International Journal of Business, Human and Social Sciences
ISSN: 2517-9411
Vol:6, No:4, 2012

The Effect of Social Capital on Creativity in Information Systems Development Projects: The Mediating Effect of Knowledge Integration

Hsiu-Hua Cheng

***Abstract*—**This study analyzed the creativity of student teams participating in an exploratory information system development project (ISDP) and examined antecedents of their creativity. By using partial least squares (PLS) to analyze a sample of thirty-six teams enrolled in an information system department project training course that required three semesters of project-based lessons, the results found social capitals (structural, relational and cognitive social capital) positively influence knowledge integration. However, relational social capital does not significantly influence knowledge integration. Knowledge integration positively affects team creativity. This study also demonstrated that social capitals significantly influence team creativity through knowledge integration. The implications of our findings for future research are discussed.

***Keywords*—**Information system development project (ISDP), Social capital, Knowledge integration, Team creativity.

I. Introduction

CREATIVITY is often considered an important source of competitive advantage requires. Continuous renewal is required for contemporary organizations. In software companies, creating new knowledge is increasingly important for establishing sustainable and competitive advantage [12]. Project teams are a basic unit in the software company operations [35]. Promoting team creativity is therefore a major requirement for software companies in the years to come. Thus, contemporary educational units must increase creativity of information system development project (ISDP) teams and provide training for teams to product creative results.

Group collaboration has become rather a popular approach in organizations [45]. Educational researchers and practitioners have long advocated the need to equip students with collaborative learning skills [31], which are essential for 21st century workforce. Collaborative learning is essential for effective brainstorming, which is an effective method of stimulating team creativity [39]. Creative behavior/product within an ISDP team seems to be promoted by expertise integration [44]. Reference [44] indicated team creativity results from integration of individually held expertise of team members. Besides, they show relational social capital influences ISD team creativity through expertise integration. Numerous interactions occur among team members during the collaborative learning process [29], [21]. These interactions constitute the social capital of such teams [38].

Previous researchers indicated interpersonal interaction is an important factor of creativity [47]. Reference [44] demonstrated interpersonal interaction (relational social capital) influences creativity via knowledge integration.

Hsiu-Hua Cheng Author is with the Department of IM, Chaoyang University of Technology, Taiwan, R.O.C. (e-mail: hhcheng@cyut.edu.tw).

However, the influences of structural social capital and cognition social capital on creativity are less addressed. The purpose of this study is to fill the void by establishing an analytical model for empirically testing the relationships among social capital, knowledge integration, and creativity in ISDP student teams.

II. Theoretical Background And Hypotheses

A. Creativity of Information System Development Teams

Teams are groups that cooperate to achieve a common goal [10], [19]. Creativity is often defined as the development novel and useful ideas [2], [30], [33], [42].

Reference [11] indicated software development is using information technologies and development methods to develop a software or system. Information system development (ISD) includes many activities such as system analysis and design, programming, testing and maintain. The members of an ISD team who are responsible for software development typically have diverse backgrounds and knowledge [8]. Most ISDs employ "project teams" to perform development tasks [27], [35], [47]. In information system development project (ISDP) teams, team members cooperate in various project-related matters, develop solutions from various views and combine individual outcomes or ideas into systems. Thus, this study defined creativity as any proposal of a new and useful idea by an ISDP team during information system development.

B. Collaborative Learning

Collaborative learning is an instructional approach in which a small number of learners interact and share knowledge and skills in order to achieve a specific learning goal [28]. Collaborative or cooperative learning is the instructional use of small teams where peer interaction plays a key role in learning [41]. Cooperative learning requires team members to work together to maximize their own learning and that of other team members [29]. Team-oriented work environments enable for employees to learn from colleagues with expertise and to help one another through working together and sharing information [25], [32]. Cooperation, coordination, and collective approaches to work are all desirable characteristics of knowledge creation, sharing, and the overall learning process [7], [13], [15], [23], [26]. Many tasks in an ISDP are interdependent. For example, programmers must program according to documents produced by system analysts. Project leaders, system analysts and programmers must co-work. If some members fail to complete their tasks, the team cannot succeed. Thus, the ISDP student team in this study was instructed as in collaborative learning.

