Project Performance in Global Software Development Teams: Do Prior Work Ties and Nationality Diversity Matter?

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Abstract

One of the challenges that global software development teams face is the development of rich and meaningful interactions among members from different countries. Researchers and practitioners in the field are constantly looking for factors that may help organizations understand and mitigate the negative effects that nationality diversity may have on performance in global teams. This paper follows this line of research and proposes prior work ties as a moderator of the relationship between nationality diversity and team performance in global software development teams. In a field study involving 93 global software development teams with members distributed across 5 different countries (e.g., Colombia, Mexico, Brazil, France, and Denmark), nationality diversity was found to have a negative effect on team performance when team members had low prior experience working together. However, nationality diversity did not have a negative effect on performance on teams composed by members with high levels of prior work ties. Moreover, prior work ties exceeded the individual explanatory power of nationality diversity, team dispersion and current experience working together (current project duration) on team performance. This finding suggests that managers should consider how familiar team members are with each other when forming global software development teams.

Keywords: Global Teams, Diversity, Prior Work Ties.
1 Introduction

Global software development (GSD) is a multi-site, multi-cultural arrangement whereby individuals from different countries engage in a collaborative endeavor to develop IT applications. In order to be successful, members of GSD teams have to coordinate work across multiple sites spanning national, cultural, language and time-zone barriers (Kankanahalli et al., 2006; Kotlarsky, & Oshri, 2005). A substantial body of research focuses on understanding how the global nature of these teams impacts their processes and outcomes (Barthélemy, 2001; Herbsleb, & Mockus, 2003). Our paper is an effort to contribute to this stream of literature by examining how national diversity and prior work ties are associated with the performance of GSD teams.

Prior research has extensively documented the challenges arising from having members from diverse nationalities working together in teams. Individuals from different countries may have different approaches towards teamwork, different perceptions of power relations and even deadlines (Hofstede, 2002; Walsham, 2002). Such differences may impede social integration (Blau, 1977; O'Reilly et al., 1989), prevent the development of rich and meaningful interpersonal relationships (Earley, & Mosakowski, 2000; Tajfel, 1982), and create in-group bias among members from different countries (Cramton, & Hinds 2005; Lau, & Murnighan, 2005), leading to low team performance (Carmel, & Agarwal, 2001).

Although nationality diversity is usually characterized to have a negative impact on performance in global software development teams, the relationship between diversity and performance may not by constant over time. The impact that nationality diversity have on team performance may evolve as members from different countries gain experience working together (Harrison et al., 2002). In this paper we argue that prior work ties among GSD team members can mitigate the negative impacts that nationality diversity may bring to performance in GSD teams. Prior work ties among GSD team members could increase their mutual understanding, and improve their interpersonal and work relationships. For instance, extensive research from the organizational behavior literature on diversity and group dynamics suggest that as team members engage in meaningful interactions with each other, they gain a better understanding of the culture, attributes, and personality of their peers, which leads to higher levels of behavioral integration (Hambrick et al., 1998; O'Reilly et al., 1989; Watson et al., 1998), and coordination among members, reducing the negative effect that diversity may have on team performance (Earley, & Mosakowski, 2000; Harrison et al., 2002). Although these findings may bring some insight about the effect that prior work ties may have on the relationship between nationality diversity and performance in GSD teams, those studies examined collocated teams, and did not specifically examine nationality diversity. Thus, their results may not apply in an environment where interaction among team members is limited, and differences among them go beyond their age, gender, or tenure. Thus, in this paper, our goal is to extend those prior findings from the organizational behavior literature to the context of global software development teams, and empirically examine how prior work ties among GSD members affect the nationality diversity – performance relationship.

The basic research questions addressed in this paper are as follows:

- Does national diversity inhibit team performance in GSD teams?
- Does prior work ties among team members help improve team performance in GSD teams?
- Does prior work ties mitigate the negative association between national diversity and GSD team performance?

