Virtual Team Performance in Crowdsourcing Contests: 
A Social Network Perspective
(Extended Abstract)

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Abstract

Social media technologies have made it feasible for organizations to tap “wisdom of the crowd” beyond their own workforce. Many organizations use online crowdsourcing contests to find solutions for their business problems. In these contests, self-organized virtual teams compete for monetary reward. Motivated by this phenomenon, this research investigates how the social network structure of a virtual team impacts its performance in the context of online crowdsourcing contests. Specifically, we empirically assess the impacts of member social-capital, intellectual-capital, and the alignment of these two measures on team performances. Our analysis suggests that the alignment of member social-capital and intellectual-capital has a negative impact on team performances. Our findings have strategic implications to participants of virtual crowdsourcing competitions and to the design of virtual work teams.

1. Introduction

Social media technologies have made it feasible for organizations to pool expertise around the globe, i.e., “wisdom of crowds”, to seek solutions [15]. Companies increasingly use digital platforms such as, Kaggle (predictive modeling), IdeaStorm (idea generations), InnoCentive (R&D), and TopCoder (software development projects) for crowdsourcing. Academic studies have shown that crowdsourcing can be used as an effective tool for seeking solutions to a company’s problems due to advantages including lower cost [12], lower risk [6], higher quality solutions [9], and multiple alternative solutions [24]. Given the importance of crowdsourcing, the extant literature has focused extensively on the design of crowdsourcing contests [16, 6, 24], or on the effects of individual behaviors on contest outcomes [1, 4, 12, 18] with the goal of maximizing payoff.

Crowdsourcing technologies bring changes not only to how project workforce is sourced, but more importantly to the ways that workforce is organized, coordinated, and collaborated. Through digital media, this new web-based business model allows individuals who are often located in different geographic areas and unaffiliated with the organization to self-organize into “virtual teams”, and coordinate team members with different skill sets to work collectively towards the goal of winning the contest. For example, virtual team members share ideas, brainstorm and negotiate alternative solutions, and make decisions. With the increasing popularity of virtual team practices in crowdsourcing, there is an increasing interest in understanding how the advantages created by team member’s location in teams’ social connection structures or social-capital [7], with varying skills of team members (such as task-related skill, knowledge gaining from experience, learning, and education) [14] or intellectual-capital affect the performance in an open contest environment.

To the best of our knowledge, there is a lack of studies on crowdsourcing contests that look at the aspect of team network structure. In this study, we examine the impacts of the member roles and their social network structure on team performances in crowdsourcing contests. Specifically, using data of 732 teams participating in 52 contests from one of the largest data analytic crowdsourcing platforms, Kaggle.com, and adopting the concept of centrality-skill alignment [13], we empirically explore how the distribution of intellectual-capital and social-capital within a team affects team performance in crowdsourcing.

2. Literature review

Scholars applied social network theory to investigate team behavior in different contexts. Chen and Lim [8] showed that socializing among team members’ yield higher effort in team-based contest
than an individual-based contest. Singh and Tan [21] investigated the network formation in OSS teams to characterize the stable and efficient structures. Magni et al. [17] studied how the team network structure influences individuals’ technology use behaviors. Balkundi and Harrison [5] showed that teams with densely configured interpersonal ties have higher task performance, and teams with leaders who are central in the teams' intragroup networks and teams that are central in their intergroup network tend to perform better. Kane and Borgatti [13] showed empirical evidence that a group will perform better when their more proficient members are highly centralized in the communication and work flow network. Hahn et al. [11] applied the social network perspective to study how past collaborative ties among developers impact their choice of new projects in OSS.

This paper extended Kane and Borgatti [13]'s research on alignment between skill and network positions to a competitive virtual team setting that demands both innovative work and extensive communication. In a different research setting, we provided contrasting results compared with some of the literature.

3. Research model

Team members bring two types of capitals to their teams: Social-capital and intellectual-capital. Intellectual-capital is basically their task-related skill and knowledge gaining from experience, learning, education and so forth [14]. Social capital refers to “advantage created by a person’s location in a structure of relationships” [7]. Following literature we operationalized these relations as ties that team members have to others [22].

Literature on team performance has identified team’s intellectual-capital or skills as an essential ingredient for team effectiveness and performance. Specifically, in the software development teams, members with high intellectual-capital plays critical roles in success of IS projects [10]. Studies conducted in the context of open contest have shown that solver intellectual-capital is a very significant factor that determines their performance [24, 1] and probability of winning of crowdsourcing competitions [6, 18].

Besides intellectual-capital mentioned above, practical research [23, 2] also emphasized team members’ social competencies, that is, the abilities to work in teams effectively. In particular, researchers have addressed the impact of the structural position of members within a network or social-capital on team performance. Sarker et al. [20]'s study indicate that a member’s centrality in trust and communication networks enhances member performance. Baldwin et al. [3] and Reagans and Zuckerman [19] have shown that more ties increase team performances.

