often clashing institutions — i.e., values, norms, work practices, and regulatory frameworks. However, virtually no attention has been paid to the potential knowledge sharing and innovation benefits that can arise from bringing together these diverse participants. The varied teams and working locations that global infrastructure and building providers encounter present an enlarged information and knowledge base, offering opportunities for learning and innovation that can benefit both global and local organizations. For instance, contractors based in developing countries use and refine labor-intensive work methods due to the high availability and low price of labor; these methods can be learned and reused by global infrastructure providers, e.g., for relief operations following natural disasters in other locations. At the same time, global infrastructure providers can transfer well developed policies and practices in areas such as safety management to local firms. Unfortunately, history shows that many organizations fail to acquire, store and transfer knowledge from projects to their organization. They “reinvent the wheel” on each project, wasting both time and money. This working paper describes the current state of knowledge about learning in project organizations and global organizations; it lays out the special challenges of acquiring and sharing tacit knowledge about new kinds of local, national institutions; and it describes an ongoing program of research that is using a series of in-depth case studies to explore the ways global engineers, contractors and developers currently acquire, store and transfer knowledge from multi-participant global projects. The research examines firms’ organizational systems, information technologies, and managerial policies and practices related to institutional knowledge acquisition and transfer across global operations. In addition, it seeks to identify and examine the effectiveness of these alternative approaches in acquiring, storing and transferring knowledge about unique local institutions in different countries at various phases of project development.

## **1. INTRODUCTION**

With expectations of a billion more inhabitants on earth in the next decade (Sachs, 2004), developers, contractors, and engineers are working internationally to address a shortfall of approximately US\$3 trillion in basic infrastructure (ADB, 2005). Most of the projected increase in population will occur in emerging market countries that often lack the institutional capacity to administer infrastructure development and operation, let alone the tax revenues to finance it. The required water supply and treatment, roads, railroads, ports, airports, power and telecommunications infrastructure will have to be financed, developed and operated by global and local firms and governments working together in these countries,

Building this infrastructure both efficiently and sustainably will require drawing effectively on lessons learned in the past, both to meet the impending demand and to avoid making the same environmental, social and economic mistakes on an even larger scale. However, firms in project-based industries like construction tend to repeat the same mistakes continually. They dash from one project to another without pausing to reflect and capture “lessons learned” from the problems and experiences encountered on past projects explicitly. Furthermore, project teams are seldom kept together across projects, so new project teams are not privy to the more subtle or “tacit” knowledge developed by previous project teams about mistakes made, problems encountered, and subsequent lessons learned. The lack of time and resources dedicated to recognition, capture and sharing of knowledge from projects causes organizations and even nations to reinvent the wheel continually, wasting precious time and money.

Despite having a wealth of experience from past projects to capitalize on, the global construction industry —like other project-based industries—has failed to realize, capture, and share many crucial lessons. The cost of continually repeating history— a history riddled with failures—is enormous. And sadly for the developing world, these failures often occur at their expense. For example, the public-private partnership (PPP) model initiated under the United Kingdom’s Private Finance Initiative has diffused around the globe as a mechanism to meet infrastructure needs in both developed and developing countries needs. Under the PPP approach, governments invite private investment in public projects to spur development and economic growth. But this structure only works under specific conditions and has led to many failures around the world. Emerging markets, in particular, have been faced with overwhelming problems of costly and unsustainable PPP infrastructure construction and operation (Mol, 2003; Mahalingam, Levitt and Scott, 2005). For instance, 40% of PPP infrastructure contracts during the 1990’s were renegotiated with an average renegotiation time of 2.2 years (Vives et al, 2006). The continual reoccurrence of failed projects has resulted in decreased private sector investment in the development of infrastructure projects whose original investment already fell far short of meeting these country’s requirements.