C.Social capital and Knowledge Integration

Reference [18] proposed the concept of knowledge integration capability and interpreted three related characteristics: the efficiency of integration, the scope of integration, and flexibility. The efficiency of integration refers to organizational ability to rapidly and effectively use knowledge possessed by individual members. Three factors are important in determining the efficiency of integration. (1) The level of common knowledge among members, including common language, knowledge and culture, determines knowledge sharing speed and thus influences integrating efficiency. (2) Frequency and variability of task performance: integrating efficiency increases with reducing variation of routines. (3) Structure: organizational structures must be designed to help organize activities such as to reduce the extent and intensity of communication needed for knowledge integration. The scope of integration means that the improvement on knowledge span increases organizational capability. The flexibility of integration describes the extension of existing capabilities to encompass additional types of knowledge and the reconfiguration of existing knowledge to new capabilities.

Reference [6] defined knowledge integration as the process of combining, applying and absorbing different types of knowledge. Furthermore, Tiwana, Bharadwaj and Sambamurthy [43] defined knowledge integration as a process via which organizations absorb outside knowledge and combine external knowledge, internal techniques and domain knowledge. Researchers expanded organizational knowledge integration capability to team knowledge integration capability, and defined team-level knowledge integration capability as teams having the ability to combine individual ideas and information to create team-level products [37]. Reference [44] expressed that knowledge integration synthesizes individual expertise at the project level.

As described above, this study defined knowledge integration capability as the ability of a team to merge team member knowledge at the project level to achieve project targets. Restated, team knowledge integration capability refers to the ability of team members to recognize knowledge applicable to a project, share and acquire required knowledge under the project structure, understand the complement and correlation among different types of knowledge, and flexibly combine diverse knowledge types to accomplish project tasks.

Reference [40] defined social capital as “features of social organization, such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated actions.” Reference [34] also defined social capital as “the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit.” Social relationships are considered social capital [38].

Three proposed dimensions of social capital are structural, relational and cognitive dimensions [34]. The structural dimension refers to the connections between actors. The relational dimension is personal relationships which people have developed with each other through a history of interactions. The cognitive dimension refers to resources used to share representations and interpretations among parties.

ISD team members with high structural social capital can know what knowledge other members have [22], [34], thus, they can recognize knowledge applicable to a project and understand the complement and correlation among different types of knowledge. Besides, ISD team members with high structural social capital can connect to each other [22], [34], so, they can share and acquire required knowledge. The above discussion of the relationship between structural social capital and knowledge integration suggests the following hypothesis:

H1: Structural social capital influences knowledge integration.

Relational capital means there are strong relationships among members [22], [34]. ISD team members with strong relationships are intimate, trust each other and provide help to others. Thus, ISD team members with high relational capital can trust knowledge which is provided from team members to enhance the efficiency of integration. Thus, the following hypothesis is proposed:

H2: Relational social capital influences knowledge integration.

Cognitive capital refers to individuals have common understanding and interpretations [22], [34]. In an ISD team, database managers and programmers with cognitive capital share the common language needed to communication with other team members, to understand knowledge held by other team members and to exchange information. The common language can facilitate knowledge integration. Thus, the following hypotheses are proposed:

H3: Cognitive social capital influences knowledge integration.

D.Knowledge Integration and Creativity of ISD Team

Reference [3] noted that creative thinking skill is crucial in developing individual/team creativity. According to the knowledge integration theory of Grant [18], an organization with good knowledge integration capability can combine new and old knowledge or recombine existing knowledge to produce creativity. Knowledge integration capability thus is a key mean of developing creativity.

The above discussion of the relationship between knowledge integration and team creativity suggests the following hypothesis:

H4: Knowledge integration influences team creativity.

Fig. 1 shows the model for exploring the relationships among social capital, knowledge integration and team creativity.

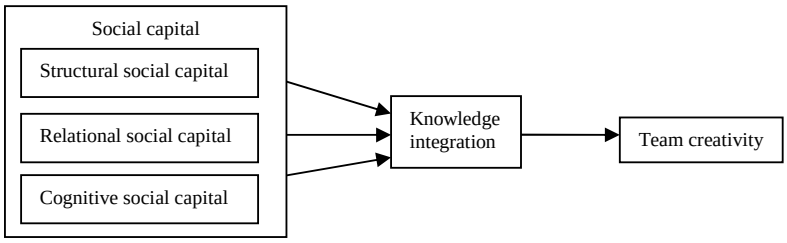

Fig. 1 Research model

III. Method

A. Subjects

This study investigated student teams which had been asked to develop information systems. The tasks for these teams include developing e-learning system, on-line community system, and project management system and so on. These teams are consisting of 5-7 students of information management department of a Taiwan university. Each student attended to a project team of project training course for three semesters.

