CROSS-CULTURAL VIRTUAL DESIGN TEAMS: CULTURAL INFLUENCES ON TEAM PERFORMANCE IN GLOBAL PROJECTS

Tamaki Horii[1], Raymond E. Levitt[2], and Yan Jin[3]

ABSTRACT

Globalization of the construction industry has brought unique challenges such as coordination among project participants from different countries. This research attempts to understand cultural differences in international joint-venture (IJV) teams composed of Japanese and American participants, and to develop a prototype computational model—"*Cross-Cultural*"-Virtual Design Team (CC-VDT)—to seek better organization designs for cross-cultural engineering teams. Based on our case studies, we characterize cultural differences along the dimension of *cultural values* and *cultural practices*. Cultural values refer to an individual's preferences in decision making and communication. Cultural practices include the cultural norms for adopting specific coordination mechanisms to control organizations and tasks. CC-VDT incorporates value-practice dimensions based on our observations and a literature survey. The simulated results of the effects of cultural impacts are qualitatively consistent with cultural contingency theory and our observations, validating the reasoning of CC-VDT. These results extend the possibility of using simulation modeling to capture distinguishing cross-cultural phenomena that emerge in global construction projects.

KEY WORDS

Organization design; Cultural differences; Practices; Values; Virtual Design Team (VDT); Team Performance

INTRODUCTION

In an era of globalization, as economic borders between countries come down, cultural barriers will most likely go up and pose new challenges and opportunities for business (House et al, 2004). Project managers in global construction projects face unique challenges in coordinating among project participants from different countries. The participants work for companies with varying corporate cultures and management styles. The companies' headquarters are located in different countries, so project participants must cope with a variety of languages, business customs, and cultures. Rapidly accelerated globalization in the construction industry has caused various problems. According to one study, two out of every five international joint venture (IJV) project teams struggle through their projects and show poor performance (Beamish and Delios, 1997). A key problem is the increased internal complexity caused by pre-existing

[1] PhD Candidate, Civil and Environmental. Eng. Bldg. 550, Room 553H, 416 Escondido Mall, Stanford, CA 94305, Phone (650)725-8970, FAX (650)723-4806, Email: Tamaki_Horii@stanford.edu

[2] Professor of Civil and Environmental. Eng. Terman 294, 416 Escondido Mall, Stanford CA 94305, Phone (650)723-2677, Email: Ray.Levitt@stanford.edu

[3] Associate Professor, Aerospace & Mechanical Engg. Dept., 3650 McClintock Ave., OHE-430, Los Angeles, CA 90089, Phone (213)740-9574, Fax (213)740-8071, Email: yjin@usc.edu

differences in cultural values, beliefs, norms, and work practices among IJV team members. Underestimating the influence of differing cultural perspectives on global projects can potentially have a large negative impact on team performance.

How can we design better project-organizations for global projects? Generally, most facility project managers generally use a form of trial-and-error adaptation to design their project-organizations (Tatum, 1983). Adaptation can eventually lead to acceptable solutions in a stable environment, but a more systematic approach is needed when institutional and cultural environments change dynamically. Computational models such as the Virtual Design Team (VDT) model (Levitt et al. 1994, Jin and Levitt 1996) can be a useful platform for project participants to explore effective organization designs by generating accurate predictions of schedule, cost, and quality performance for technically complex projects. However, VDT represents only "*mono-cultural*" engineering teams composed of actors who have one set of cultural values and beliefs. In order to run global projects successfully, there is now increased need for a managerial tool that examines cross-cultural influences on team performance. Thus, the goal of this research is to develop a computational model for designing "*cross-cultural*" teams, which we call the "*Cross-Cultural*"-Virtual Design Team (CC-VDT) model. The current work on CC-VDT uses cases from two cultures, Japanese and American. We choose to start with two cultures in order to keep the initial models simple, yet still complicated enough to represent the case of cross-cultural teams, and use it as a prototype for examining multi-cultural cases.

We extend the current VDT model to capture cultural phenomena that our research indicates emerge in global construction projects. In the course of developing CC-VDT, we encountered a number of cultural and organizational modeling questions including:

- What kinds of cultural differences are at play in global projects, and which ones are critical to team performance?
- How much do cultural factors affect team performance?
- How can we model cultural factors on global projects, and validate the proposed models to predict consequences? What is the appropriate level of abstraction that can capture reality at a sufficient level of detail and, at the same time, avoid becoming too complex or too "realistic" to comprehend?