Only after over 15 years did the knowledge of the Inter-American Development Bank get systematically captured in an attempt to provide an analytical framework for how to finance and structure infrastructure projects in public-private partnerships. Using historical data and lessons learned from past projects, Vives (2006) identified three components that, in combination, are critical to a projects success: local conditions, project modalities and tools. Combining knowledge acquired from 150 past projects, he developed a contingency table to help planners structure effective and sustainable deals that attempt to allocate risks appropriately in a given project locale. The development of this framework can help host countries and multilateral banks design financing structures and terms for infrastructure development, but leaves us with a question: *Will we have to wait another 15 years to recognize and disseminate similar kinds of*

*collective tacit knowledge about how to develop, design and build projects in developing countries?* The predictions of population growth, urban movement and environmental problems indicate that we do not have time to wait.

Instead, we must capitalize on our collective knowledge to create solutions that address the impending demands. The global marketplace provides a setting where developers, contractors and engineers will encounter diverse teams and working locations that offer new and enlarged information and knowledge bases. The global firms involved in these projects will need to not only acquire, integrate and share knowledge across the diverse participants involved within the project, but they will also need to document and share the lessons learned from the projects across their global organization and supply chain. While this creates significant challenges, it also provides business opportunities for firms who are able to tackle these problems while working in diverse environments.

Previous studies of global projects in construction and other industry sectors have primarily focused on the cross-national problems (conflicts, cost and schedule overruns, etc.) that result from working globally in transnational teams and unfamiliar institutional environments (Orr, 2005; Mahalingam, 2005; Orr and Scott, 2007, Mahalingam, Levitt and Scott, 2005). Far less attention has been paid to potential opportunities for cross-national knowledge sharing that can flow from such projects. Developing residential, industrial and infrastructure projects globally exposes a firm to diverse settings that increase the flow of ideas, challenges and experiences to which a firm is exposed (Huber, 1991) affording opportunities for involved organizations to learn and gain new capabilities from both the projects and each other (Barkema and Vermeulen, 1998).

As an ever more tightly interconnected world, we have an enormous repertoire of lessons from which to draw. The urgent need for development and infrastructure combined with a past riddled with environmental, social and economic mistakes creates an urgent need to address the problems with sustainable solutions now. It requires us to have a commitment to learn from the past, share our knowledge, and apply lessons learned on future projects. The opportunities for learning, knowledge sharing and innovations that can result from global projects have the power to enhance the economic well being of firms and nations, improving both knowledge and practice. The question now is: *How can we accomplish this?*

### ***Objectives***

This working paper describes a program of ongoing exploratory research on how global companies engaged in development, engineering and construction projects are able to *acquire, integrate and transfer* the knowledge gained from projects across their global operations. Our objectives are to:

- Enhance understanding of how institutional, cultural, geographical and work practice differences lead to the creation of new knowledge
- Explore the ways that global firms acquire local institutional knowledge
- Identify the conditions, social structures, and carriers that facilitate or inhibit knowledge sharing
- Explore the ways in which global providers currently store and transfer knowledge from global multi-participant projects by examining organizational infrastructure, information technologies and managerial policies and practices
- Examine the effectiveness of alternative approaches in diffusing knowledge across a firm's projects, organization and global supply chain

## **2. RESEARCH POINTS OF DEPARTURE**

*Most organizations “don’t know what they know” and all organizations “know more than they can tell” (Polanyi, 1967).*

### **2.1. Organizational Learning**

Employees have individual pools of knowledge that seldom flow together into a common knowledge reservoir from which everyone within the organization can draw. In order for knowledge to add value to an organization, the knowledge needs to be accessible when and where it is needed. The absence of structured ways of learning and sharing within an organization equates to lost time and resources spent on continually repeating the same mistakes or reinventing the wheel. Emerging markets have precious little institutional capacity to capture and reuse even the knowledge gained in their own country about better ways to design, deliver or operate aspects of infrastructure projects. If the global engineering, construction and management firms who serve their needs do not learn from experience within and across firms, the emerging market governments and citizens end up paying the price of having their suppliers of infrastructure repeatedly make the same mistakes and “learn” the same lessons—at their expense—over and over.