B. Investigation Procedures

Before the final report of the project training course of the third semester, each student and the instructor of each team were asked to complete the questionnaire. Students were asked to answer the items related to social capital and knowledge sharing in the project training course. Students were required to return the questionnaire to the author. Thirty-eight teams (224 members) were surveyed. Eight students dropped out of the class. All the other members of the thirty-eight project teams (216 members) completed the questionnaires. The response rate was 100%. The instructor of each team was also asked to answer the items related to team creativity. All instructors (25 teachers) completed and returned the 38 questionnaires, providing a valid response rate of 100%.

C. Measures

All variables in the survey were measured on a Likert-type scale from 1 (strongly disagree) to 5 (strongly agree). The scale developed by Hooff and Huysma [22] was modified to include items for structural social capital, relational social capital, and cognitive social capital. The reliabilities for the scales of Hooff and Huysma [22] were 0.76, 0.76, and 0.63. The items of knowledge integration were drawn from Tiwana and McLean [44]. The reliability of knowledge integration scale of Tiwana and McLean [44] was 0.95. All students responded to the questionnaires, which included items regarding structural social capital, relation social capital, cognitive social capital and knowledge integration. The team creativity items developed by Zhou and George [48], with some modification, were also measured. In a study by Zhou and George [48], creativity had a reliability of 0.96. Team creativity questionnaires for each team were completed by their instructor, who guided the student team in completing the ISDP.

IV. Analysis And Results

A. Aggregation Tests

This study justified the aggregation of responses via test inter-rater agreement (r_{wg}) and used ANOVA to test whether between-group variance was sufficient to warrant team-level modeling.

Testing for team-level effects required the aggregation of structural social capital, relational social capital, cognitive social capital and knowledge integration by team member scores. This study tested the suitability of such an aggregation for examining between-group differences and within-group agreement for these measures [17]. Reference [4] demonstrated that one-way ANOVA can be used to test between-group differences. The analytical results indicated that all between-group variances for the four constructs significantly exceeded the within-group variances.

Within-group agreement (r_{wg}) was estimated using the method developed by James, Demaree and Wolf [24], which assesses within-group consistency using ratings on a common scale. According to George [16], an r_{wg} exceeding 0.7 indicates within-group agreement. In this study, the analytical results showed that knowledge integration of two teams had r_{wg} coefficients of 0.5, which was lower than 0.7. The data for the two teams was therefore excluded. Four constructs of data for the other team (thirty-six teams, 204 members) were suitable for aggregation by averaging the scores of team members.

B. PLS Analysis

Partial least squares (PLS) method was used for data analysis. The PLS method is a component-based approach for measuring construct reliability and validity and for estimating the relationships among constructs [46]. The PLS method can accommodate numerous variables as well as direct, indirect and moderating effects [1]. The research model in this study included several variables and explored direct and indirect effects. Thus, PLS was a suitable data analysis technique.

1. Measurement Model

The reliability, internal consistency and validity of the measurements were assessed. Reference [36] indicated that construct internal reliability should exceed 0.7. Reference [5] recommended a value of 0.7 to establish composite reliability. Alpha coefficients for all constructs exceeded 0.7, as did the values for composite reliability of constructs. All constructs were thus reliable, as listed in Table I.

Reference [9] indicated that, when estimating the measurement model, the reflective scale must assess indicator factor loading. This study assessed internal validity based on indicator loadings. Reference [20] noted that the indicator loadings must exceed 0.3. Table I lists the loading and t-value of all indicators. All path loadings of reflective indicators exceeded 0.3 ($p < 0.05$), which was significant. Therefore, all indicators exhibited validity. This study assessed convergent validity based on average variance extracted (AVE). Reference [14] indicated that an AVE score exceeding 0.5 is acceptable. Table I shows that the AVE of each construct exceeded the minimum acceptable value. The measurements exhibit convergent validity.

Finally, instrument discriminant validity was verified by examining the square root of AVE as recommended by Fornell and Larcker [14]. The results listed in Table II confirm the discriminant validity. The square root of the AVE for each construct exceeded the correlations involving the construct [9].