BACKGROUND

Research on cultural differences provides an initial point of departure for this research. We begin by defining culture. Generally, culture can be defined as a set of shared experiences, understandings, and meanings among members of a group, an organization, a community, or a nation. Through sharing common successes and struggles, groups create their own unique cultures, leading to the development of unique sets of values—i.e., broad tendencies to prefer certain states of affairs over others—and practices (norms)—i.e., conceptions of appropriate business practices to include legitimate means and processes-. Both *cultural values* and *cultural practices* are fostered in a society or group and elaborated upon over years, playing a central role in cultural differences on IJV projects. Therefore, this research views cultural differences from two dimensions: *cultural values* and *cultural practices* (e.g., Hofstede 1991, House et al 2004). Hofstede (1991) originally describes national culture in terms of both values and practices. Although the focus of this research is on project organizations rather than national culture, the value-practice dimensions provide a good starting point for us to study culture and

cultural differences in project teams. Our work extends Hofstede's definitions to cover project organizations.

Computer simulation is growing in popularity as a research tool for seeking efficient organization design and analyzing organizational performance (Burton & Obel 2004). Computer simulation models such as VDT have succeeded in measuring team performance based on "information processing theory" (Galbraith 1977), which views project organization as information processing systems. VDT extended Galbraith's information processing view by measuring the fit between the information processing capacity and the information processing demand at the level of an individual actor, based on the "neo-information processing" approach (Burton & Obel 2004). Preliminary studies of cultural differences imply that team participants exhibit different behaviors in processing information and imposing different rules that constrain or enhance individuals' activities in information processing. VDT possesses rich characterization of both organizational and actor behaviors, providing the capability to represent different types of cultural actors and different types of organization styles. This research can be categorized as an extension of contingency theory (Galbraith 1977): a micro-contingency theory of information processing demand and capacity based on cultural differences.

This research focuses on the two cultures, Japanese and American, as an example of dyadic units of cultural interactions. Differences in business practices between the two cultures have been cast by many researchers (e.g., Nakane, 1970). However, there have been few studies that look into the construction industry, even though the international construction market alone is worth $139.82 billion in 2003 (Engineering News Record (ENR) 2004). In addition, we can potentially apply findings drawn from this study to other cultures.

RESEARCH METHODOLOGY

As the first step, this research characterized cultural differences between Japanese and American teams along value-practice dimensions through observations and a literature survey. We conduced four case studies using the ethnographic approach (Spradley 1979) conducted between April and August 2003. All four projects[4] were joint-venture projects between Japanese and American firms located near the San Francisco Bay Area. Thus, we were able to exercise good control over the broader legal and political regulative institutional contexts (Scott, 2001). As a second step, we developed a prototype model of CC-VDT that incorporated value-practice dimensions. We encoded and calibrated organizational and micro-level behavior parameters in CC-VDT based on our observations and a literature survey. The third step was to validate the reasoning of CC-VDT. This is the first step of a validation trajectory for computer simulation projects, proposed by Thomsen et al (1999). In particular, we examined encoded cultural values and cultural practices by addressing ideal cases, via "intellective experimentation." Finally, we discussed the implications at this stage and further issues for CC-VDT.

CASE STUDIES

We characterized Japanese and American cultures observed in IJV projects along value-practice dimensions as the basic building blocks of "culture."

[4] There are two bridge projects (C bridge project, G bridge project), one tunnel project (SF tunnel project) and one semiconductor facility building project (SC project).