We use a dataset of 93 global teams from a multinational software service provider company to examine the aforementioned questions. Our research intends to contribute and extent the literature in the following ways. First, we intend to shed some light on the association between nationality diversity and performance in GSD teams as prior research has provided mixed results (Mortensen, & Hinds, 2001). It is our objective to address this gap in the literature and contribute to the calls that have been made in this regard (Horwitz, & Horwitz, 2007; Jackson et al., 2003). Second, we seek to
highlight the importance of prior work ties among members in GSD teams. Most organizations tend to form transient GSD teams paying little attention to the potential impact of such adhoc teams on project performance. Third, although GSD teams have become commonplace in many organizations, these teams still have to face several challenges, often leading to conflicts and project failures. We hope our study will provide a better understanding of GSD team dynamics, especially highlighting the roles of national diversity and prior work ties among GSD team members may have on team performance.

1.1 Motivation

In the last 10 years, the software development industry has shifted from an in-site, onshore approach, to an outsourced, offshore approach. Organizations across the globe have increasingly assembled dispersed teams for software development, and this trend continues unabated. It has been estimated that the value of the offshore software development market has increased 25-fold over the past 10 years, and it is expected that over one-quarter of IT spending on application development, integration and management services in USA and Europe will go off-shore in the short future (Arora, & Gambardella, 2004; NASSCOM, 2001).

Despite the growth of global software development teams, questions have been raised about their comparative benefits with respect to collocated teams. Collocated teams tend to outperform global software development teams because of the relative ease in coordination and collaboration (Herbsleb, & Mockus, 2003), which are critical task in any software endeavor (Faraj, & Sproull, 2000; Levesque et al., 2001). However, when GSD overcome their coordination and communication problems, they can reduce costs, decrease project duration, and improve software quality (Barthélemy, 2001).

We believe it is important for practitioners and researchers to understand the mechanism and social structures that can help members of global software development teams improve coordination and overcome their cultural barriers (Herbsleb, & Mockus, 2003). This study adds to this endeavor and proposes that having global software development teams composed by employees that have previously worked together significantly increases the chances of success of those teams.

2 Theoretical Background and Hypotheses

2.1 Social Identity Theory and Social Categorization

Social identity theory proposes that in diverse groups, individuals classify themselves and others based on different attributes such as age, gender, values, or political views. Those who are perceived to have similar attributes or values are classified as in-group members, and those who are perceived as different are classified as out-group members (Tajfel, 1982; Williams, & O’Reilly, 1998). This classification process is called social categorization process (Pelled et al., 1999).

Considering that people tend to identify themselves with those whom they perceive as similar, rather than with those whom the perceive to be different, individuals in diverse teams usually trust, accept, understand and sympathize more with in-group members than with out-group members (Tajfel, 1982). This in-group bias within diverse teams may lead to interpersonal conflict (Mannix et al., 2002; Pelled, 1996), and low social integration among team members (Von Glinow et al., 2004; Rico et al., 2008), which leads to low team performance (Williams, & O’Reilly, 1998; Bezrukova et al., 2009).

2.2 Social Categorization Process and Nationality Diversity in Global Teams

Although theory suggests that any dimension of diversity (e.g., age, tenure, values, gender) may be used for social categorization purposes (van Knippenberg et al., 2004), the changes of social categorization based on nationality rather than any other attribute are high in GSD teams. Nationality
clearly divides global teams into subgroup composed by individuals that not only have a strong sense of identity, and share a common set social rules and cultural background, but that also perceive themselves as different from other subgroups (Cramton, & Hinds 2005; Earley, & Mosakowski, 2000). The effects of social categorization based on nationality manifest itself in different ways in GSD teams. For example, members of global teams usually refer to local members as “us”, and to foreign members as “them” (Kankanhalli et al., 2006; Von Glinion et al., 2009). Likewise, members of global teams are less open to implement suggestions or ideas that come from members from other countries (Earley, & Mosakowski, 2000). Finally, there is also evidence that team members tend to have a more lenient attitude towards their fellow countrymen (Lau, & Murnigian, 2005), and experience more conflict with and less trust in members from other countries (Polzer et al., 2006).