The construction industry is particularly apt to understand that incomplete transfer of knowledge can cause unnecessary rework and delay (Paulson, 1976; Jin and Levitt, 1996). The flow of knowledge always tends to lie on the critical path of workflows and, as a result, affects organizational performance (Nissen, 2006). Thus, lost knowledge can impact a project’s duration as well as its cost (Ibrahim, 2005). Despite the fact that they understand this, previous studies have shown that few developers, constructors or engineering consultants have formal procedures to capture and reuse information from past experiences (Harris, 1995). Even though organizations have the desire and need to learn from experience, they give reasons of lack of time, money and increased pressure of upcoming work for not capturing and sharing knowledge (Scott and Harris, 1998). For knowledge to be a sustainable competitive advantage and improve organizational performance, a firm must gather and store all of its reusable knowledge and make it available for others to access.

In his review of the state of the art and practice of knowledge management, Nissen (2006) identifies six activities associated with the life cycle of a knowledge flow within an organization, including creating, organizing, formalizing, sharing, applying and refining knowledge. Our research aims to build upon Nissen’s (2006) model of the multi-dimensional aspects of knowledge flow (See Figure 1). It seeks to examine the flow of knowledge based on knowledge type (y axis), the phase within the knowledge lifecycle (z axis), and the “reach” of the knowledge as it spreads from individual to group, project team, organization and beyond (x axis). Additionally, we aim to study the various managerial mechanisms, incentives and structures (designated by stars added on the diagram) that are in place to facilitate knowledge flow.

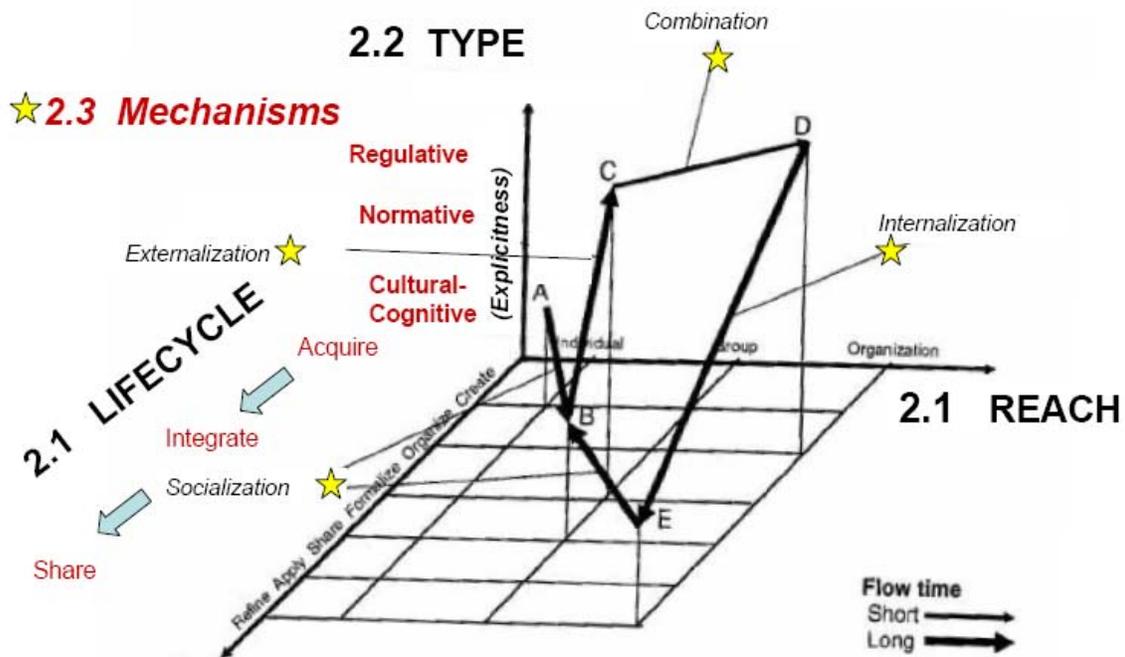


Figure 1  
“Multi-Dimensional Knowledge Flow”  
Adapted from (Nissen 2006)

## 2.2. Knowledge Lifecycle and Reach

We will elaborate on the lifecycle activities of acquisition, integration and transfer of knowledge, intertwining it with the reach of knowledge as it expands from the individuals and teams engaged in the engineering and construction of global projects and spreads across their global firms and global supply chains.