Cultural values can be seen as the driver of preferred or desirable behaviors, when participants make decisions or coordinate with each other. We call the behavior, "micro-level behavior" (Jin and Levitt, 1996), which can be observed by focusing on how participants make decisions and communicate with others. Therefore, *cultural values* at the project team level are represented by how project participants make work-related and communication-related decisions. For instance, based on our observations, Japanese workers tend to seek consensus before making decisions, while Americans prefer to decide independently. We observed that Japanese and American workers have distinctly different patterns of micro-level behavior. These observations are consistent with existing literature (e.g., Nakane 1970). In addition, *value differences* are linked to national culture (Hofstede, 1991). Hofstede's work[5] provides a useful set of dimensions against which value differences can be measured. For instance, the *individualism-vs.-collectivism* index Hofstede proposes can explain why Japanese people tend to seek consensus among team members, since Japanese workers are high on the Collectivism scale. In collectivist countries, "harmony should always be maintained and direct confrontations avoided" (Hofstede, 1991, p.49-78). Based on our observations, harmony and trust among group members are key aspects of Japanese workplace culture, and can be seen in many different activities, including meetings and contracts. Thus, lower individualism, high collectivism countries like Japan tend to have group-based decision-making.

Our observations show that cultural subgroups comprising an international project team are most likely to have their own work practices for coordinating people and tasks. These practices have been accumulated and standardized in their home country or their corporation. At the project organization level, we define *practice differences* referring to specific coordination mechanisms used to organize people and tasks, which have been adopted according to cultural norms. Therefore, *practice differences* have two attributes: (1) *organization control systems* and (2) *task control systems*.

This research found that there are three important elements in *organization control system*: the level of centralization of authority, the level of formalization of communication, and the depth of the organizational hierarchy. Different cultures tend to set these organizational elements differently, because difference in cultural norms prescribes a different reasoning and legitimacy for each of these organizational elements. For instance, Japanese project teams tend to have multiple levels of hierarchy and to be more centralized, while American firms usually adopt a flatter organization hierarchy and decentralized authority. These observations are consistent with existing literature (Lincoln & Kalleberg 1990).

The *task control systems* are related to standardized or legitimated rules that control tasks. We observed two types of task control systems: a process-based control style vs. a result-based control style. Hofstede (1991) defines the process-based control style as the extent to which people are concerned with using the correct means, in order to avoid risks. Similarly, the result-based control style refers to the extent to which people are primarily concerned with goals and results. Based on our observations, Japanese teams tend to place a great deal of attention on processes in tasks -e.g., a Japanese fabricator tried to use their conventional processes and specifications which meet with metric system and Japanese standard systems in terms of efficiency, while the American team on the same

[5] Hofstede proposed using four dimensions to describe cultural differences among 53 countries including Japan and the United States: 1) power distance, 2) individualism vs. collectivism, 3) masculinity vs. femininity, 4) uncertainty avoidance, and 5) long term orientation vs. short term orientation.

project tended to pay more attention to results and outcomes of tasks -e.g., an American design firm required them to satisfy the specific number set by the codes or the American standards. Since *task control systems* have been generally influenced by the various institutions of their home countries (Scott, 2001), different national groups are most likely to have different *task control systems*, or **"institutionalized practices."** Differences in *task control systems* between subgroups generate demands to exchange information with each other in order to agree upon a task control style. We call these events "**institutionally-driven exceptions.**" For instance, we found in one case study that the Japanese steel fabricator took one year to get an approval from the American design firm about specifications and processes for pre-fabricated steel components, due to different approaches in *task control systems*. In addition, several researchers have addressed differences in institutionalized practices in IJV projects (Mahalingam et al, 2004).

Table 1 summarizes the two culture dimensions, their attributes, and the values of these attributes for Japanese and American cultures. At the project level, each culture has its own sets of micro-level behavior, organizational control style, and task control style.

Table 1: Summary of Cultural Differences

Cultural Values

Micro-level behavior	American	Japanese
Decision making	Individualized decision making	Consensual decision making
Communication	Individually-based	Group-based

Cultural Practices

Organization control system	American	Japanese
Centralization	Decentralized authority	Centralized authority
Formalization	Medium level of formalization	High level of formalization
Organizational hierarchy	Flat level of hierarchy	Multiple levels of hierarchy
Task control system	American	Japanese
Task control style	Results-based	Process-based

PROTOTYPE MODEL

Based on our observations, we develop a prototype model of CC-VDT that contains two additional constructs to VDT: *cultural values* and *cultural practices*. These constructs represent the increased internal complexity that IJV teams can encounter due to differences in cultures. As similar to VDT, the neo-information processing view of organizations (Burton and Obel, 2004) provides a foundation for how to model cultural constructs. For instance, Japanese participants show a certain pattern of behaviors in processing information, which is distinguished from American one. Therefore, this research views individual actors' behaviors as stochastic patterns in decision making and communication driven by differing *cultural values*. In other words, we set up two heterogeneous types of agents in CC-VDT. Similarly, this research models organization control styles as stochastic decision-distribution patterns, and task control styles as stochastic demands for processing information driven by differing *cultural practices*.