In-group bias among members from different countries can lead to frustration and misunderstandings during the execution of software development activities (Herbsleb, & Mockus, 2003). If in GSD teams members from different countries cannot properly communicate and interact with each other due to their differences, they may have problems creating and developing rich and meaningful interpersonal interactions (Blau, 1977; O'Reilly et al., 1989). And key activities such as knowledge integration and expertise location will be hard to achieve (Faraj, & Sproull 2000; Rico et al., 2008), and team performance will suffer.

Hypothesis 1: In global software development teams, nationality diversity is negatively associated with team performance.

2.3 Prior Work Ties and Team Performance

Prior work ties describe the extent of discrete, formal and professional interaction among team members before to the formation of their current team (Parise, & Rollag, 2010). As members interact with each other during different projects, they gain a better understanding of the knowledge, skills, and abilities of their peers, and create mental models to represent that information (Larson et al., 1996, Lewis, 2003). The creation of mental models about other team members’ knowledge, skills, and abilities improve the flow of information within the team (Gnyawali, & Madhavan, 2001) and makes coordination possible and effective (Faraj, & Sproull 2000; Rico et al., 2008). When team members have prior experience work together, the transaction cost associated with information sharing and coordination is also low (Boh et al., 2007; Harrison et al., 2002; Reagans et al., 2005). Team members already know ‘who knows what’ within the team, and they expend less time and effort trying to understand how and where knowledge is distributed across the team (Faraj, & Sproull, 2000; Lewis, 2003).

Considering that the benefits of prior work ties are based on the idea that individual gain a better understanding of their peers as they interact with each other, one could argue that those benefits will be hard to obtain in GSD teams, when team member interactions are limited and team members have a low understanding others ideas, situations and context (Cramton, 2001). However, there is evidence that members can improve their understanding of others even when they are not physically close to each other (Kanawattanachai, & Yoo, 2007; Oshri et al., 2008). In addition, researchers have found that the effects of prior work ties are stronger on software development teams’ performance when team members are geographically dispersed rather than when they are collocated (Espinosa et al., 2007).

Hypothesis 2: In global software development teams, prior work ties are positively associated with team performance.
2.4 Prior Work Ties and Nationality Diversity

Nationality diversity creates barriers for team coordination, and reduces social integration among members in global teams (Lau, & Murnighan, 2005). Literature from organizational behavior on group dynamics suggests that one way for members to overcome the challenges created by nationality diversity is through continuous personal interaction. It was shown that as members continuously interact with each other, they gain a better understanding of others’ cultures, attributes, and personality, leading to higher levels of personal interaction within the team increase (Hambrick et al., 1998; O’Reilly et al., 1989; Watson et al., 1998). We propose that discrete interactions, in this case, prior work ties, may also mitigate the negative impact of nationality diversity on team performance. Prior work ties can reduce uncertainty (Kotlarsky, & Oshri, 2005; Harrison et al., 2002), and increase the levels of trust among distant members (Jarvenpaa et al., 2004; Jarvenpaa, & Leidner, 1999). As people work together, though different projects, they abstain from antisocial and opportunistic behavior, and increase their mutual trust (Coleman, 1988). Thus, as experience working together increases, understanding, trust, and empathy among team members from different nations may increase, strengthening the bonds of their interpersonal relationships, reducing the negative effect that nationality diversity would have on team performance.

Hypothesis 3: In global software development teams, prior work ties moderate the relationship between nationality diversity and team performance such that the relationship is weaker for teams with high levels of prior work ties.

A diagram that depicts our research model is presented in Figure 1.

![Research model including control variables](image)

Figure 1. Research model including control variables.

3 Method

3.1 Sample and Settings

This study is based on secondary data provided by a global information service provider company. The company employs over 250 people and has offices in Europe, Africa, the Middle East, Central and South America. The data included information of 118 GSD teams that worked between 2006 and 2008 on projects related to Central and South America customers. We excluded 25 teams from our initial dataset due to missing or inconsistent data leaving a final data set of 93 teams. Members of those teams were located across 5 different countries: Mexico, Colombia, Brazil, France, and Denmark.
3.2 Measures

3.2.1 Team Performance

We obtained measurements of team performance using archival data from an internal survey filled by team leads. Team leads appraised team’s performance using a five-point Likert scales rating various attributes such as the team efficiency, quality of work delivered, and capacity of the team to deliver work according to schedule. The Cronbach’s alpha of the scale was .82.

