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Toward a Framework of Cultural Effects on Software Development

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ABSTRACT
Culture is one of the major concerns when companies choose offshore outsourcing for software development. However, cultural effects on software development are hard to measure. Therefore, culture is often ignored in offshore outsourcing contracts for software development, or treated as a patch-up issue in the software eventually delivered by the offshore entity. Either scenario might jeopardize the achievement of effective software solutions, or make it difficult for companies to achieve the economic benefits of outsourcing software development to offshore entities. To better understand cultural effects on software development, this paper develops a framework of the influences of offshore-country culture on software being developed for a foreign country. It examines culture’s effects on both the process and product aspects of offshore software development.

Keywords
Culture, offshore, outsourcing, cultural effect, software development.

INTRODUCTION
Culture is one of the main issues in IT offshore outsourcing (Coward, 2003; Herbsleb and Moitra, 2001). In other manufacturing industries, companies choose offshore outsourcing for several reasons including cost reduction and localization. Localization has been perceived an important reason because companies feel the need to embed local culture into their products. Otherwise, they would lose competitiveness. In software development, however, companies tend to choose outsourcing as a way to reduce cost. Therefore, a firm located in a high cost country, say country ‘A’, contracts its software development needs to a firm located in a foreign country, say country ‘B’, because that foreign country has lower software development costs than its host country. In this context, what may be a benefit of localization in other types of industries may indeed be a detriment to the acquisition of effective software solutions - that is, software solutions that aptly fit/match the culture in which the software is to be used. It may be that one of the unanticipated consequences of offshore outsourcing is that the culture of the country in which the software was developed may become embedded in the software solution. Where that culture is in conflict with the culture in which the software solution is to be used, then the users of the software may experience or perceive usability difficulties when employing the software.

Locating the development of software in a foreign country, especially one whose culture is different from the culture in which the developed software will be used, may also have some influences, perhaps negative, on the process of developing that software. There may be barriers to communicating system requirements, milestones and client expectations that are culture specific. We do not claim that these barriers are caused by differences in language; rather, we feel that they are caused by the innate nature of norms, beliefs, habits and values and the differences in these across the contracting countries. Therefore, we posit that culture, amongst several other factors, may be an impediment in successful offshore outsourcing of software development, when the fit between the contracting cultures is not right. On the other hand, where the two cultures are similar, it may enhance the efficacy of the outsourcing arrangement.

Although research on culture in the context of IT has been conducted, most of it focuses on how culture impacts technology acceptance and diffusion (Loch et al., 2003), or on the customization of IT solutions to fit specific cultures (Singh et al., 2003). While some research has been conducted on culture in outsourcing arrangements, most of it has been on the communicative (i.e. language) barriers in outsourcing and how to overcome these, or on the effectiveness of distributed software development arrangements (Bin et al., 2003; French and Layzell, 1998). Not much has been done on the deeper cultural influences on cross-culture software development as exemplified in the offshore-outsourced development of software.
by one culture for use in another (Carmel, 2001). Shore and Venkatachalam argue that cultural influence is indirect, hard to separate, and difficult to quantify (Shore and Venkatachalam, 1995). The reason for this is that culture itself is hard to measure and its effect is difficult to capture. Furthermore, culture is contested, temporal, and emergent (Myers and Tan, 2002). Therefore, there remains a gap in the understanding of how culture affects software development in the offshore outsourcing environment.

This research focuses on how culture affects software development process effort and customer satisfaction with the software solution in the offshore outsourcing environment. Five constructs (development process, product, complexity of product, complexity of project, and service level agreement (SLA) identified from an extensive literature review as having a bearing on process effort and user-satisfaction are introduced. The relationship between culture and these five constructs is theorized with a view to hypothesizing the influences of culture on process effort and customer satisfaction in the offshore outsourcing of software development. The research questions for the study are thus:

a) How does culture affect software development in the context of offshore outsourcing?, and

b) What are the factors that moderate culture’s effects on process effort and customer satisfaction?

The contributions of this research are two fold. First, the study identifies the factors/constructs that are theorized to mediate the influences of culture on software development outcomes. Evaristo et al. (2000) identify three core elements that MIS cross-cultural research is lacking: lack of theory base (testing or building), inclusion of culture as antecedents of constructs, and general improvement in methodologies used. This research tries to address the first two issues (Evaristo et al., 2000). It does so by providing a theory-based conceptual framework that would help us better understand the direct and mediated relationship between culture and software development outcomes, on the one hand, and the specific factors that mediate this relationship, on the other.