2. Structural Model

Table III shows the results of PLS tests of the proposed hypotheses. Fig. 2 shows that the mediating effect can be divided into two different parts. The first is from independent variable to mediator and the second is from mediator to dependent variable. The independent variable-to-mediator relationships are shown in the first three rows of Table III. The results indicated that structural social capital positively and significantly affected knowledge integration, ($\beta = 0.35$, $p < 0.05$), that relational social capital did not significantly influence knowledge integration, ($\beta = 0.17$, $p > 0.05$), and that cognitive social capital significantly related to knowledge integration, ($\beta = 0.44$, $p < 0.05$), which supported H1a and H1c respectively. However, H2b is not supported. The results indicated that mediator (knowledge integration) significantly and positively affected team creativity ($\beta = 0.76$, $p < 0.05$). H2 is supported. Fig. 2 shows the results for the proposed research model.

TABLE I
DESCRIPTION OF RELIABILITY AND AVE

Construct	Cronbach's Alpha	CR[1]	AVE[2]
Structural social capital	0.85	0.89	0.53
Relational social capital	0.85	0.89	0zzz.60
Cognitive social capital	0.82	0.91	0.84
Knowledge integration	0.89	0.92	0.61
Team creativity	0.85	0.89	0.63

[1] CR is composite reliability.

TABLE II
CORRELATIONS AMONG CONSTRUCTS

Construct	(1)	(2)	(3)	(4)	(5)
Structural social capital (1)	0.73[1]				
Relational social capital (2)	0.64	0.77			
Cognitive social capital (3)	0.60	0.37	0.92		
Knowledge integration (4)	0.62	0.58	0.74	0.78	
Team creativity (5)	0.61	0.48	0.66	0.65	0.79

[1] The diagonal elements represent the square root of AVE.

V. DISCUSSION AND CONCLUSIONS

The results of this study indicate that structural social capital and cognitive social capital significantly associate with knowledge integration, and knowledge integration is a critical role as a mediator between social capital and team creativity. Social capitals explained 73% of the variance in knowledge integration. Knowledge integration explained 57% of the variance in team creativity

TABLE III
THE RESULTS OF PLS

	Mediator		Dependent variable	
	Knowledge integration		Team creativity	
	Coefficient	T-value	Coefficient	T-value
Structural social capital	0.35	2.21*		
Relational social capital	0.17	1.68		
Cognitive social capital	0.44	3.56*		
Knowledge integration			0.76*	11.15

* indicates $p < 0.05$.

These team members need to combine various knowledge and skills to complete their project. In a team with high social capital, the team member can know what knowledge other members have (structural capital) and share the common language to understand complement among knowledge which held by other team members (cognitive capital). In a cooperative learning context, social capital (structural and relational capital) assists team members in executing knowledge integration activities.

However, the results of this study indicate no significant association between relational social capital and knowledge integration. The finding is not as expectation. ISDP student teams in this study already had very high relational social capital (mean=4.72). Therefore, it may be not possible for an ISD team which has higher relational social capital than other teams to have better knowledge integration.

Although the research findings provide meaningful implications, this study has some limitations. It did not measure how team members' social capital and knowledge integration activities change over time. All measures were taken at a single point in time. Besides, the results were obtained within the context of ISDP student teams and need further validation across other software development teams. Therefore, the results of our study may have to be carefully interpreted.

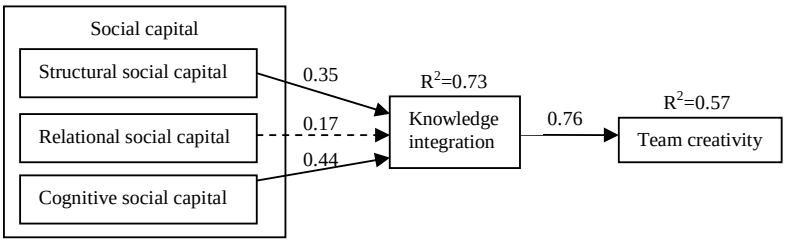

Fig. 2 PLS results for the proposed research model
Notes---Nonsignificant path; significant path are in boldface ($p < 0.05$)

