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Jianping Peng
Sun Yat-Sen Business School, Sun Yat-Sen University, Guangzhou, China 510275;Sun Yat-Sen Xinhua College, Guangzhou, China 510275

Taiye Luo
Sun Yat-Sen Xinhua College, Guangzhou, China 510275

Jing Quan
Franklin P. Perdue School of Business, Salisbury University, Salisbury, MD 21801, USA

Peiwen Guo
Sun Yat-Sen Xinhua College, Guangzhou, China 510275

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Jianping Peng[1,2], Taiye Luo[2], Jing Quan[3], Peiwen Guo[2]*
[1]Sun Yat-Sen Business School, Sun Yat-Sen University, Guangzhou, China 510275
[2]Sun Yat-Sen Xinhua College, Guangzhou, China 510275
[3]Franklin P. Perdue School of Business, Salisbury University, Salisbury, MD 21801, USA

Abstract: This paper investigates the relationships between individual creativity, social network position, and knowledge sharing in a heterogeneous team with personnel from four different companies to complete a software outsourcing project. Our research model is based on a theoretical construction attained from the analysis of previous frameworks proposed in the literature. Based on the survey data of the team members, we construct the advice social network, extract employee network centrality, and obtain employee behavioural variables. We find that a positive and strong relationship between knowledge sharing and creativity. The relationship between network centrality and creativity is also positive, but the relationship is moderated by knowledge sharing. Based on the findings, we propose measures and strategies for the hosting company to effectively coordinate the heterogeneous team.

Keywords: creativity, knowledge sharing, employee social networks, heterogeneous team

1. INTRODUCTION

As the information technology (IT) outsourcing market grows, a new outsourcing approach has emerged for software developers to implement large- and medium-sized software outsourcing projects. Different from the existing model in which a project is divided into parts that are then outsourced, this new approach allows a firm to build a temporary need-based human resource development plan to attract software developers from companies that have a surplus of developers, and embed those developers into the firm's own software project teams. Once the project is finished, the developers return to the companies where they are originally employed. In this model, software developers from the entire IT industry can be considered a pool of potential human resources for software developers. Companies are able to acquire suitable software developers from this pool based on the specific needs of a project. Compared to the traditional method of software outsourcing, this new heterogeneous team model approach can better control costs, progress, and quality of the project.

Because team members on the heterogeneous team are not familiar with each other, questions arise about effective team management. One of the key research questions is how the creativity of individual employees is affected in this context. As new members join an existing team, how would the relational network structure evolve? Would the creativity be enhanced or hindered as a result? What is the role of knowledge sharing among the new and old team members?

The answers to these questions are inconsistent in the research community, reflecting, in a broader sense, the debate between the "pessimistic" and "optimistic" views of how the demographic diversity of a team affects its performance [11]. In the "pessimistic" view, demographic diversity is considered problematic, because it introduces social divisions that hinder effective teamwork, due to tensions between members of different organizational cohorts [10]. Hence, it is easier to coordinate the activities of homogenous groups than diverse teams and, as a result, the performance of such teams is expected to be better ([7], [9], [14]).

In contrast, the "optimistic" view argues that diverse teams improve team productivity and performance, because members from different parts of the organization know different sets of people and often have different technical skills [1]. Researchers (e.g., [2]) who hold this view contend that the relative redundancy of

homogenous team members' perspectives, information, and resources limits the team performance. Teams with greater demographic diversity, however, entail relationships among people with different sets of contacts, skills, information, and experiences, thus enhance creativity for problem solving ([3], [4], [5], [6], [8], [12], [13]).

Our research extends the existing understanding of team diversity and performance from two different perspectives. First, instead of team heterogeneity within an organization, our focal point is on diversity of team members from different organizations. In our study, a research and development (R&D) team in the host software company was formed by temporarily hiring additional workers from three other software companies. Second, instead of focusing on the team productivity, our focal point is the individual team members' creativity. Although research on how team diversity relates to team creativity is extensive, little research has been done to explore the relationship between team diversity and individual creativity. Similarly, research calls for the investigation of the individual-level outcomes of team diversity, because team diversity may not have a similar effect on individual creativity as it does on team-level creativity. Other research suggests that team creativity is a function of individual creativity, as well as other team dynamics including structure, climate and leaders' abilities. Further study proposes an interactionist model in which individual creativity is a result of complex person-situation interaction influenced by events of both past and current situations. Creativity is a function of antecedent conditions, cognitive style and ability, personality factors, relevant knowledge, motivation, social influences, and contextual influences.

