Partnership and Knowledge Transfer Performance: An Empirical Study of University-Industry Knowledge Collaboration (Postprint)

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Abstract

[Purpose/Significance] This study systematically reviews and analyzes existing relevant research literature, exploratorily proposes that the relationship between knowledge transfer parties should be composed of three dimensions: work, benefit, and friendship, and creatively incorporates these three types of relationships into a unified theoretical framework for investigation. [Method/Process] Through empirical analysis of 304 cooperation data sets between domestic universities and enterprises, it examines the relationships between the three relationship dimensions (work, benefit, and friendship) and knowledge transfer performance. [Results/Conclusions] The results reveal that: the friendship relationship dimension has a negative impact on knowledge transfer performance; friendship relationship negatively moderates the relationship between benefit relationship and knowledge transfer performance; close work relationships and benefit relationships have a positive impact on knowledge transfer performance. Finally, the theoretical contributions and practical implications of the empirical research are discussed, and the limitations of this study are presented.

Full Text

Preamble

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Collaborative Relationships and Knowledge Transfer Performance: An Empirical Study of University-Industry Knowledge Cooperation

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Abstract

[**Purpose/Significance**] This paper systematically reviews existing literature and proposes that the relationship between knowledge transfer parties should be conceptualized as comprising three dimensions: working relationship, interest relationship, and friendship relationship. It innovatively integrates these three relational dimensions within a unified theoretical framework.

[**Method/Process**] Using empirical analysis of 304 samples of university-industry collaboration in China, we examine the effects of working, interest, and friendship relationships on knowledge transfer performance.

[**Results/Conclusions**] The findings reveal that: (1) the friendship relationship dimension negatively impacts knowledge transfer performance; (2) friendship relationship negatively moderates the relationship between interest relationship and knowledge transfer performance; and (3) close working relationships and interest relationships positively influence knowledge transfer performance. Finally, we discuss the theoretical contributions and practical implications of this study and acknowledge its limitations.

Keywords: knowledge transfer; tie strength; working relationship; interest relationship; friendship relationship
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1. Introduction

In the knowledge economy era, knowledge represents a firm's most critical strategic resource and a primary source of competitive advantage. Organizations can secure market competitiveness through knowledge creation, acquisition, and utilization. To a significant extent, firm development depends increasingly on external knowledge [**?**]. Zahra and George argue that firms capable of effectively absorbing and utilizing external knowledge will be more competitive in the marketplace [**?**], and existing research has confirmed that firms tend to directly leverage external knowledge in their R&D activities [**?**]. Knowledge sources, as creators of external knowledge, constitute important channels for firms to acquire external knowledge [**?**, **?**]. However, without appropriate trust and understanding between firms and knowledge sources, and without sufficient relationship strength, inter-firm knowledge transfer may fail [**?**]. Conversely, strong relationships enable firms to share information, exchange ideas, and better leverage each other's experiential knowledge and expertise, thereby reducing errors, implementation defects, and uncertainties during transfer. Thus, establishing robust collaborative relationships is key to successful inter-organizational knowledge transfer [**?**], making collaborative relationships a central research topic in the knowledge transfer field [**?**, **?**].

In inter-organizational knowledge transfer, the relationship between knowledge source and recipient fundamentally influences both the transfer process and its

outcomes [?], ultimately affecting knowledge transfer performance. Current research on the relationship between transfer parties and performance primarily focuses on two aspects: (1) antecedents of the relationship, such as trust [?, ?], willingness [?, ?], and organizational distance (cultural, knowledge, and physical distance) [?]; and (2) variables measuring relationship strength, such as communication [?] and relationship intensity [?]. Extensive empirical studies have examined the relationships between these variables and transfer performance, enriching our understanding of collaborative relationships in knowledge transfer. However, research on relationship closeness and performance has yielded two contradictory perspectives. The "weak ties" view argues that loose relationships can filter out redundant knowledge, allowing recipients to directly acquire useful knowledge, whereas overly close relationships lead to routine communication patterns that cannot eliminate redundancy [?, ?]. The "strong ties" perspective contends that close relationships increase trust, cohesion [?, ?], and willingness, thereby positively influencing knowledge transfer. As Levin and Cross state: "Weak ties have the additional function of eliminating redundant information compared to strong ties and can provide more useful information; however, we do not deny the positive role of strong ties in knowledge transfer" [?].