As the scope and complexity of IT increase, many organizations decide to move the burden of in-house development to outsourcing counterparts to better leverage their resources and provide better quality of information services (Lee et al., 2003). However, there is little empirical evidence on the influences of culture on this arrangement. This research is based on the question of whether offshore outsourcing can realize the benefits above without consideration and understanding culture. Culture might be the major obstacle in the realization of the promises of offshore outsourcing. By extensive literature review on the influences of culture and cultural fit on the efficacy of offshore outsourcing of software development, this study adds to the knowledge in the body of literature on culture-IT research. In so doing it provides some important findings and implications to practitioners and researchers alike.

The paper is organized as follows. The ensuing section provides a brief but concise review of the literature on this topic. In the section after that, the conceptual framework is illustrated, a theoretical underpinning of each construct presented, and the study’s hypotheses elaborated. Thereafter, the proposed research methodology is presented. The conclusions section then ends the paper.

**LITERATURE REVIEW**

While there are several models that theorize culture within the context of IT, the three that have received the most attention and usage in past IT research are Hofstede’s five cultural dimensions model (Myers and Tan 2002), Structuration Theory (Giddens, 1984; Walsham, 2002), Hall’s (1996) monochronic-polychronic culture classification model (Rose et al. (2003). Hofstede’s five cultural dimensions are the most widely used model for studies on cultural and cross-cultural issues in the IS field (Myers and Tan 2002). A study by Myers and Tan (2002) noted that 24 of 36 studies from cross-cultural IS literature used Hofstede’s cultural dimension constructs. Although Hofstede’s study has merit of enabling us to recognize the importance of culture in IS, it can be criticized as simple and crude. In addition it is hard to explain cultural difference in organizational and individual level with Hofstede’s work. Additionally, since Hofstede views culture as a static entity, it is hard to use the dimensions he provides to explain the dynamic aspects of culture (Myers and Tan 2002).

The structuration theory developed by Giddens (1984) has been used by IS researchers to better explain and understand cultural contradiction and conflict (Walsham, 2002). This theoretic approach has proved effective assessing the dynamic aspects of culture(Walsham, 2002). The reason is that it views cultural issues from three dimensions of action and structure: systems of meaning, forms of power relations, and sets of norms. In addition this approach can capture and explain the dynamic nature of culture by enabling analysis of reflexivity and change. Although Walsham (2002) identifies this structuration approach can offer theoretical underpinning for detailed work level study, the three constructs used are rather generic. Additionally, while they have been used to explain political and organizational issues in team activities for the system development, they have as yet to be applied within the context of offshore outsourcing of software development.
Rose et al. (2003) argue that culture is a crucial issue in developing software products (Rose et al., 2003). They accommodate Hall’s (1966) classification of culture based on the event perception: monochronic and polychronic. They experiment how differently monochronic and polychronic people perceive download delay in web site. They find that culture does influence the ways in which people use software solutions and users perceptions about the usability of the software solutions. Therefore, they recommend that culture should be a key consideration when developing software solutions.

Starting from Hofstede’s culture dimensions, researchers has been focusing on cultural issues in IS field. As they find the limit of using Hofstede’s approach, researchers in IS field try to draw on other theories to understand and explain better cultural issues in software development and usage. While these studies have greatly enriched our understanding of IS cultural issues and helped us to deal with cultural issues better they do not provide a general understanding of how culture affects specific area of software development and customer satisfaction, especially within the context of offshore outsourcing. Therefore, we extend this stream of inquiry by examining this specific dimension.

METHODOLOGY

To develop our framework in Figure 1, we searched related literature extensively. The main key words used include IT outsourcing and software development because we want to examine the relationship between outsourcing and software development. Seven major IS journals we searched are MIS Quarterly, Decision Science, Communications of ACM, Journal of Management Science, IEEE Transactions on Software Engineering, and IEEE Software. In addition, Journal of Global Information Management was searched extensively because this journal is dedicated to global issues in IS management. Finally papers published in major and related conferences are searched. The articles which examine relationship between cultural constructs and software development constructs were selected and used to develop the framework. The major constructs contributing software development were identified and those are related to culture.

THEORETICAL FRAMEWORK

We posit that within the context of offshore outsourcing where the home country culture is different from the developer’s country culture, this difference in cultures influences the outcomes of the software development process. Further, we posit that such influence is both direct and indirect. Cultural differences between the countries of the contracting firms will have a bearing on the (a) efficacy of the formal development processes employed, (b) the complexity of the project itself, (c) the architectural composition of the product (software solution), (d) the functional/technical complexity of the product (software solution), and (e) the nature and efficacy of the service level agreement. These constructs will in turn impact the customer satisfaction and the process effort (comprised of the time and money expended to develop a software solution) of the outsourced offshore software development initiative. It is also likely that difference in culture directly influences customer satisfaction and process effort. The framework in Figure 1 presents these conceptualized relationships.
An explanation of the constructs in the framework ensues.