To investigate the relationship between team diversity and individual creativity under the aforementioned new perspectives, we construct an empirical model with two main variables, i.e., network centrality and knowledge sharing. The reasons for these variables are as follows. First, the basis for the relationship between social networks of the heterogeneous team and the creativity of individual team members is the interplay of network centrality, risk cognition and creativity. Research has established that nodes in the center of a given network are more capable of acquiring information and knowledge through communication than those in the peripheral positions. The opportunity and ability to acquire knowledge would further give individuals the confidence and judgment to take risks. Studies assert that risk taking is integral to creativity. Risk is associated with the uncertainty about outcomes of decisions, given creative efforts. Creativity is risky because the action-outcome link is highly uncertain and lengthy in time. For example, creativity required for inventing innovative products and/or proposing a novel and effective solution to existing problems often involves a high degree of risk taking. When employees are willing to take risks, it is conducive to creativity.

Second, for the role knowledge sharing, current research suggests two possible linkages: social network to knowledge sharing and knowledge sharing to creativity. The first linkage can be explained from the perspective of the Social Capital Theory. Social capital refers to the relationships in a social network and the associated set of embedded resources. The Social Capital Theory believes that social capital strongly influences the extent to which knowledge sharing between the network nodes occurs. Empirical research has found significant relationships between employee social networks and knowledge sharing. Study finds that social interaction ties are positively associated with individuals' knowledge sharing in virtual communities. For the second linkage, research has shown that collaboration among knowledge workers is an important factor for successful R&D projects. Knowledge sharing and knowledge reconstruction within a team is important for promoting creativity, because team members can more effectively process information and generate creative ideas by sharing information. Researchers find that knowledge sharing facilitates the generation of new ideas, and that higher levels of knowledge sharing are significantly correlated with higher levels of creativity in work projects.

Specifically, this study attempts to answer the following three research questions:

RQ1: How is network centrality related to the individual creativity of a heterogeneous team?

RQ2: How is knowledge sharing related to the individual creativity of a heterogeneous team?

RQ3: Does knowledge sharing moderate the relationship between network centrality and creativity?

2. THEORETICAL BACKGROUND AND RESEARCH MODEL

2.1 Team Diversity and Creativity

Creativity can be defined as the generation of novel and useful ideas concerning products, services, processes, and procedures by an employee. Researchers agree that a prerequisite for creativity is the ability to think differently, to see things from unique perspectives, and to sense the possibility of turning previously unrelated processes, products, or materials into something new and better. Although individual cognition and motivation are the main sources for creative ideas, the interactions within teams foster their generation [8]. Researchers find that team creativity is iterative and interactive in nature and requires an individual's willingness to engage in individual level creativity.

Diversity can be defined as the distribution of differences among the members of a unit with respect to a common attribute such as tenure and ethnicity. The diversity literature suggests the value of team diversity and performance can be seen from the "structural holes" conception of social capital that emerges from social network theory [11]. Structural holes are the gaps between nodes in a social network [2]. The value derived from bridging the gaps lies in the boundary spanning that generates "information benefits", because information tends to be relatively "redundant" within a given group ([2] p. 13-16). Hence, members who span team boundaries to create ties with other teams can gain access to a wider range of ideas and resources than those who are restricted to a single team [4]. This reasoning is also applicable to the value of team diversity. According to research, heterogeneous teams with members from diverse pools of talents can develop ties between people with different skills, knowledge, perspectives, and experiences. Such links bridge structural holes within the team [11], and can be very valuable sources for team creativity. The heterogeneous team structure can also be conducive for individual creativity because it allows team members to draw from individuals with differences in backgrounds, knowledge, skills, thinking styles, perspectives and experiences. Such benefits can be even greater with a heterogeneous team that draws members from different organizations, because those differences are more pronounced.