3.2.2 Nationality diversity

Nationality diversity was measured using Teachman’s (entropy) index, which is the recommended index to use when one is interested on measuring diversity that reflects variety (Harrison & Klein, 2007). The index is calculated as follows: $H = -\sum(P_i \times \ln(P_i))$, where $P$ represents the fractional of team members from the $i^{th}$ nationality. Note that $0 < H < -1\times \ln(1/i)$. Values near zero correspond to homogeneous groups related to nationality diversity and values near one correspond to highly diverse teams.

3.2.3 Prior Work Ties

Prior work ties can be represented as a social network that describes the working relationships among all team members before to the formation of the current team (Parise, & Rollag, 2010). We used archival data from the host company to identify the projects in which members have worked together for the last two years before to the formation of their current team. Following prior literature on network analysis in teams we computed the density of the prior work ties network for each project as: $(\sum\Sigma (d_{ij})/D_{ij})$, where $d_{ij}$ is the number of days that members $i$ and $j$ had worked with each other during the two year period before the project started and $D_{ij}$ is the summation of days if all team members have continuously worked together with each other during the two years period before the project started (Sparrowe et al., 2001; Parise, & Rollag, 2010). Potential values range from zero if there is no prior work tie among any team member, to one if all members in the team have continuously worked together for the two years period before their current project started.

3.2.4 Control Variables

We controlled for project duration, team size, and team dispersion because they can impact performance of GSD teams. Longer software development projects can be exposed to higher risks such as changes in the requirements, the environment, and user’s attitudes, which could ultimately impacts team ability to deliver on time, within budget, and with the expected quality (Huang, & Han, 2008). In relation with team size, a large team size usually reflects better distribution of skills, and better distribution of skills tends to improve software quality (Banker, & Slaughter, 1997). Finally, we also controlled for team dispersion because it is possible that some of the negative effects of nationality diversity on team performance may be actually caused by the levels of team dispersion resulted from having members located in different countries. Team dispersion among team members was measured using the index defined by O’Leary & Cummings (2007). This index includes physical distance, number of locations, temporal dispersion, members’ isolation, and imbalanced distributions of team members across locations. For reference about how the index was calculated refer to O’Leary & Cummings (2007).
4 Analysis and Results

Table 1 indicates that teams were highly diverse in terms of member’s nationality (M = .93). In relation with prior work ties, the sample included teams with no prior work ties among its members (Min = 0.00) and teams composed by members with a long history working together (Max = .99). The positive correlations between nationality diversity and prior work ties suggest that members of highly diverse teams tend to have longer experience working together than members of low diverse teams (r = .30, p < .01). Finally, the positive correlation between team performance and prior work ties is aligned with our hypothesis that as prior work ties and team performance are positively related.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Min</th>
<th>Max</th>
<th>M</th>
<th>SD</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>3.95</td>
<td>3.35</td>
<td>.35</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Nationality Diversity</td>
<td>.45</td>
<td>1.10</td>
<td>.93</td>
<td>.22</td>
<td>-.31*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior work Ties</td>
<td>.00</td>
<td>.99</td>
<td>.48</td>
<td>.30</td>
<td>.28*</td>
<td>.30*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Duration (days)</td>
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<td>85.0</td>
<td>49.0</td>
<td>14.1</td>
<td>-.26</td>
<td>.03</td>
<td>23*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team Size</td>
<td>3.00</td>
<td>9.00</td>
<td>5.21</td>
<td>1.41</td>
<td>.06</td>
<td>.26*</td>
<td>-.11</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>Team Dispersion</td>
<td>0</td>
<td>3.11</td>
<td>.53</td>
<td>.54</td>
<td>-.05</td>
<td>-.17</td>
<td>.05</td>
<td>-.12</td>
<td>-.68**</td>
</tr>
</tbody>
</table>