a) Culture

Hofstede’s (1991) model of culture has been extensively used in offshore outsourcing research. The main focus of our research is treating culture as antecedent of other related constructs in the context of software development (Evaristo et al., 2000). In addition, this research will use (a) Hofstede’s (1991) five dimensions of culture, namely power distance, individualism, masculinity, uncertainty avoidance, and long-term orientation, and, (b) Hall’s (1966) monocronic-polycronic dimensions of culture to classify various countries and thereby determine the extent of their similarity with the other countries in the study (Hall, 1966). We will then determine the cultural fit of each client-supplier pair of countries, based on how they rank on the seven dimensions contained in Hofstede and Hall’s classification schemes. Culture, specifically the cultural fit of an outsourcing country to its supplying country, will be the only independent variable in the study.

b) Efficacy of the Development Process (Process Efficacy)

Shore and Venkatachalum (1995) identified effect of culture on systems development life cycle (Shore et al., 1995). Additionally, much has been published on the influence and importance of software engineering processes on the quality of IS artifacts (Basili et al., 1999; Hans-Werner et al., 1997; Highsmith, 2000; Howard et al., 1999; Sugumaran and Storey, 1999) and the productivity of the development team (Balasubramanian et al., 1995; Blum, 1994; Hans-Werner et al., 1997; Shapiro, 1997; Sinha and Vessey, 1999; Vessey and Glass, 1998). These past studies posit that culture influences the development process and that the development process influences the outcomes of the systems development effort. Consequently, in this research we will focus on cultural effect on the software development process in the offshore outsourcing context. We plan to use Hofstede’s (1991) four classifications of culture based on power distance and uncertainty avoidance, and Hall’s (1966) two classifications of polycronic and monocronic cultures to assess the influence of cultural fit both on the nature and efficacy of the development process, and on the outcomes of this process – process outcome and customer satisfaction respectively.

c) Structure and Composition of Software Product (Product Make-up)

According to Kersten and Rakowski (2002), internationalized software development should recognize the need for localizing customer interfaces to specific cultures (Kersten et al., 2002). They argue that determining which software characteristics are culturally dependent is the key to successful software development. Most research that has addressed this issue contends that it is only the presentation layer that needs to be modified as a software product is migrated across cultures. However, little empirical evidence exists to show that this is all that is required. It may be that cultural differences not only impact how users interact with the software but how those interactions impact the deeper tiers (middle-tier, business logic tier, and data tiers of a system). Law and Perez (2005), for example found that there were major usability problems with software developed for an Indian firm by a foreign entity. The software did not allow for order processing in a manner consistent with Indian culture resulting to salespersons in India ignoring to use the system when negotiations and transacting a sale with their clients. In this context, the effect of a foreign culture on the software solution went beyond the presentation layer. It impacted the business logic layer and data layer as well (Law and Perez, 2005). As seen in Law and Perez (2005), the structure and composition of a software solution may be biased to suit the culture of the persons developing the software. If this is the case, then representation of key elements and functions within the software, and also representations of data structures, may be diametrically opposed to those considered conventional in the culture where that software will eventually be used, if the culture of the users is bi-polar to the culture of the software developers. Therefore we intend to reexamine the influence of culture on each of the three common tiers of an enterprise wide software solution – data tier, business-logic tier, and presentation tier. We will seek to identify which of these three tiers is most heavily influenced by difference in culture in the context of offshore outsourcing. We also seek to identify if it is indeed true that culture shapes the representations and thus the eventual nature that software elements in each of these three tiers will exhibit. The study will also examine if indeed cultural influences on the nature of each of these three tiers in turn impacts the overall process effort and customer satisfaction of the software development effort.

d) Complexity of the Software Solution Created (Product Complexity)

The complexity of product increases according to the number of functions of product attributes, variability of product attributes, and interdependence of product attributes (Jahng, 1999). As companies try to adapt or modify their products to a different culture, the complexity of their products is expected to increase. Communication difficulties and differences in understanding of the same set of requirements across the cultures involved in the offshore outsourced software development initiative may result in an inefficient structure and composition of the software solution being developed. It is likely that simple functions will end up being coded with many lines because the language of the developer’s culture may be less efficient than that of the host/client culture, or initial instructions were misinterpreted leading to re-work of the code.
Consequently, bi-polarity in cultures may result in use of more resources to develop the solution and lower customer satisfaction with the solution eventually developed. In the proposed study, we will empirically examine if indeed differences in culture increase the complexity of the solution and the resources need to develop the solution.

e) Complexity of the Development Process (Process Complexity)