2.2 Network Position and Creativity

Centrality reflects the number of ties between a member and all other members within a given network. A node with a higher degree of centrality implies the actor has many ties. The high number of ties allows them to have alternative ways to satisfy needs, and to gain access to more of the resources of the network as a whole. Within a social network, individuals in the center are more capable of acquiring information and knowledge through communication, are more likely to be perceived as a having higher status, and are more likely to know what is going on within the network. A central individual, with this access and status, should have more favorable perspectives and outlooks, and enjoy freedom and power. Researchers argue that the advantages should provide the confidence and personal judgement for risk cognition and risk taking. Research has identified positive links between risk taking and creativity, because creativity often implies either doing something new or using an unusual approach for an existing problem. The fact that central individuals are more likely to be exposed to the various disparate social circles within the network allows them to see different perspectives and to think creatively. Because of the connections, they may be more open-minded when considering different approaches or ways of thinking. This line of reasoning leads researchers to propose that centrality is positively related to individual creativity.

In our context, the triad of network position, risk cognition and creativity is even more pronounced.

Because the heterogeneous team was comprised of members from different companies, such a high degree of the diversity requires some sort of persona to maintain the connections between members. The person in the center can draw from many individuals including those with different backgrounds, knowledge, skills, and experiences. Because the person knows what is taking place within the network, and enjoys freedom and power, the individual will have sound judgment for risk cognition and confidence for taking risks. As a result, this person is more open-minded to different approaches or ways of thinking, leading to be more creative.

Hypothesis 1: The network centrality is positively related to individual creativity.

2.3 Knowledge sharing and Creativity

Knowledge sharing is the dissemination of knowledge. Knowledge sharing takes place between owners of knowledge and recipients of knowledge, so that the emphasis is on the exchange and the relationship that exists between the participants. Knowledge sharing behavior is a selective interpersonal process under specific circumstances. Knowledge givers not only choose with whom to share their knowledge, but they decide what knowledge to share.

When team members share new and relevant ideas with each other, it boosts their creativity. Knowledge sharing takes place when a person is eager to engage in knowledge collection and knowledge dissimilation for rising novel ideas. One of the positive outcomes of knowledge sharing is that new knowledge can be generated. Creativity needs new knowledge because knowledge can enhance an individual's learning, problem solving, and decision making [7]. Research finds that the intensifying role of knowledge sharing helps shape employee creativity. Given that creativity is the result of knowledge formation [13], employees with a higher level of knowledge sharing are more likely also creative. Recent studies confirm that employees with a high level of knowledge sharing are associated with tuning their creative potentials into creative outcomes.

Hypothesis 2: Knowledge sharing is positively related to individual creativity.

2.4 Knowledge Sharing as a Moderator

Given the importance of knowledge sharing, a great amount of research has been undertaken to explain the motivational factors for the transfer of knowledge between providers and recipients. One of such efforts relies on the social network theory to help explain why people share knowledge. In particular, the centrality of an employee's network position is one of the most prominent social network structural characteristics used by researchers to demonstrate that possessing a central network position predicts knowledge sharing in positive ways [6]. Central employees with more numerous network ties have more relationships to draw on to accumulate more knowledge. The knowledge accumulation positively affects their knowledge sharing with colleagues. Their accumulated knowledge and large networks as valuable resources help others to perceive them as attractive knowledge sharing partners. Because credibility is attached to their positions, employees are more likely to seek feedback from them. This further increases their engagement in knowledge sharing. Consequently, many opportunities exist for them to engage in a high extent of knowledge sharing with colleagues. In an empirical study, Research [6] shows that a central network position and the amount and diversity of the knowledge acquired by an employee are positively related. In addition, researchers find that centrally positioned organizational units in company's networks engage in more knowledge sharing, and are more innovative than those in the peripherals of the network.

We hypothesize the moderation role of knowledge sharing by reviewing its relationships with the network position and creativity, respectively. Our reasoning is that although the network position is important for creativity, the knowledge of the central individual still needs to be effectively shared with other team members. Research [7] finds employee creativity is strengthened through extensive knowledge sharing. Consistent

with prior research, we argue that a creative individual requires a strong sense of knowledge sharing. Specifically, the correlation between network central position and creativity is high only when an individual's belief that knowledge sharing can produce creative outcomes is high [7]. Hence, we propose our final hypothesis:

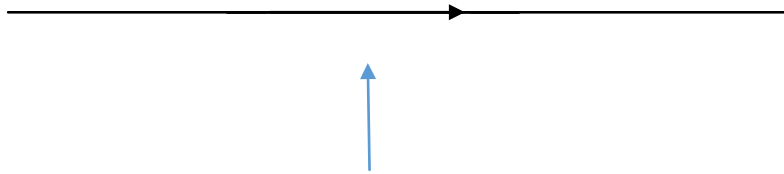**Hypothesis 3:** Knowledge sharing moderates the relationship between centrality and individual creativity.