### 2.2.1. Knowledge Acquisition

Global projects expose firms to a diversity of environments, experiences, challenges and cues (Miller and Chen, 1996). However, gaining new knowledge requires not only that the information be available, but also that the firm actively search and acquire the information or knowledge (Levitt and March, 1988). In order to obtain new knowledge, an organization can enable three types of “sensing” with which it interacts, co-evolves and coordinates its activities with the environment. These activities are the exposure to and awareness of something new, interactive processes and interpretation or “sense-making” (Weick, 1995), and experimentation with new ideas (Maula, 2006). The ability to recognize the value of new external information, digest it, and exploit it for future application is critical to innovative capabilities and is dependent on the “absorptive capacity,” or the prior knowledge of the project team or firm (Cohen & Levinthal, 1990). If a project team starts with a relatively broad perspective and practice, they will be better able to detect and subsequently transmit novel information or knowledge from external institutions and sources of knowledge (Cohen & Levinthal, 1990). Global firms face additional challenges, however, due to “double layered acculturation” which requires adjusting to, or having previous experience with, both the different national cultures and the different corporate cultures. However, if they continue to learn through increased exposure and expansion they may be better able to reduce barriers and exploit lessons and knowledge from their experiences in a foreign country (Barkema et al, 1996).

### **2.2.2. Knowledge Integration**

In order for firms to benefit from the knowledge gained on global projects, they need not only to capture the knowledge, but also to integrate the lessons learned into their collective memory. The knowledge-based theory of the firm states that organizational knowledge is a resource with at least the same level of importance as capital (Grant, 1996). March (1991) suggests that due to limited resources a firm must balance between exploration (acquiring new knowledge) and exploitation (applying the lessons learned). Grant (1996) asserts, however, that if knowledge is the most important resource of the firm and knowledge resides within individuals, then the most important organizational capability is the *integration of individuals' specialized knowledge*. A global firm engaged in multiple projects across the globe is interested in integrating and storing the lessons in such a way that they become accessible to other firm members on different projects and retrievable through either formal or informal mechanisms in order to build competencies and achieve high performance (Ghoshal, 1987; Zahra et al., 2000).

### **2.1.3 Knowledge Transfer**

In addition to the level of knowledge inventory and availability, the flow of knowledge is critical to an organization's success (Nissan, 2006). The theory of knowledge conversion (Nonaka, 1994) assumes that knowledge is created or converted through a spiral-like process involving four steps:

- Socialization: knowledge transfer through shared experiences such as mentoring and on-the-job training
- Combination: knowledge transfer through mechanisms such as meetings, information processing and technology
- Externalization: knowledge transfer through questioning and reconstruction of perspectives and decisions
- Internalization: awareness of knowledge through learning

Knowledge flows also require us to focus on the reach of the transfer, whether between individual, group or the organization (Nissan, 2006). The power of knowledge that is transferred and then deployed through action is said to "amplify" (Nonaka, 1995, p.20) through increases in organizational reach. Kogut and Zander (2003) argue that the multinational corporation arises out of its superior efficiency to transfer knowledge across borders which enable it to extend the usefulness and power of the knowledge and information.

## **2.3. Knowledge and Learning Types**

The type of knowledge is integral to how knowledge is able to flow. In Nissen's diagram, the y axis designates the explicitness of the knowledge type. Our research will focus on institutional knowledge and learning involved in global projects. We plan to modify the y axis of this diagram (as shown) with our findings based on the institutional element and its degree of explicitness (ranging from tacit to explicit).

### **2.3.1. Technical Learning**

Technical learning includes learning about new technologies, techniques or methods for construction or engineering. It can include work processes or practices or the use of alternative materials or equipment. This type of knowledge is typically easier to identify, acquire and diffuse through an organization as it is often explicit and easily coded for storage and retrieval.

Note, however, that it is not possible to disentangle technical from institutional features. Technologies carry meanings which can enhance or restrict their usage, and technologies often

fail to diffuse or persist because supportive institutional frameworks are lacking. For example, Taylor (2005) found that the use of modular units in home construction used with success in Finnish companies did not diffuse in U.S. firms because of differences in the allocation of work to specialists in networked organizations.

### **2.3.2. Institutional Learning**

Institutional learning concerns knowledge of the social and cultural frameworks that undergird social life. In a single context, these frameworks vary little and constitute the unnoticed background of social behavior. However, in situations involving multiple people from diverse organizations and countries working in unfamiliar locales, institutional differences loom large, and institutional learning becomes of paramount importance.