These competing perspectives have constrained research on knowledge transfer relationships, increasing the difficulty for scholars to conduct systematic studies. In fact, current empirical research on the relationship between transfer parties and performance primarily focuses on strategic alliances, multinational parent-subsidiary relationships, mergers and acquisitions, supply chain partnerships, and university-incubator relationships [?]. Since these organizations already have strong cooperative connections, the findings lack explanatory power for knowledge transfer between more independent organizations. According to Fan, collaborative relationships between transfer parties encompass a series of activities undertaken by both sides, affecting not only transfer performance through relationship closeness but also influencing inter-organizational knowledge transfer through different dimensions or pathways. However, existing literature lacks research on how different relational dimensions affect knowledge transfer performance.

This paper uses the dimensional division of knowledge transfer relationships as a breakthrough point to address four key questions: (1) What dimensions constitute the relationship between transfer parties? (2) What characteristics does each dimension possess? (3) How can the closeness of each dimension be measured? (4) What impact does each dimension have on knowledge transfer? By answering these questions, we aim to reveal the true nature of the relationship between knowledge transfer parties and performance, break free from the constraints of the "strong versus weak ties" debate, and provide theoretical foundations for advancing knowledge transfer research.

2. Theory and Hypotheses

2.1 Overview of Knowledge Transfer Relationships

Szulanski conceptualizes knowledge transfer as a complex process of recreating the knowledge application context while preserving the transferred knowledge's functionality [?]. To better understand this process, he divides knowledge transfer into four stages: initiation, implementation, ramp-up, and integration. The complexity of knowledge transfer manifests not only in the "transfer process" but also in the "knowledge characteristics." According to Nonaka, knowledge can be categorized as explicit or tacit [?]. Explicit knowledge is easily codified, transferred, and made public, whereas tacit knowledge is deeply embedded in organizations, difficult to articulate, transfer, and imitate [?], making its transfer extremely complex [?] and significantly increasing transfer difficulty [?].

At this point, knowledge sources and recipients must establish positive collaborative relationships to jointly overcome obstacles in the knowledge transfer process [?]. Such relationships also enable both parties to better understand the transferred knowledge, each other's capabilities and intentions, and to adopt and implement better transfer measures, thereby enhancing overall transfer efficiency. Therefore, the relationship between transfer parties is established to overcome various barriers and comprises three dimensions: working relationship, interest relationship, and friendship relationship. We now analyze the effect of each dimension on transfer performance and propose a theoretical framework.

2.2 Working Relationship Closeness and Knowledge Transfer Performance

Many scholars have meaningfully explored knowledge transfer relationships from different perspectives. Inkpen argues that transfer relationships are primarily established through formal and informal connections between individuals or organizations for specific purposes or interests (e.g., funding, technology, strategy) [?]. Relationships built through formal organizational connections typically have formal working attributes, whereas those established through personal connections have friendship attributes. Ramasamy et al. studied the impact of friendship relationships on knowledge transfer performance from a moral perspective, similar to teacher-student relationships [?]. Chinese scholars Zhou Changhui and Cao Yinghui consider working and friendship relationships as important dimensions of the relationship between parties [?]. Lai argues that interest relationships form the basis of cooperation, stimulating willingness and releasing cooperative potential [?], a view strongly supported by Ankrah et al. [?].

However, existing literature does not clarify which relationship attributes are being studied, often conflating working, friendship, and interest relationships under the general term "relationship" [?], which greatly increases difficulty for knowledge transfer scholars. For example, Reagan and McEvily's and Pan Wen'an's research can be understood as focusing on friendship relationships [?, ?]; Hansen and Szulanski's studies can be categorized as examining both

working and friendship relationships [**?**, **?**]; Tang et al.'s research focuses on working relationships [**?**]; and Arvanitis's study falls within the scope of working and interest relationships [**?**]. To more accurately understand relationships in knowledge transfer, we systematically review and categorize existing literature, as shown in Table 1 .

Table 1 Literature Classification of Knowledge Transfer Relationships

Relationship Dimension	Representative Literature
Working Relationship	Martin & Salomon (2003); Schulze et al. (2014); Park (2011); Tang et al. (2010)
Friendship Relationship	Ramasamy et al. (2006); Reagan & McEvily (2003); Zahra & George (2002); Robbins & Judge (2012); Pan Wen'an (2012)
Interest Relationship	Lai (2011); Ankrah et al. (2013)
Working & Friendship	Zhou & Cao (2011); Levin & Cross (2004); Hansen (1999)
Working & Interest	Arvanitis et al. (2008); Battistella (2016)

Based on this analysis, we argue that the relationship between transfer parties comprises three dimensions: working relationship, interest relationship, and friendship relationship. We now analyze the effect of each dimension on transfer performance.