Figure 1 Research Model

3. RESEARCH DESIGN

For this research, we used a case from a software supplier's R&D project in a telecommunication company in China. In order to meet the project's demand, the parent company temporarily employed R&D workers from three other software companies. The temporary R&D team of the project is made up of 68 employees from four companies: 32 from the parent company, and 20, 8, and 8 from the three other companies, respectively.

3.1 Instrument development

We designed our instrument based on established constructs from the literature. The measure of individual creativity was based on an established scale, modified slightly to reflect the Chinese working environment. To measure knowledge sharing, we used measurement models based on a framework from [16]. We performed confirmatory factor analysis (CFA) on individual creativity and knowledge sharing using AMOS 7.0. The models provided a generally good fit to the data. For individual creativity ($\alpha = 0.899$), $\chi2 = 17.6$, df =13, $\chi2/df = 0.74$, RMSEA = 0.073, NFI = 0.939 and CFI = 0.934. They all satisfied the suggested critical value requirements of $\chi2/df \leqslant 2.5$, RMSEA$\leqslant$0.08, NFI$\geqslant$0.9 and CFI$\geqslant$0.9. For knowledge sharing ($\alpha = 0.924$), $\chi2 = 69.0$, df =34, $\chi2/df = 2.03$, RMSEA = 0.11, NFI = 0.85 and CFI = 0.84. Although RMSEA, NFI and CFI ere slightly below the suggested values, we believed that the model was still acceptable given the overall goodness of fit $\chi2/df$ is below 2.5. As for the network centrality, we used UCINET6 to calculate the work advice social network based on the survey data.

3.2 Data collection

Before we distributed the questionnaire, we first contacted the hosting company's Human Resources Department and the project manager. We stated the academic purpose of our research with the promise of keeping the data strictly confidential and sharing the research results with them. After obtaining their consents, we communicated with the project managers from the three partner companies and obtained their consents. The electronic version of the questionnaire was sent to the project managers via e-mail, who then distributed it to project team members. A total of 68 questionnaires were distributed. All respondents emailed their responses to the project managers, who then forwarded the responses to us. After receiving the responses, we first performed a visual screening to check for completeness and accuracy. With the support from the Human Resources Department, we obtained the basic information for each person, and reconciled the information with the completed questionnaires. After performing the steps above, we concluded that all 68 returned questionnaires were usable, yielding an effective response rate of 100%.

The demographics of our data show gender: male (72%) and female (28%); age: <30 (63%), 30-35 (24%), 36-40 (9%), and 41-45 (4%); tenure (years): <3 (75%), 3-5 (13%), and >5 (12%); and education: associate degree (24%), bachelor's degree (68%), master's degree (non-MBA) (6%), and MBA (3%).

4. RESULTS

Our dependent variable (y) is individual creativity. The independent variable is network centrality, with knowledge sharing as a moderator. As for the control variables, we control for gender, length of service, and education level because they might be associated with creativity through either gender induced cognitive flexibility differential, share identity, or task domain expertise [8]. We use the multiple regression and the results of the standardized coefficients are given in Table 1.

Table 1. Regression Analysis

	β
Network Centrality	0.225**
Knowledge Sharing	0.525***
Network Centrality* Knowledge Sharing	0.210**
Education	-.031
Gender	.284***
Tenure	-.091

**$p \leq .05$, ***$p \leq .01$

The results show that the regression coefficient of network centrality is 0.225 and significant at the 5% level, and that of knowledge sharing is 0.525 and significant at the 1% level. These findings demonstrate that both network centrality and knowledge sharing are positively correlated with creativity. The difference in their magnitudes shows that knowledge sharing has a stronger correlation than network centrality. Hence, both H_1 and H_2 are supported. More interestingly, the interaction term between knowledge sharing and centrality is significant and positive, indicating the moderation effect of knowledge sharing on the relationship between network centrality and individual creativity. This shows that a higher level of knowledge sharing strengthens the relationship between network centrality and creativity, while with a low level of knowledge sharing, the relationship between network centrality and creativity is relatively flat (see Figure 2). This result shows that H_3 is supported.