Following Scott (2001: 48), we define institutions broadly as including “regulative, normative, and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning to social life.” To elaborate and illustrate these distinctions in the context of global projects:

- *Regulative elements*, stressed particularly by economists, include the formal machinery of governance: laws, rules, surveillance machinery, sanctions and incentives. These are more easily observed and more readily manipulated; and hence, they are earlier to learn.
- *Normative elements*, emphasized particularly by sociologists and historical institutionalists, focus primarily on the prescriptive, evaluative, and obligatory dimensions of social life. Shared values and norms, interpersonal expectations, and valued identities are stressed. The corporate culture of participating companies, conventional work practices enforced by occupational communities, and professional standards are obvious examples of normative elements at work in global projects.
- *Cultural-cognitive elements*, a focus of cultural anthropologists and organization scholars, tap into a deeper layer that includes widely-shared beliefs about the nature of the world (cultural frames) and cause-effect relations (social logics). The beliefs are “cultural” because they are socially constructed symbolic representations; they are “cognitive” because they provide vital templates for framing individual perceptions and decisions. Hofstede (1984; 1991) has identified a useful set of dimensions for assessing these elements.

As noted, regulative elements are more easily learned: they are more visible and more easily captured in published information and available from consultants. More difficult are the normative elements, which are encoded into the behavior of the people in the local context and in the cultural features of companies and work groups. Only sustained, interpersonal exchanges and prolonged exposure can uncover these differences. Most difficult are the cultural-cognitive elements—elements which more likely to be tacit and taken-for-granted by all parties—requiring self-conscious and disciplined attention to differences.

Ideally, as such differences or “institutional exceptions” (Orr and Scott, 2007) appear they are not ignored or suppressed but become the object of attention and sense-making activities. We will attend to conditions under which institutional differences are recognized and become the subject of active learning efforts. Building on related research (Mahalingam & Levitt, 2004), we will also study the role of expatriates—employed by both project companies and host organizations—who have been shown to play critical role in brokering institutional differences.

## **2.4. Organizational Learning Mechanisms**

Today's globally competitive environment requires companies to improve and add capabilities continually. The diversity of ideas and stimuli that global projects offer can help by facilitating learning and allowing firms to gain new capabilities from external sources (Barkema and Vermeulen, 1998).

### **2.4.1. Mechanisms for Knowledge Acquisition**

The exposure firms receive from new experiences, challenges, and cues creates the possibility for them to learn something from each market they enter (Miller and Chen, 1996). Due to the possibilities it enables, a key asset of a firm that operates globally is the diversity of environments in which it operates (Ghosal, 1987), however, the diversity of environments only becomes an advantage to the organization if it is able to acquire and gather generalizable lessons and knowledge from its projects and through its alliances. Kogut and Zander (2003) indicate that the firm is a social community which utilizes mechanisms to create and transform knowledge into economically rewarded products and services, creating advantages for global firms. Clearly, some global firms engaged in development do this better than others. Our research will explore effective managerial and organizational mechanisms for construction and engineering companies engaged in infrastructure and building development to facilitate the acquisition of knowledge from their global projects and alliances.

### **2.4.2. Learning as an Objective**

The diversity among global projects offers great potential for learning. Due to the relationship between aspirations and observable outcomes (Levitt and March, 1988), organizations (or nations) must: (1) consider learning to be an objective or goal; (2) create mechanisms and systems for the learning to take place (Ghoshal, 1987); and (3) be actively engaged in the search for new ideas and information. The rate of discovery is a function of both the richness of the pool, which should increase on global projects, and the intensity and direction of the search (Levitt and March, 1988).