N = 93

***. p < 0.001, **. p < 0.01, *. p < 0.05

Table 1. Descriptive statistics and correlations among variables in the study

A hierarchical multiple regression analysis was used to test our hypotheses (Cohen et al., 2003). In the first model we regressed the dependent variable (e.g. team performance) on control variables (team size, project duration, and team dispersion). In the second model we added the scores of nationality diversity. The third model included the scores of previous working ties. Finally, the fourth model included the interaction term between nationality diversity and previous working ties. Predictors were standardized to have a sample mean of 0 and a sample standard deviation of 1.0. The interaction term was computed using standardized components. The criterion was not standardized, and all analyses examined unstandardized regression coefficients after centering the predictor variables (Aiken, & West, 1991).

The results of the hierarchical multiple regression analysis are presented in table 2. Diversity among team members’ nationalities was found to be significant, and negatively associated with team performance in all three models. Moreover, it explained a significant proportion of variance in team performance even after controlling for team size, project duration, and team dispersion, see model 2. This lends support for our Hypothesis 1 that questioned the association between national diversity and GSD team performance. Results also indicate a significant and positive association between prior work ties and GSD team performance, see model 3 and 4. Prior work ties also accounted for additional variance in team performance after controlling for nationality diversity and all control variables, see step 3. These findings support Hypothesis 2. Finally, the interaction between nationality diversity and team members’ prior work ties was also significant, and explained an additional variance on team performance after controlling for all other predictors, see model 4. Figure 1 provides a graphical depiction of the simple slope analysis as suggested by Holmbeck (2002). Results indicate that the relationship between nationality diversity and team performance was significant and negative at low level of prior work experience. However the relationship between nationality diversity and team performance was not significant at high level of prior work experience. These results support Hypothesis 3.
Table 2. Hierarchical Multiple Regression Analysis predicting Team Performance From Nationality Diversity and Prior Work Ties.

![Figure 2](image_url)

Figure 2. Prior work ties as a moderator of the relationship between nationality diversity and performance in Global Software Distributed Teams

5 Discussion

Our findings suggest that prior work ties not only have a direct impact on performance of global software development teams, but they also have an indirect effect by mitigating the negative impacts of nationality diversity. The results of his study suggest that GSD teams composed by members that have continuously worked together in the past tend to perform better than those teams composed by members that are not very familiar with each other. Moreover, the strength of the negative relationship between nationality diversity and team performance was weak on teams composed by members with high levels of prior work ties. These findings suggest that in GSD teams in which members are not familiar with each other, their differences due to nationality diversity have a negative impact on team performance. However, as they work together in different projects, they gain better understanding of each other until the point that their differences due to nationality diversity are no longer a source of problems that can jeopardize team performance.
An interesting finding was that at low levels of nationality diversity there was no difference in performance among teams composed by members with low or high prior work ties. Figure 1 indicates that the difference in performance between GSD teams composed by members with high and low prior work ties was significant only among teams with high levels of nationality diversity. The results suggest that prior work ties have a stronger effect on GSD teams’ performance when teams are highly diverse rather than in more homogenous teams. A possible explanation could be that because in homogeneous teams, members are less different from each other, they do not require to gain a deep understanding of their peers in order to coordinate their activities. On the other hand, in highly diverse teams, the differences among members are bigger. Thus, the better their understanding of their peers the easier will be for them to coordinate their activates, which capitalize on the value of prior work ties.

5.1 Theoretical and Practical Contributions

We believe that our paper makes contributions that are important for both academics and practitioners. First, most of the studies that examine nationality diversity in global software development teams have taken a static approach, and had not examined how the effect of diversity on team performance changes as members interact with each other. Our paper address this gap in the literature by suggesting that past interaction among team members can influence how nationality diversity impacts their current projects performance. Likewise, we hope that our findings help clarify why the literature is full of mixed findings related to the diversity – outcome relationship. We believe that past researchers had neglected to consider the effects that contextual factors may have on how diversity affects team process and outcomes; especially factor that can influence team members’ coordination and social interaction, such as prior work ties. Secondly, some studies in the organizational behavior literature had already examined how the effects of diversity on team performance change as members interact with each other had (Harrison et al., 1998; Harrison et al., 2002; Schippers et al., 2003). Although those studies had similar results as the ones we presented here, they took place in a collocated environment. Our findings expand this line of research to a distributed global environment, and suggest that the benefits of prior work on the diversity – outcome relationship can also take place in an environment characterized by limited social context and low face-to-face interaction among team members (Cramton, 2001).