Working relationships integrate various aspects of transfer parties, facilitating successful knowledge transfer [**?**]. Early scholars Makhija and Ganesan argue that close working relationships enhance knowledge transfer performance because knowledge sources can use these relationships to plan application paths for recipients and help construct appropriate contexts for new knowledge application [**?**]. Martin and Salomon propose similar views, suggesting that knowledge sources should go beyond recipient firms' boundaries, accurately assess their absorptive capacity based on actual conditions, and select optimal knowledge application paths [**?**]. Despite these early contributions, research in this area remained limited by the prevailing "weak ties" perspective.

Recently, scholars have explored the impact of close relationships on transfer performance with significant progress. Arvanitis et al. argue that given knowledge sources' superior ability to manage new knowledge, their active participation in knowledge application facilitates transfer [**?**]. Building on prior research, Schulze et al. examined the knowledge source's role throughout the transfer process, finding that knowledge sources should play a more important role by deploying dedicated personnel into recipient firms to guide new knowledge application, thereby enhancing absorptive capacity and transfer performance through

strengthened working relationships [**?**]. Park's research further suggests that knowledge sources' leadership in the application process within recipient firms is more conducive to knowledge transfer [**?**].

Therefore, working relationships are formed through daily communication and interaction regarding tasks and responsibilities during the knowledge transfer process. Theoretically, the deeper the knowledge source penetrates into the recipient firm and the more knowledge application tasks it undertakes, the closer the working relationship. Based on this analysis, we propose:

H1: Closer working relationships are more conducive to knowledge transfer performance.

2.3 Interest Relationship Closeness and Knowledge Transfer Performance

Obtaining benefits is the fundamental reason for inter-organizational cooperation to promote knowledge transfer [**?**]. In knowledge transfer, knowledge sources typically seek funding, while recipients aim to enhance knowledge reserves, technical capabilities, innovation, excess profits, and competitive advantages. Ankrah et al. argue that knowledge transfer cooperation ultimately leads to either benefits or losses; when benefits outweigh costs, the likelihood of cooperation increases substantially [**?**]. In university-industry knowledge transfer, universities prioritize obtaining research funding to support laboratory development and knowledge innovation. Given the importance of research funding, universities are naturally motivated to seek knowledge transfer cooperation with firms. In other words, the higher the benefits universities obtain from knowledge transfer, the stronger their willingness and motivation, and the greater the promotion of university-industry knowledge transfer. As Lai argues, interests determine the willingness of knowledge sources and recipient firms to participate in cooperation, mobilize both parties' enthusiasm, promote labor and knowledge absorption efficiency, and ultimately enhance knowledge transfer performance [**?**].

Thus, the interest relationship dimension is the economic relationship arising from both parties' pursuit of respective benefits, forming the fundamental guarantee for transfer cooperation. The more benefits both parties obtain from knowledge transfer, the closer the interest relationship. Based on this analysis, we propose:

H2: Closer interest relationships are more conducive to knowledge transfer performance.

2.4 Friendship Relationship Closeness and Knowledge Transfer Performance

According to Robbins et al., friendship relationships can create a relaxed working atmosphere, enhance cohesion, increase cooperative willingness, and mobi-

lize both parties' enthusiasm [**?**], thereby encouraging greater time and effort investment [**?**]. Additionally, friendship deepens trust, facilitates deeper information sharing, and creates conditions for recipients to learn from knowledge sources [**?**]. Francis and Sandberg argue that close friendship relationships are characterized by stability, frequent interaction, and mutual dependence, with these characteristics becoming more pronounced as the relationship strengthens [**?**]. Therefore, establishing deep friendship relationships not only increases interaction opportunities and facilitates relaxed, harmonious communication but also generates mutual dependence, positively affecting both parties' psychology [**?**]. This positive sense of closeness increases knowledge sources' willingness to share knowledge-related information with recipients without reservation [**?**].

Thus, friendship-based relationships are affective relationships established through long-term interaction, representing mutual goodwill. The higher the degree of goodwill, the closer the friendship relationship, which should enhance knowledge transfer performance [**?**]. Based on this analysis, we propose:

H3: Closer friendship relationships are more conducive to knowledge transfer performance.