#### **2.4.2.1. Learning in Alliances**

Global projects, because of their size and scale, often involve the collaboration of multiple companies. Therefore, they offer the opportunity to learn not only from the host country and environment, but also from the alliance and joint venture partners participating in the project. The transfer of knowledge across company lines can occur through either public (newsletters, conferences, journals, etc.) or private (emails, telephone calls, meetings, etc.) mechanisms. Due to their contractual professional relationships with multiple organizations, engineering consultants can act as carriers, diffusing information and knowledge across firms and projects (DiMaggio and Powell, 1983). Infrastructure and building providers' sharing of knowledge through collaborations with countries or other firms is influenced by a multitude of factors, including:

- The type of contractual agreement (equity joint-ventures tend to ease knowledge transfer) (Mowery, Oxley and Silverman, 1996).
- The absorptive capacity of a firm (Cohen and Levinthal, 1990) and experience in related areas (Barkema et al, 1996).
- The firm's transparency and receptivity to learning (Hamel, 1991).
- The objectives of the partners within the alliance.
- The mechanisms the firms use to influence communication between each other.

- The types of temporary structures set up for interaction among firms and with the host country (Hamel, 1991).

### **2.4.3. Mechanisms for Knowledge Integration and Transfer**

Due to the importance of knowledge and the competitive advantages knowledge sharing can provide, a central feature within organizations is the set of mechanisms and processes through which knowledge is integrated (Grant, 1996). Of particular importance for global firms is achieving competitive advantages by leveraging their organizational knowledge across national boundaries and linking their resources through worldwide learning (Bartlett and Ghoshal, 2000). Managers are realizing the need to develop techniques and practices to facilitate knowledge flow within their companies by building knowledge databases, systematically and routinely transferring best practices and otherwise creating the foundation for a knowledge-based company (Ball et al, 2006). We will study the organizational and managerial mechanisms, whether formal or informal, that facilitate the integration and transfer of the knowledge gained from global projects across global firms.

#### **2.4.3.1. Formal Mechanisms**

Formal mechanisms for knowledge integration and sharing include processes, procedures, rules, standards, templates, methodologies, technical support, formal functional groups and discussion forums. Information and communication technology (ICT) often helps facilitate the formal integration of explicit knowledge by simplifying the process of coding, communicating, assimilating, storing and retrieving the knowledge (Rockart and Short 1989). However, ICT is insufficient as a complete knowledge management system, because people, not technology, are central to the flow of tacit knowledge (Polanyi, 1967; Nissan, 2006). Organizational incentives also affect knowledge sharing. Formal incentive systems that reward sharing and collaboration, such as performance reviews, raises or special recognition, help encourage the flow of knowledge through a firm (Appleyard, 1996).

Some companies have established an online enterprise-wide collaboration network which contains both rules and standards such as templates, procedures, and lessons learned, as well as a platform to enable communication among employees through functional groups, discussion forums and the use of experts. The technology platform enables employees to post questions and retrieve answers to problems as they arise, enabling them to improve performance and provide optimal and timely solutions to their clients. Knowledge audits, a diagnostic activity that focuses on identifying gaps or potential problems to be addressed (Liebowitz et al, 2000), may be employed along with training sessions and the publicizing of best practices.

#### **2.4.3.2. Informal Mechanisms**

Informal mechanisms for integrating and sharing knowledge can include social processes and procedures such as on-the-job training or informal meetings to discuss projects and lessons learned. A study by Nonaka (1994) found that many individuals seek knowledge from individual experts on a personal basis. Some global engineering and construction firms rely almost exclusively on informal social interactions (meetings, phone conversations, etc.) to facilitate relationships amongst the employees and gain referential data, an understanding of who knows what (Schreiber and Carley, 2003). Norms among firm participants can either encourage or discourage the discussion of mistakes and the acknowledgement of errors.

We are encountering a wide range of managerial practices and mechanisms intended to facilitate knowledge flows within the firm. We are aiming to learn more about: the benefits associated with each type; how they are linked to the corporate culture and structure; and

whether, and what kinds of, incentives are needed to encourage employees to take the extra effort and risk required to share knowledge.

The institutional factors that can affect project success are both numerous and complex. Cognizant of this complexity, we propose exploratory research to allow us to identify varying practices among companies. We are focusing, in particular, on the interactions of different (1) phases of knowledge flow, (2) mechanisms of knowledge management; and (3) types of knowledge. This will allow us to examine *which mechanisms are more or less useful for managing different types of knowledge at different phases of the knowledge flow and conversion.*

### **3. RESEARCH METHODOLOGY AND WORK PLAN**

We are conducting exploratory research through case studies of global firms involved in global projects for this early-stage research in this area. Through these case studies, we are attempting to understand the ways in which different approaches and tools used to capture and reuse knowledge impact global firm's attainment of higher levels of shared knowledge on global projects and across their organizations.