Among the control variables, only gender is significant, indicating that in this study the males were more creative than the females in the specific heterogeneous team, holding other variables constant. This may be attributable to the relatively small number of females (only 28%) on the team. While the findings of insignificant education and tenure are inconsistent with those in other research, we think the nature of the heterogeneous team may offer some explanation. Since the members on the team were from different companies, the tenure or seniority does not matter as much as when all the members had come from single firm. Similarly, the education level may play a role in promotions in the home company but not so much on a temporary team.
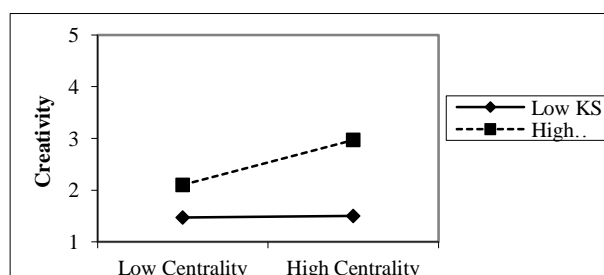

Figure 2. Cross level interaction plot

5. DISCUSSION

Our findings that network centrality and knowledge sharing are positively correlated with creativity. They are in agreement with the existing literature. The cross level interaction plot shows that a team member's knowledge sharing moderates the relationship between network centrality and individual creativity. That is, network centrality is more positively related to individual team member creativity when the level of knowledge sharing is high. When the knowledge sharing level is low, the relationship is somewhat flat. This finding is consistent with [7]. In addition, although our results show a positive correlation for creativity with both network centrality and knowledge sharing, the relationship is stronger with knowledge sharing than with network centrality. There are a couple of implication about this finding. First, in agreement with the existing literature, our study confirms that knowledge sharing plays important roles in helping individuals capitalize on the potential benefits of team diversity for their creativity. Second, the finding implies that network centrality by itself is not sufficient for a high level of individual creativity, as Figure 2 shows that the association between network centrality and creativity is stronger only when the level of knowledge sharing is high. This may be attributable to the environment of the heterogeneous team. When the team was first formed, members from the different companies still needed time to acquaint with each other. Hence, the team coordination would heavily rely on a few leaders from the hosting company. Those were most likely to occupy the central positons of the network. Occupying these positions did not necessarily imply that they were creative. As our findings show that the person at the central position must share their work related knowledge to be associated with the high level of creativity. Another possible explanation could be that other variables should be considered. Researchers have argued that central network position is insufficient if motivation and ability to share knowledge are not taken into account. Finally, we found that gender diversity was significant while other research did not confirm the significance. This may be sample specific and should be studied further in future research.

Our findings show the importance of knowledge sharing in fostering individual creativity. Managers in the parent company should provide strong support and incentives for team members to share knowledge, especially those who are in the central network positions. This can capitalize on the members' creative abilities and their location "linking" the diverse team members and allow them to generate innovative ideas. At the same time, managers should encourage team members from the parent company to share ideas and opinions with employees from other companies. This way, a team can make best use of members' knowledge to boost creativity.

The heterogeneous team model is based on reduced R&D costs and complementary knowledge that employees contribute to a team project. The core problem of integrating team members from various firms and completing software development projects is to develop ways to select best-fit employees and form an efficient R&D team. Under a heterogeneous team model, the company responsible for R&D team-building must develop ways to stimulate the employee knowledge sharing and creativity. Specific tasks include encouraging various types of communication among the employees from different companies, planning team activities that are aimed toward improving mutual trust, and awarding employees who are willing to share knowledge and help others.

6.CONCLUSION

This study provides insights about individual creativity in a heterogeneous team where the team members come from different independent companies. Based on existing research, we theoretically develop the cross-level interaction effect of knowledge sharing on the relationship between network central position and individual creativity. Using a data set collected on an IT company's project team that was formed under a heterogeneous team model with the members coming from four different companies, we empirically demonstrated that the relationship between network centrality and creativity is moderated by knowledge sharing.

Specifically, the relationship between network centrality and creativity is stronger when the level of knowledge sharing is high. When the knowledge sharing level is low, the relationship is almost flat. In addition, while we find that the correlations of creativity and network centrality and knowledge sharing are both positive, our results also show that the correlation with knowledge sharing is stronger. We draw theoretical implications for future research and practical implications for strategies to improve employee knowledge sharing and creativity in a heterogeneous team.

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