In our context, members with high intellectual-capital provide the necessary knowledge to solve problem posted by the seeker in a crowdsourcing contest. At the same time, members with high social-capital provide the necessary coordination within the team to allocate work and facilitate communications among team members. Thus, we hypothesize that team’s intellectual-capital and social-capital positively influences the team performances.

Besides considering the effect of team’s social capital and team’s intellectual capital on team performance, another important factor on team performance is the alignment between the two types of capitals within a team [13]. While both social-capital and intellectual-capital are important to team performance, a member often has a limited capability to do both well in competitive environments. This is because group communication and coordination can take a significant amount of time and distract members with high intellectual-capital from focusing on solving the problem. For the same reason, members with high social-capital can play a better role as facilitators in the team coordination and communication network. Hence, we argue that allowing division of labor by letting members with high intellectual-capital to focus on solving main task and members with high social-capital to handle coordination and communication activities influences team performance. Thus, we hypothesize that negative alignment between social-capital and intellectual-capital positively influences the team performances.

4. Data

We collected data from a specialized crowdsourcing platform that focuses on data analytics projects Kaggle.com. Companies, government, and researchers provide datasets to Kaggle along with their problems and reward amount they are willing to pay to the winners. Based on these inputs, Kaggle sets up contests. Each participant or participating team can submit multiple solutions before the contest deadline. Kaggle evaluates all submissions in real time using a test dataset and provides instant feedback to the participants, which includes information on the prediction accuracy of their model and their relative positions (e.g. ranks) in the contest.

For this study, we collected data on all public contests since the launch of the platform until July 2012. After eliminating contests without monetary rewards, teams with a single member, and outliers, our
final sample consists of 732 teams that participated in 52 contests.

4.1. Variables

We used team rank as the measure for our primary dependent variable team performance. Team rank is the relative position of a team in a given contest.

Our primary independent variables are intellectual-capital (IC), social-capital (SC), and social-intellectual (SI) alignment. These team level measures are based on individual-level intellectual-capital and social-capital. We used individual skill score reflect in their profile as a proxy for individual-level intellectual-capital. We calculated the team’s intellectual-capital by taking the average of profile scores of all the members. We operationalized social capital as ties that team members have to others. Following Hanh et al. (2008) these ties are based on prior collaborations. We used two types of centrality measures based on ties in our calculation of SI-alignment: degree centrality and eigenvector centrality. In this study, we defined an individual’s degree centrality as the number of prior ties each individual has with other team members for a given contest. If two members have collaborated in a virtual team in a previous contest, then they have a tie. We calculate the team’s social-capital by taking the average of degree centralities of all the members in a team. Following Kane and Borgatti [13], we define the SI-alignment of a given team as the correlation coefficient between members’ intellectual-capital (skill) and their social-capital (degree or eigenvector centrality) in the team social network.

Based on the literature on crowdsourcing, we control for team size, number of submissions made by each team. To control for observed and unobserved contest specific effects (e.g., contest rewards and duration), we included contest specific fixed effects in the model. We also control for standard deviation of team’s social capital and standard deviation of team’s intellectual capital.

5. Results

Our results suggest that both intellectual-capital and social-capital helps team performance. Furthermore, the alignment between intellectual-capital and social-capital, even after controlling for the average levels of intellectual-capital and social-capital in the team, has a negative effect on team performance. The result suggests that teams will perform better if their members with high intellectual-capital are not highly centralized in the network structure. This negative impact of social-intellectual alignment on performance could be mainly due to the high competition on these open contest environments. That means when the competition intensity is high, it is important to members with high intellectual-capital to focus on the main task.

To validate the robustness of our results and address some econometrics issues, we conducted several tests. First, to address endogeneity issues of our main explanatory variables intellectual-capital and social-capital, we conducted Hausman test. Second, to control for the impact of different types of tasks on our results, we used contest specific fixed effects. We also found that time effects do not have any significant impact on our main results. Third, our team plots over time have shown that team compositions are not sticky overtime.

6. Discussion

This study examines the impact of the alignment of team member social-capital and intellectual-capital on virtual team performances in the context of crowdsourcing contests. Specifically, we empirically investigate whether the centrality of team members with high intellectual-capital in team social network has an impact on team performances. We found that intellectual-social alignment significantly and negatively affects team performance in crowdsourcing contests. This is potentially due to highly competitive nature of crowdsourcing contests with hundreds of teams competing for the limited number of awards. The harsh external environment makes the division of the central social positions from high intellectual members critical in our setting.

Our findings have a number of theoretical and managerial implications. First, rich data set allows us to control for contest heterogeneity and uses within-contest performance variations to assess the relationship between team social network structure and team performance.

Second, we complement research on online social network by introducing the concept of intellectual-social alignment to a competitive environment. We presented new findings regarding the impact of intellectual-social capital distribution in a team social network on team performance.

Third, understanding how the alignment of intellectual-capital and social-capital affects team performance promises benefits for managers. They can use these insights when segmenting workforce based on their relative strengths. Furthermore, digital platform providers can use these insights to offer advice to participants, make interface design changes, through policies, manage team-formation and so forth.
12. References