In relation with practical implications, the results of this study provide guidance to IT project managers about personnel selection for GSD teams. In addition to the technical skills and work experience of their employees, managers should consider the degree of familiarity among possible team members when it comes to selection of team personnel. The best and the brightest employees may gather together to be part of a GSD team, but if they have never worked together in the past, it is possible that they would spend considerable part of their time trying to overcome their cultural and social differences instead of exchanging knowledge, collaborating or executing task related activities. In this case, expert employees will not be able to bring value to the team regardless of their technical skills experience, or of how much IT support the organization can provide to them.

Based on our findings on the importance of prior work ties, IT project managers should encourage the formation of GSD team composed by members that have worked together in the past. By doing so IT projects managers improve the chances to success of GSD team and take advantage of the time, effort, and resources that those employees have spent trying to overcome their cultural and social differences during prior projects.

5.2 Limitations and Directions for Future Research

We acknowledge the following theoretical and methodological limitations of our study, and provide recommendations for future research. First, we propose than prior work ties improve performance regardless of the nature of those ties. However, it is possible that the impact of prior work ties on
performance may depend on the quality of the ties. A team composed by employees that had good relationship working in the past would perform better than a team composed by members with unproductive or conflictive prior work ties. Future research should measure the quality of the relationships between team members as a mean to understand better how each relationship could affect the team as a whole. Second, we only explored the negative effect that nationality diversity may have on team performance. However, nationality diversity could also benefit GSD teams. Heterogeneous teams have access to a wider range of cognitive resources such as skills, knowledge and abilities than homogeneous teams. The combination of this cognitive information can enhance team’s creativity as well as its capabilities to solve problems (van Knippenberg, De Dreu, & Homan, 2004). We encourage future research to examine under which conditions nationality diversity could have a positive or negative impact on team dynamics.

In relation with our methods, some of our measures could be improved in future research. Our measure of team performance is based on team leader’s perceptions, and leaders could be bias towards their own teams. However, the descriptive statistics of our example suggest that leaders did not give high scores to their teams. The average score for team performance was 3.35 and the highest score core was 3.95, on a 5 points scale. However, we cannot rule out the possibility that project leaders were actually bias towards their teams based only on these statistics. Future studies could try to use an objective measure of team performance as a mean to overcome this limitation. Other option could be to collect information about team performance from different sources such as team members or customers. However, we believe that team leads are in a better position to rate team performance than any other possible informant, such as team members or customers. Team members may not be fully aware of the budget constrains and problems of the team as a whole. Likewise, customers could only rate team’s ability to comply with the customer budget, schedule and requirements, and are not aware of the internal demands and constrains that the team must face. Finally, we followed the recommendations of Podsakoff et al. (2003) and Sharma et al. (2009) and tested for Harman’s one-factor (or single-factor) as a mean to determine whether our dataset could suffer of Common Method Variance. We loaded the variables into an exploratory factor analysis and examined the unrotated factor solution. A study could suffer of common method bias if a single factor emerges from the factor analysis or one general factor accounts for the majority of the covariance among the variables. Three factors with eigenvalues higher than 1.0 emerged from the analysis and explained 30%, 28.5% and 19% of the variance, respectively. These results suggest that common method bias may not be a present in our dataset. Likewise, our data set represents correlations of a self-report perceptually anchored measure (all our dependent variable) with a system-captured measure (our independent variables), which is the method–method pair that is least susceptible to CMV (Sharma et al., 2009, pg 478).

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the negative effect of cultural differences among members on team processes reduces.


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