2.5 Moderating Effect of Friendship Relationship

In the Chinese cultural context, friendship plays an important role in business cooperation and significantly influences collaborative relationships. Friendship can better protect personal relationship interests and includes components such as implicit mutual obligations, commitments, and understanding, thereby governing business relationships. Therefore, in inter-organizational knowledge transfer, appropriate use of friendship can increase the likelihood of successful transfer; otherwise, it may create difficulties and reduce transfer efficiency. Liu et al.'s study of knowledge transfer in China concludes that the key to firms' successful knowledge absorption is to quickly integrate into knowledge sources' specific circles, establish deep friendships, gain sufficient trust, and become so-called "insiders" [**?**]. According to social exchange theory, if recipients establish good friendships with knowledge sources and become "insiders" within the circle, they can not only reduce inter-organizational transaction costs and enhance transfer cooperation closeness but also obtain specific privileges beyond conventional rules and laws (Ramasamy), such as expressing opinions and ideas about knowledge transfer without reservation, thereby affecting working relationships, or enjoying preferential treatment in payment terms, thus influencing interest relationships. Therefore, we propose:

H3a: Friendship relationship moderates the effect of working relationship on knowledge transfer performance.

H3b: Friendship relationship moderates the effect of interest relationship on knowledge transfer performance.

The conceptual model is shown in Figure 1 [Figure 1: see original paper].

Figure 1 Theoretical Hypothesis Model

3. Research Design

3.1 Data Collection

Given this study's focus on knowledge transfer and inter-party relationships, the research subjects should exhibit significant knowledge transfer and cooperation characteristics. After careful consideration, we selected "university-industry knowledge collaboration" as our research context. University-industry collaboration centers on knowledge transfer, enhancing firms' knowledge (or technological) capabilities and promoting development through the absorption and application of new knowledge within firms [**?**].

We collected data through questionnaires administered to university faculty who had led or participated in university-industry collaboration projects completed within the past two years. University faculty offer several advantages: (1) as knowledge sources, they understand the transferred knowledge and the specific contexts required for its application; (2) as the transferring party, universities can comprehensively grasp the collaborative relationship and identify knowledge transfer difficulties; and (3) university faculty possess higher educational attainment and respond to questionnaires more rigorously with deeper comprehension.

Data collection occurred from May 2016 to November 2016. Based on China's university classification system, we selected samples from "985" universities, "211" universities (excluding "985" institutions), and regular universities. Considering that research universities have the strongest knowledge innovation capabilities and that university-industry knowledge transfer primarily occurs between research universities and industrial enterprises, we focused on engineering faculty teams from 28 universities with high proportions of research-oriented teams. We distributed 807 questionnaires, receiving 330 responses. After eliminating 26 invalid questionnaires, we obtained 304 valid responses, yielding an effective response rate of 37.7%. Sample characteristics are shown in Table 2 .

Table 2 Sample Basic Characteristics

Characteristic	Category	Percentage
University Level	"985" University	21.38%
	"211" University (excluding "985")	42.11%
	Regular University	36.51%
Administrative Position	Yes	58.88%
	No	41.12%
Age	Under 30	33.22%
	31-40	20.39%
	41-50	48.36%
	51-60	29.93%

Characteristic	Category	Percentage
	Over 61	7.61%
Participation in UI Collaboration	Yes	76.97%
	No	23.03%
Collaboration Experience	Yes	87.17%
	No	12.83%

3.2 Variables and Measurement

3.2.1 Inter-party Relationships Based on our analysis, we measured knowledge transfer relationships across three dimensions: working relationship, interest relationship, and friendship relationship, using a 5-point Likert scale (Table 3).

(1) Working Relationship. Park measured working relationship closeness by the knowledge source's control over the recipient firm. Stronger control enables the knowledge source to integrate recipient resources according to its vision, indicating a closer working relationship. We adapted scales from Park [**?**] and Schulze [**?**] to our context, using five items to measure working relationship.

(2) Interest Relationship. Lai argues that universities participate in knowledge transfer to obtain funding for laboratories, while firms aim to acquire university knowledge. We designed items from both parties' perspectives, adapting Santoro's [**?**] scale with four items to measure interest relationship.

(3) Friendship Relationship. Reagan and McEvily measured friendship by time spent together outside work, while Levin and Cross used trust characteristics as friendship indicators. We adapted scales from Reagan and McEvily and Levin and Cross [**?**, **?**], using five items to measure friendship relationship.

3.2.2 Knowledge Transfer Performance Many scholars have developed mature scales for knowledge transfer performance. We adapted Santoro et al.'s [**?**] research to our context, using two items: (1) project completion according to schedule, and (2) project's substantial help to the firm (production processes, profits, market share, etc.).