Figure 1 illustrates input and output variables for a CC-VDT simulation. We predetermine two types of inputs: project description and organization design. Project descriptions define the team members and activities with their dependencies, -e.g.,

number of actors and activity dependency network (Jin and Levitt 1996). The organization design comprises the organization structure, such as the level of centralization, the level of formalization, and depth of organizational hierarchy. In CC-VDT, we add national cultural indices as properties of the team members. The national cultural index defines micro-level behavior patterns and task control systems of subgroups. Micro-level behavior patterns determine how each actor processes information, while task control styles generate information demands between subgroups. For a given project, one may change the organization design to see its effect on team performance. The dependent variables of CC-VDT reflect project performance such as the project duration, project cost, and project quality.

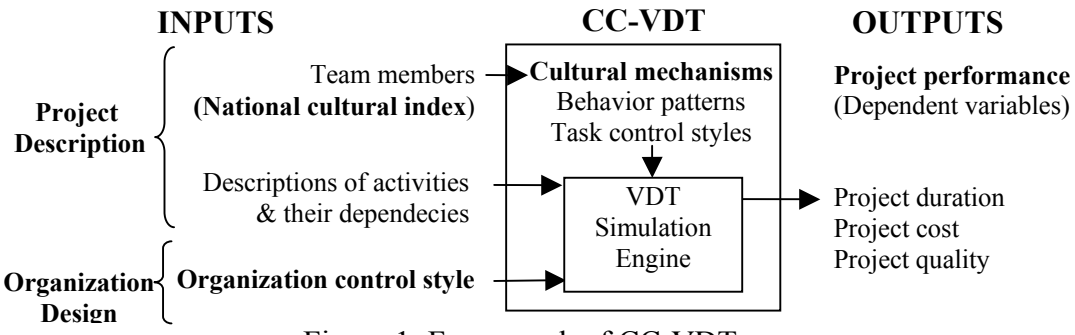
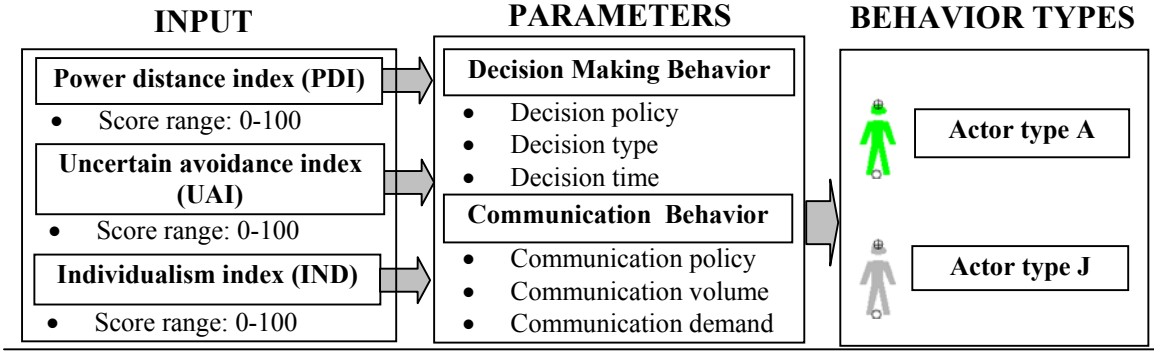


Figure 1: Framework of CC-VDT

Note: The CC-VDT model adds a national cultural index to the current VDT model. The input to the national cultural indices determines micro-level behavior patterns and task control styles. We initially calibrate parameters by observing Japanese and American cultures.

Table 2: Relationships between National Cultural Index and Behavior Types



Note: Table 2 shows relationships between national cultural indices and behavior types. Decision making behavior pattern is composed of three parameters: decision policy, decision type, and decision time. Decision policy determines which actor should make the decision for an exception. Decision type is used by a decision-maker to determine how an exception should be dealt with. Decision time defines how long an actor waits for a decision. Actors in different managerial roles have different time-out durations. Communication behavior is also composed of three elements: communication policy, communication volume, and communication demand. Communication policy defines the probability that an actor attends to a given type of communication; Communication volume defines the volume of information exchange each actor processes; and Communication demand determines the information exchange frequency at the project team level.