We selected the case-based methodology because it provides a level of in-depth analysis that more general survey methods neglect and thus offers the prospect of rich, new insights (Eisenhardt, 1989; Yin, 2003). In addition, because it responds to the question of "How?" it will allow us to focus on organizational and institutional knowledge flow processes that occur naturally. After an extensive literature review, data will be gathered through observations, document collection, and interviews with participating firms.

#### **3.1.Preparation**

In parallel with our fieldwork, we are conducting an extensive review of literature, existing theories and previous studies of global project structure and governance, institutional theory, organizational learning and knowledge management, and the project based business literature. The literature review will help us to understand existing theories and provide opportunities to elaborate and validate these theories in a global and project based context. We will also consult executives of leading global companies affiliated with our host organization, CRGP, regarding their experiences.

#### **3.2.Case Studies**

Cases have been selected to allow for comparisons that contribute to the building of theory (Yin 1984, 2003; Eisenhardt 1989). We intend to study three different firm types (developers, contractors and engineers) in order to observe different organizational structures and roles across a project's lifecycle that enable different types of knowledge flows, recognizing that the firm type often determines the level of embeddedness an organization or project team has within the local institutions (Orr, 2005). The level of embeddedness and engagement with different types of institutions on a project is expected to have a significant affect on their learning processes.

Developers and Contractors tend to be deeply embedded in the local context at varying times whereas Engineering Consultants tend to face medium to high levels of embeddedness (Orr, 2005). For instance, Developers are concerned with the entire project life-cycle, working with a variety of people from the conceptual stages through operation of the project. They often engage with local partners and rely on these local contacts to provide recommendations and advice for successful project development. While the majority of decisions are decentralized, the large investments often require that the locus of control reside with a regional office. In contrast, Contractors commit teams and resources to a project full time throughout the construction of the project. The team members typically reside at the project location, separated physically from the

organization's offices. Due to the need for rapid responses required on the project, they control the project directly with little interaction or connection to the main offices. Moreover, the large size and temporary nature of these projects requires Contractors to engage a complex team of locals, expatriates and outside consultants to help them manage the work. Engineering Consultants, on the other hand, engage in an advisory capacity to assist the project sponsor throughout various stages of the project. They often work on multiple projects at once, frequently from their firm's offices, and can transfer methods, technologies and knowledge across both projects and organizations.

Additionally, we have sought to engage firms who obtain at least 30% of their revenue from international work (based on ENR 2005 rankings) in order to ensure that global projects are a significant focus of their business. Using the well-respected case study approach advocated by Yin (1984, 2003), these firms will be selected to ensure both *literal replication* —i.e., having more than one firm of each type (e.g., engineer, contractor, developer) — as well as *theoretical replication* —i.e., firms believed to differ along key dimensions that are expected to impact their acquisition and transfer of knowledge (such as those that stress formal IT approaches versus those that stress informal community building approaches). We will be attentive to differences associated with such factors as the organizational structure, size of company and experience and length of time in specific foreign markets and the global realm.

### **3.3.Data Collection and Analysis**

All case studies are being conducted in company offices or on construction sites and involve data collection through:

- *interviews* with key informants
- *observations* of project meetings and collaboration
- *collection of documents and secondary data related to specific examples of knowledge acquisition and sharing* from global projects, including specific knowledge type, and the structure, incentives and format in place to allow for the sharing of this knowledge
- *collection of documents related to company structure, experience, incentives and managerial mechanisms* that are in place to promote formal or informal knowledge management

Case collection and analysis will focus on identifying the type of knowledge gained on projects, identifying and describing how knowledge is shared, and the mechanisms used by companies to enable and encourage knowledge flows between projects and throughout global organizations. We will transcribe the interviews and then code and analyze our transcriptions using a grounded-theory-building approach (Eisenhardt, 1989).