The project management may become difficult due to cultural effects on the project. Shore and Cross (2004) explain the relationship between Hofstede’s model of culture and project management (Shore and Cross, 2004). Leadership style based on different culture can also increase complexity of project management (Ma’kiliouko, 2003). Kim and Peterson (2003) argue that developers’ perception on information systems success factors is different across Japan and United States (Peterson and Kim, 2003). Their research identifies the characteristics of project leaders and communication as important factors to Japan and United States respectively. They explain these differences in conception through cultural difference and argue that software development project will be hard to manage without addressing cultural differences and conflicts. The reason is that cultural difference increase the complexity of project and its management. However, they do not ask whether and how the complexity increased by cultural differences might affect process effort or product quality which can affect customer satisfaction in turn. This research fills the gap mentioned above.

f) Service Level Agreement (SLA)

A Service level agreement (SLA) is a formal written agreement developed between the service recipient and the service provider that specifies a product or service to be provided at a certain level in order to satisfy business goals (Sturm et al., 2000). Characteristics of relational elements in SLAs may affect relational attributes; and, in turn, relational attributes may affect relational behaviors such as conflict resolution (Goo et al., 2004). Our research will examine how cultural difference affects the efficacy of the SLA and how this SLA influences both the process efforts and customer satisfaction.

g) Process Effort

Process effort can be represented by cost and time expended during software development (Zmud, 1980). Cost includes not only money but also other resources such as people and offices. In addition to material resources, non-material resources like mental effort can be included as cost. We assess the effects of culture directly on process effort.

h) Customer Satisfaction

One of primary concern of researchers and practitioners is improving customer satisfaction with IT products and services regardless of outsourcing. Customers’ perception on information services can be very diverse in a multi-national setting (Ives et al., 1993). Kettinger and Lee identify that dimensions of service quality are different across countries. They argue that even service quality measurement should be localized to measure customer satisfaction correctly (Kettinger and Lee, 1994).

FUTURE RESEARCH

As a next step of this research, we will empirically test the framework. The survey methodology will be employed to collect requisite data from a number of countries involved as suppliers and customers/clients of outsourcing arrangements. Specifically the web survey method will be used and two questionnaire instruments administered to respondents in various countries. Our intention is to select countries that classify diametrically differently according to the Hofstede’s (1991) and Hall’s (1966) cultural classification schemes. At the moment countries being considered include the US, Ireland, United Arab Emirates, South Korea, Kenya, Nigeria, Cameroon, and India.

Following Straub’s recommendation, a brief situation of IT offshore outsourcing will be provided to subjects. Using a scenario helps subjects involve the situation (Straub et al., 2002). This way enables subjects having little or no experience in offshore outsourcing to involve the offshore outsourcing situation and to generate response more easily. In essence we shall develop two scenarios – one scenario will make a respondent assume the role of developer, while the other scenario will make respondents assume the role customers consuming software developed in another culture. These two different scenarios will be randomly assigned to respondents who log onto the server to complete the web survey. Regardless of the scenario received, each respondent will complete the very same set of questions on the questionnaire. Therefore, Using this method, we will be able to capture, analyze, and compare the credible responses from both the perspective of consumers and developers. The survey instrument will contain three types of questions (a) likert-scaled questions designed to capture the respondents answers for each of the key constructs in the study, and (b) open-ended questions designed to allow respondents to provide comprehensive responses for these key constructs, and (c) questions to obtain personal, firm specific and country/culture specific demographic information about each respondent.

The instrument, comprised of the scenarios and the survey questionnaire, will be validated through pretest and pilot test (Straub, 1989). The main language in which the instrument will be developed is English. We will translate the instrument into
the respective languages. To ensure that the instrument meets the requisite standards for face validity, content validity, and "semantics validity," we will solicit feedback from individuals who hail from the cultures of the countries selected. Semantic validity is to ensure that the items on the translated instrument convey the same meaning as the same items do on the English instrument.

Following data collection, the data will be analyzed using statistical methods that support factor analysis and causal analysis. Factor analysis methods will verify that the items on the instrument do indeed capture the intended phenomenon. Causal analysis methods will be used to evaluate the propositions. Therefore we project to use Factor analysis as supported in SPSS software, and the partial least squares method as supported in PLS Graph software (Chin, 1998). We also intend to use open ended questions to allow respondents to provide us with deeper reflections about core items in the data-collection instrument. These responses will be analyzed using qualitative research techniques to see if indeed the qualitative results corroborate the quantitative analysis results obtained from the non open-ended web survey questions.

CONCLUSION

As more companies rush into offshore outsourcing to develop IT systems, many of them do not have clear understanding of cultural effects on software development. This research focuses on capturing and explaining how culture affects software development through various constructs. Understanding the relationship among culture, these constructs, and effects on software development will enhance understanding how culture affects software development. Otherwise, cross-cultural software development often involves cost escalation and conflict (Eastman, 1991). This research will help practitioners focus on what, how, and when they should rely on offshore outsourcing in software development. This research cannot cover all aspects of cultural effect on software development, however, it will pave the way to better capture and understand how culture affect IT system development.

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