REFERENCES

[1] M. Ahuja, D. Galletta, K. Carley, "Individual centrality and performance in virtual R&D groups: An empirical study," *Management Science*, vol. 49, no. 1, pp. 21-38, 2003.
[2] T. M. Amabile, *Creativity in context*. Boulder. CO: Westview, 1996.
[3] T. M. Amabile, "Motivating creativity in organizations: On doing what you love and loving what you do," *California Management Review*, vol. 40, no. 1, pp. 39-58, 1997.
[4] A. C. Amason, "Distinguishing the effects of functional and dysfunctional conflict on strategic decision making: Resolving a paradox for top management teams," *Academy of Management Journal*, vol. 39, pp. 123-148. 1996.
[5] R. P. Bagozzi, and Y. Yi, "On the evaluation of structural equation models," *Academy of Marketing Science*, vol. 16, no. 1, pp. 74-94. 1988.
[6] M. Bhandar, S. L. Pan, and B. C. Y. Tan, "Towards understanding the roles of social capital in knowledge integration: A case studey of a collaborative information systems project," *Journal of the American Society for Information Science and Technology*, vol. 58, no. 2, pp. 263-274, 2007.
[7] C. H. Bixler, "Knowledge management and the learning organization converge," *KM World*, vol. 11, no. 4, pp. 18-19. 2002.
[8] A. Bubshait, and G. Farooq, "Team building and project success," *Cost Engineering*, vol. 41, pp. 34-38. 1999.
[9] W. W. Chin, "Issues and opinion on structural equation modeling," *MIS Quarterly*, vol. 22, no. 1, pp. vii-xvi. 1998.
[10] S. G. Cohen, and D. E. Bailey, "What makes teams work: Group effectiveness research from the shop floor to the executive suite," *Information of Management*, vol. 23, no. 3, pp. 239-290, 1997.
[11] B. Curtis, H. Krasner, and N. Iscoe, "A field study of the software design process for large systems," *Communication of the ACM*, vol. 31, no. 11, pp. 1268-1287, 1988.
[12] P. Drucker, "The coming of the new organization," *Harvard Business Review*, vol. 66, no. 1, pp. 45-54, 1998.
[13] M. du Plessis, "Drivers of knowledge management in the corporate environment," *International Journal of Information Management*, vol. 25, no. 3, pp. 193-202, 2005.
[14] C. Fornell, and D. Larcker, "Evaluating structural equation models with unobservable variables and measurement error," *Journal of Marketing Research*, vol. 18, pp. 39-50, 1981.
[15] B. S. Gardner, and S. J. Korth, "A framework for learning to work in teams," *Journal of Education for Business*, pp. 28-33, 1998.
[16] J. George, "Personality, affect, and behavior in groups," *Journal of Applied Psychology*, vol. 75, pp. 107-116, 1990.
[17] P. S. Goodman, E. C. Ravlin, and M. Schminke, Understanding groups in organizations. In L.L. Cummings & B.M. Staw (Eds), Leadership, participation, and group Behavior (pp. 323-385). Greenwich, CT: JAI Press, 1990.
[18] R. M. Grant, "Toward a knowledge-based theory of the firm," *Strategic Management Journal*, vol. 17, Special 2, pp. 109-122, 1996.
[19] J. R. Hackman, The design of work teams. In J.W. Lorsch (Eds.), Handbook of organizational behavior (pp. 315-342). Englewood Cliffs, NJ: Prentice-Hall, 1987.
[20] J. F. Hair, R.E. Anderson, R.L. Tatham, and W.C. Black, *Multivariate data analysis*. New Jersey: Prentice-Hall, Inc. 1998.
[21] E. V. Hilke, *Cooperative learning*. Bloomington: Phi Delta Kappa Educational Foundatio, 1990.
[22] B. Hooff, and M. Huysman, "Management knowledge sharing: Emergent and engineering approaches," *Information and Management*, vol. 46, no. 1, pp. 1-8, 2009.
[23] G. T. M. Hult, R. F. Hurley, L. C. Giunipero, and Jr. E. L. Nichols, "Organizational learning in global purchasing: A model and test of internal users and corporate buyers," *Decision Sciences*, vol. 31, no. 2, pp. 293-325, 2000.
[24] L. R. James, R. G. Demaree, and G. Wolf, "r_{wg}: An Assessment of within-group interrater agreement," *Journal of Applied Psychology*, 78, pp. 306-309, 1993.
[25] B. D. Janz, "Self-directed teams in IS: Correlated for improved systems development work outcomes," *Information and Management*, vol. 35, no. 3, pp. 171-192, 1999.
[26] B. D. Janz, and P. Prasarnphanich, "Understanding the antecedents of effective knowledge management: The importance of a knowledge-centered culture," *Decision Sciences*, vol. 34, no. 2, pp. 351-384, 2003.
[27] J. J. Jiang, G. Klein, H. G. Hwang, J. Huang, and S. Y. Huang, "An exploration of the relationship between software development process maturity and project performance," *Information & Management*, vol. 41, pp. 279-288, 2004.
[28] D. W. Johnson, and R. T. Johnson, *Circles of Learning, Alexandria*. VA: Association for Supervision and Curriculum Development, 1988.
[29] D. W. Johnson, and R. T. Johnson, *Cooperation and competition: Theory and research*. Edina, MN: Interaction Book Company, 1989.
[30] J. Kasof, "Social determinants of creativity: Status expectations and the evaluation of original products, *Advances in Group Processes*, vol. 12, pp. 167-220, 1995.
[31] R. A. Lonning, "Effect of cooperative learning strategies on student verbal interactions and achievement during conceptual change instruction in 10th grade general science," *Journal of Research in Science Teaching*, vol. 30, no. 9, pp. 1087-1101, 1993.
[32] A. Mikkelsen, and K. Gronhaug, "Measuring organizational learning climate: A cross-notional replication and instrument validation study among public sector employees," *Review of Public Personnel Administration*, vol. 19, no. 4, pp. 31-44, 2000.
[33] M. D. Mumford, and S. B. Gustafson, "Creativity syndrome: Integration, application, and innovation," *Psychological Bulletin*, vol. 103, pp. 27-43, 1988.
[34] J. Nahapiet, and S. Ghoshal, "Social capital, intellectual capital, and the organizational advantage," *The Academy of Management Review*, vol. 23, no. 2, pp. 242-266, 1998.
[35] S. R. Nidumolu, "A comparison of the structural contingency and risk-based perspective on coordination in software-development projects," *Journal of Management Information Systems*, vol. 13, no. 2, pp. 77-113, 1996.
[36] J. C. Nunnally, *Psychometric Theory*. New York: McGraw-Hill, 1978.
[37] G. OKhuysen, and K. Eisenhardt, "Integrating knowledge in groups: How formal interventions enable flexibility," *Organization Science*, vol. 13, no. 4, pp. 370-386, 2002.
[38] C. Okoli, and W. Oh, "Investigating recognition-based performance in an open content community: A social capital perspective," *Information and Management*, vol. 44, pp. 240-252, 2007.