CULTURAL VALUES

This research views "*cultural values*" as people's preferred or desirable behaviors in decision making and communication. CC-VDT links between cultural value indexes and

actors' micro-level behaviors. Based on our observations and a literature survey, three major cultural indexes – power distance index (PDI), uncertainty avoidance index (UAI), and individualism index (IND)[6] (Hofstede, 1991) – are considered as important cultural values that contribute to micro-level behavior patterns. Micro-level behavior patterns are determined by two relevant behavior parameters: 1) decision making behavior, and 2) communication behavior. We encode micro-level behavior parameters based on our observations and a literature survey. We assumed that the default behavior pattern in the current VDT model represents American micro-level behavior pattern (type A), because the current VDT model has been calibrated and validated with American firms for the past 15 years (Thomsen, 1999). We set Japanese micro-level behavior patterns relative to the default American micro-level behavior patterns.

CULTURAL PRACTICES

In CC-VDT, *cultural practices* have two components: (1) organization control systems and (2) task control systems.

Organization Control System

Organization control system refers to the organizational parameters within the VDT model that determine the exception handling paths and authority levels of decision makers. Since practices within an organization are the organizing mechanisms that enable the organization to conduct a project, practices are linked to an organization's structure. Specifically, we set three organizational parameters: the centralization level, formalization level, and depth of organizational hierarchy. These organization structural elements constrain or enhance individual information processing activities. These organization structural elements are control variables for project managers, and so they should be designed as inputs of CC-VDT, just as for the current VDT model.

Task Control System

The second aspect of cultural practices is the *task control systems*, which are characterized by one attribute: a process-based control style versus a results-based control style. CC-VDT links the cultural value indexes proposed by Hofstede (1991) and a subgroup's task control style. Specifically, Hofstede (1991) describe about the correlations between power distance indexes (PDI) and process-vs.-result-orientations. We found in our observations that larger PDI countries (Japanese firms) are associated with a process orientation, while smaller PDI countries (American firms) with a results orientation. Differences in *task control systems* between cultural groups generate institutionally-driven exceptions, requiring the demand for information exchange between two subgroups, in order to agree upon a task control style. In CC-VDT, institutionally-driven exceptions are seen as an amplification factor to exaggerate technically-driven exceptions.

VALIDATION

Validation has been a challenging problem in computational organization theory research. The evaluation trajectory proposed by Thomsen et al (1999) specifies a stepwise strategy to build up successful validation efforts for a new model: reasoning, representing, and

[6] Masculinity (MAS) index was not observed from case studies. A possible explanation is that both workers in the construction industry have relatively the same level of MAS. Long term orientation (LOT) index has relatively less impact on cross-cultural projects because of the short term focus in all cultures on the events that drive project decision making.

usefulness. We validate the reasoning assumptions of CC-VDT as the preliminary validation efforts (Horii et al 2005). Specifically, the micro-theories relating to observable micro-behavior must match the behaviors observed in the simulation. In the CC-VDT model, we created a set of micro-level behavior patterns by linking cultural theory and observed micro-level behavior through interviews. In order to validate the interactions between organization theory axioms and the emergent macro-behavior of our simulation model, we use "intellective simulation experiments" of an idealized organization. This intellective simulation step enables us to validate the Japanese and American micro-level behavior patterns.

INTELLECTIVE EXPERIMENTATION

For these intellective experiments, we use two types of micro-level behavior patterns and two types of organization control systems (the Japanese and American types). In addition, task complexity and team experience were pre-determined, representing an idealized context. We assume that two independent variables reflect the effects of changes in practices and values: *organization control style* (cultural practices), and *micro-level behavior of actors* (cultural values). These two are varied over the full range of our context variables of *task complexity* and *team experience.* Thus, we simulated a total of 48 combinations (2 organization styles x 2 micro-behavior patterns x 4 task complexity levels x 3 team situation levels) (Figure 2).