### **3.4.Validation**

We are analyzing and coding the cases to expand upon existing organizational learning and knowledge management theory and attempt to build new theory about how institutional differences can create learning opportunities for global firms. We are engaging in a process of coding that will attempt to show which organizational strategies are contingently successful in different kinds of work (e.g., engineering vs. construction) for: (a) Learning on Global Projects; and (b) Sharing Lessons and Knowledge from global projects across both the firm and global supply chain.

Because of the social dynamics involved with studying learning and teams, case attributes can often not be accurately coded in a dichotomous manner without losing pertinent information.

We will accordingly consider using “fuzzy sets” which permit membership to a varying degree across the states of non-membership to full membership. Because our number of cases will be limited, traditional statistical analysis techniques such as regression or structured equation modeling are unlikely to yield useful insights. However, the case information will be detailed. Therefore, to maximize the rigor of our research, we plan to do a “Qualitative Comparative Analysis (QCA), a novel technique for analyzing qualitative case-based data developed by Charles Ragin (1987, 2000) to test or discern patterns using Boolean algebra to compare macro social phenomena. Based on the ongoing use of this approach in a related project, we believe that using QCA to analyze this set of cases can help to address and integrate many aspects of the cases to examine how the contextual pieces fit together to produce specific outcomes (Ragin, 1987, 2000).

We plan to use specific narrative examples of knowledge collection and transfer (or the lack thereof) collected from case studies to illustrate and explain the mechanisms that facilitated or the barriers that blocked the flow of knowledge within a global project provider. Detailed stories —“thick narratives”— about, for example, how novel seismic engineering practices in San Francisco were adapted from Japan by ARUP, how knowledge about “green building” practices was transferred from Europe to the US, and how enterprise-wide project-inclusive knowledge platforms foster communication around the globe within Fluor, can help illustrate the contingent success of different approaches to knowledge acquisition, integration and diffusion in different contexts. In addition to helping identify the mechanisms and structure in place to facilitate knowledge transfer and flow, these “thick narratives” will also help us validate previous findings and theories of multi-dimensional knowledge flows and conversions conducted by Nonaka (1995, 1999) and Nissen (2006). We hope to extend these theories by focusing on the project-based industries of development, construction and engineering with a concentration on different types of institutional learning and knowledge encountered on global projects.

#### **4. EXPECTED SIGNIFICANCE AND LONGER TERM GOALS**

The authors’ ongoing program of collaborative research explores the ways in which global projects pose unique challenges through bringing together participants with different—and often conflicting— sets of national institutions that can make it difficult for them to work together. The current research builds on this long-term interdisciplinary research effort to develop an understanding of the low-level organizational mechanisms by which knowledge flows—or does not flow—in global, project-based organizations. This will enhance our understanding of institutions and cross-institutional learning. It will also provide insight on how learning can be triggered when organizations with significant institutional differences come into contact. Furthermore, it will address how organizational and managerial processes, practices and mechanisms can facilitate or hinder the acquisition and dissemination of knowledge within global projects and across global development, construction and engineering firms. In addition, it will explore the unique role that global engineering consultants can play as “carriers” in diffusing innovations through a global industry. In the future this information will allow us to develop enhanced computational models of organizations that incorporate knowledge flows, extending the information flows that present versions of VDT (Levitt, et al) do.

In June of 2006, an ASCE task force created a report, “The Vision for Civil Engineering in 2025”. In this vision, civil engineers competently, collaboratively, and ethically create a sustainable world and enhance the global quality of life (ASCE, 2006). This exploratory research aims to go forth in the direction espoused by ASCE’s vision for future civil engineering practice

*Understanding Knowledge Transfer by Infrastructure Providers in Emerging Markets*

by spurring interest and research in the benefits that can be obtained through collaboration across company lines and institutional boundaries on global projects — especially those in developing countries where the needs are most urgent. Furthermore, it seeks to identify mechanisms that encourage and engage this cooperation. We hope that future work will draw upon this research to discover how new processes and mechanisms can facilitate knowledge sharing to deliver a built environment that is more economically, environmentally and socially sustainable through a global supply chain (Levitt, 2007 in press).

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*Understanding Knowledge Transfer by Infrastructure Providers in Emerging Markets*

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