[39] A. F. Osborn, *Your creative power: How to use imagination*. New York: Charles Scribner's Sons, 1948.
[40] R. Putman, *Making democracy work: Civic traditions in modern Italy*. Princeton, NJ: Princeton University Press, 1993.
[41] R. E. Slavin, *Cooperative learning*. New York: The social psychology of the primary school, 1990.
[42] R. J. Sternberg, and T.I. Lubart, *Defying the crowd: Cultivating creativity in a culture of conformity*. New York: The Free Press, 1995.
[43] A. Tiwana, A. Bharadwaj, V. Sambamurthy, "The antecedents of information systems development capability in firms: A knowledge integration perspective," *in Twenty-Fourth International Conference on Information Systems*, 2003.
[44] A. Tiwana, and E. McLean, "Expertise integration and creativity information systems development," *Journal of Management Information Systems*, vol. 22, no. 1, pp. 13-43. 2005.
[45] M. J. Waller, "The timing of adaptive group responses to nonroutine events," *Academy of Management Journal*, vol. 42, no. 2, pp. 127-137, 1999.
[46] H. Wold, Systems under indirect observation using PLS. In C. Fornell (Eds.), A second generation of multivariate analysis (pp. 325-347). New York: Praeger, 1982
[47] H. L. Yang, and H. H. Cheng, "Creativity of student information system projects: From the perspective of network embeddedness," Computers & Education, vol. 54, no. 1, pp. 209-221, 2010.
[48] J. Zhou, and J. M. George, "When job dissatisfaction leads to creativity: Encouraging the expression of voice," *Academy of Management Journal*, vol. 44, no. 4, pp. 682-696, 2001.