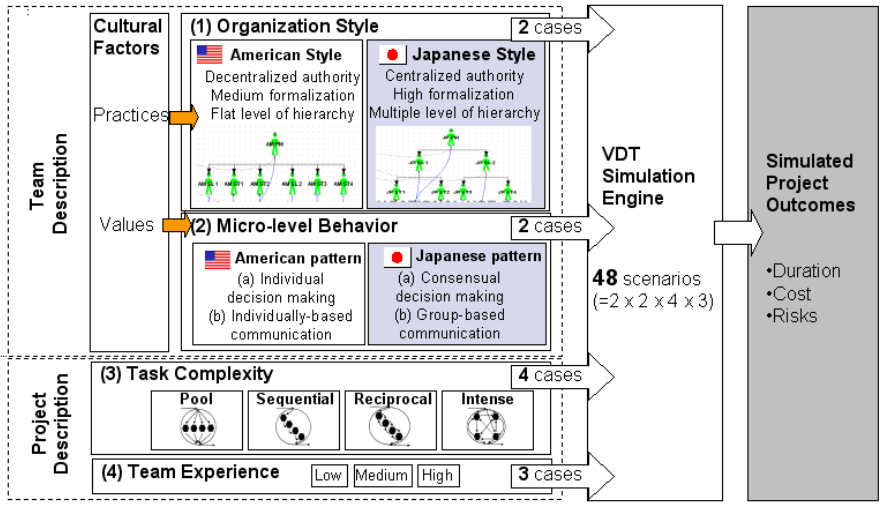


Figure 2: Framework of Intellective Experiments

Note: This shows a framework for our "intellective experiments". For experimental purposes, the actor and task configurations are identical. Actor and task configurations include the actors' skills, the skills required by tasks, the duration of tasks, the hourly salary of actors, actor-task responsibility assignments, and the total number of team participants. All teams are composed of seven members, including one project manager, two sub-team leaders, and four sub-team members

VALIDITY

We identified the effects of changes in organization control styles, in micro-level behavior patterns, and relationships between micro-level behavior patterns and organization control styles, all on project performance outcomes of cost, schedule and process quality.

Effects of changes in organization control styles: Japanese organization control style performs better in the case of high task complexity, while American practice style

performs better in the cases of low and medium task complexity cases. This implies that the better *cultural practices* are contingent upon project situations.

Effects of changes in micro-level behavior patterns: Our results contribute to the small body of evidence supporting the importance of congruence between *cultural practices* and *cultural values*. Specifically, Japanese micro-level behavior patterns perform better when using a Japanese organization control style, while American micro-level behavior patterns perform better with an American organization control style. We extrapolate from these findings to conclude that each culture's typical organization structure has evolved to match its culturally preferred micro-behavior, in order to maximize efficiency. The impact of mismatches between *cultural practices* and *cultural values* are contingent upon the characteristics and requirements of a given project.

Relative impacts between organization styles and micro-level behavior patterns: Changes in behavior patterns have less impact on team performance than changes in organization structure. At this stage, the relative contributions of the organization system or behavior pattern are unknown and cannot be analyzed quantitatively.

Our preliminary validation results support the reasoning assumptions of CC-VDT as a project organization-level analysis tool for seeking better project organization design for global project managers. Two more validation steps remain on the agenda: validation of representation and usefulness.

CONCLUSIONS

Research on IJV projects reveals the difficulties of coordinating cross-cultural teams. Our research sheds light on some of the effects of the increased internal complexity that IJV project teams face. It makes an initial attempt at developing a computer simulation model to predict the impact of differing cultural elements on team performance in IJVs. We conducted ethnographic interviews to understand and encode *cultural values* and *cultural practices* into the parameters of CC-VDT. We then developed a prototype model to simulate cross-cultural engineering teams, in order to seek better organization designs when considering the dimension of cultural values and cultural practices. As the first step of validating CC-VDT—validating its reasoning—we found that the effects of changes in micro-level behavior patterns and organizational control styles show interesting correlations between *cultural values* and *cultural practices*, and offer initial evidence that these parameters have been encoded correctly, since our model predictions align with extant theory. These findings demonstrate a possible framework for modeling the cultural differences among team members that emerge in global projects. We have encountered limitations in modeling cultural differences—e.g., we could not take into consideration potentially positive effects of cultural interactions, through innovation, creativity, and advanced technology. In addition, further validation steps of CC-VDT, specifically of its representation and usefulness, remain to be done.

We have argued earlier (Levitt et al, 1999) that global projects provide an ideal field setting in which to explore the effects of institutional clashes on the behavior and performance outcomes of organizations. Global projects bring together participants from multiple national, organizational and professional cultures. All construction projects have unusually clear goals and metrics compared to most other organizational forms; they have a finite start and end date—often with durations that are less than a typical PhD degree—and clearly defined participation. Currently, there are intriguing and unexplored research opportunities to study dynamics of cultural systems in inter-cultural, inter-organizational and inter-institutional settings, such as global projects.

ACKNOWLEDGMENTS

This research is being conducted under the auspices of the Collaboratory for Research on Global Projects (CRGP) <http://crgp.stanford.edu>. This material is based upon work supported by the National Science Foundation under Grant No. 9980109, the Clarkson H. Oglesby Memorial Fellowship Fund, and gifts from industrial affiliates of CRGP. Any opinions, findings, conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation or other sponsors.

REFERENCES

Beamish, P. W., and Delios, A., (1997), "Incidence and Propensity of Alliance Formation," In P.Beamish and J. Killing (Eds.), *Cooperative Strategies: Asian Pacific Perspectives.* Pp 91-114, San Francisco, CA: New Lexington Press

Burton, R.M, and Obel, B., (2004). *Strategic Organizational Diagnosis and Design: The Dynamics of Fit,* Norwell, MA: Kluwer Academic Publishers, 3rd edition

Engineering News Record (ENR) 2004, *Top 225 international contractors,* accessed on November 7th 2004: <http://enr.construction.com/features/international/archives/040823b-1.asp>

Galbraith, J.D., (1977). *Organization Design,* New York, NY: Addison-Wesley Inc.

Hofstede, G., (1991). *Cultures and Organizations: Software of the Mind*, Intercultural Cooperation and its Importance for Survival, New York, NY: McGraw-Hill

Horii, T., Jin, Y., and Levitt, R.E., (in press), "Modeling, and Analyzing Cultural Influence on Project Team Performance," *Computational and Mathematical Organization Theory,* Vol.10 (3)

House, R.J., Hanges, P.J., Javidan M., and Gupta, V., (2004). *Culture, Leadership, and Organizations: the GLOBE Study of 62 Societies*, Thousand Oaks, CA: Sage publications Inc.

Jin, Y., and Levitt. R.E., (1996). "The Virtual Design Team: A Computational Model of Project Organizations," *Computational and Mathematical Organization Theory*, Vol. 2 (3), pp.171-196

Levitt, R.E., Thomsen, J., Christiansen, T.R., Kunz, J.C., Jin, Y., and Nass, C.I., (1999). "Simulating Project Work Processes and Organizations: Toward a Micro-Contingency Theory of Organizational Design," *Management Science* Vol. 45 (11), pp. 1479-1495

Lincoln, J.R., and Kalleberg, A.L., (1990), *Culture, Control, and Commitment: A Study of Work Organization and Work Attitudes in the United States and Japan*, Cambridge, UK: Cambridge University Press

Nakane, C., (1970). *Japanese Society*, Berkeley, CA: University of California Press

Mahalingam, A., Levitt, R.E, and Scott, W.R. (2004). "Cultural Clashes in International Infrastructure Development Projects: Which Cultures Matter?" In: *Proceedings of the International Symposium of CIB W92*, CIB W92, Las Vegas, USA,

Scott, W. R., (2001). *Institutions and Organizations,* Thousand Oaks, CA: Sage publications Inc., 2nd Ed.

Spradley, P. J., (1979). *The Ethnographic Interview*, Holt, Rinehart and Winston Inc., New York, NY.

Tatum, C.B., (1983). *Decision-Making in Structuring Construction Project Organizations*, Civil Engineering, Stanford, CA: Stanford University

Thomsen, J., Levitt, R. E., Kunz, J., Nass, C., and Fridsma, D., (1999). "A Trajectory for Validating Computational Emulation Models of Organizations," *Computational and Mathematical Organization Theory*, Vol. 5(4), pp.385-401