3.2.3 Control Variables We controlled for team leader's professional title, administrative position, age, transfer experience, and university level (see Table 2 for measurement methods).

3.3 Exploratory Factor Analysis (EFA)

We conducted factor analysis on relationship items. The rotated factor loadings all exceeded 0.5, forming three main factors—working relationship, interest relationship, and friendship relationship—with cumulative variance reaching 66.196% (Table 3).

Table 3 Exploratory Factor Analysis

Measurement Item	Factor Loading
Frequently train recipient firm's R&D personnel	0.811
Frequently visit recipient firm for guidance	0.637
Can adjust firm processes according to project needs	0.761
Can adjust project team members according to research needs	0.805
Always respond quickly to recipient firm's questions	0.746
Very satisfied with compensation from recipient firm	0.759
This collaboration will positively impact future research	0.887
Firm's payment to university accounts for high proportion of R&D expenditure	0.576
Collaboration is very important for teaching improvement	0.637
Frequently interact with recipient firm personnel outside work	0.543
Feel pleasant during collaboration with recipient firm	0.634
Care about recipient firm personnel's interests	0.723
Concerned about recipient firm personnel's career growth	0.597
Change original ideas to accommodate recipient firm personnel's feelings	0.613

3.4 Reliability and Validity Tests

Reliability and validity tests are fundamental for scale utility. Validity is typically assessed by the first principal component's variance contribution rate, with 40% as the acceptance threshold [**?**]. As shown in Table 4 , all first principal component contribution rates exceed 40%, indicating acceptable validity. Reliability is measured by Cronbach's Alpha, with values above 0.6 considered acceptable [**?**].

Table 4 Reliability and Validity Analysis

Measurement Item	First Principal Component	Variance Contribution	Alpha
Frequently train recipient firm's R&D personnel	3.327	51.63%	0.723
Frequently visit recipient firm for guidance	3.536		0.637
Can adjust firm processes according to project needs	3.243		0.761
Can adjust project team members according to research needs	3.491		0.805
Always respond quickly to recipient firm's questions	3.686		0.746
Very satisfied with compensation from recipient firm	3.537	44.10%	0.757
This collaboration will positively impact future research	3.027		0.887
Firm's payment to university accounts for high proportion of R&D expenditure	3.742		0.576
Collaboration is very important for teaching improvement			0.637
Frequently interact with recipient firm personnel outside work	3.764	47.56%	0.681

Measurement Item	First Principal Component	Variance Contribution	Alpha
Feel pleasant during collaboration with recipient firm	3.583		0.634
Care about recipient firm personnel's interests	3.619		0.723
Concerned about recipient firm personnel's career growth	3.657		0.597
Change original ideas to accommodate recipient firm personnel's feelings	3.936		0.613

3.5 Correlation Analysis

We conducted variance inflation factor analysis, finding VIF values between 0-5, well below the threshold of 10 [**?**], indicating no multicollinearity. Means, standard deviations, and correlations are shown in Table 5 .

Table 5 Means, Standard Deviations, and Correlations

Variable	Mean	SD	1	2	3	4	5	6	7	8
1. Professional Title	2.539	0.691	1							
2. Administrative Position	1.314	0.635	0.147**	1						
3. Age	2.917	0.417	0.138	0.163**	1					
4. University Level	1.836	0.757	0.051	-0.035	0.076	1				
5. Experience	1.881	0.772	0.073	0.092	-0.018	-0.136**	1			
6. Working Relationship	3.456	0.359	0.067	-0.031	0.097	-0.071	0.052	1		

Variable	Mean	SD	1	2	3	4	5	6	7	8
7. Interest Relationship	3.529	0.603	- 0.007	- 0.170**	0.224**	0.230**	0.115	0.327**	1	
8. Friendship Relationship	3.712	0.442	0.011	0.073	0.251**	0.265**	0.138	0.549**	0.375**	1

Note: **P<0.05;** *P<0.01

4. Hypothesis Testing and Analysis

Given potential interdependencies among variables, we employed hierarchical regression models, sequentially adding control variables, independent variables, and interaction terms. To avoid multicollinearity from interaction terms, we centered all variables before creating interaction terms.

Table 6 presents regression results for the three relationship dimensions and knowledge transfer performance. Model 1 shows control variables' effects. Administrative position and experience positively affect knowledge transfer performance. Model 2 adds working relationship, which significantly impacts performance (β=0.639, P<0.01), substantially improving explanatory power (Adjusted R^2=0.365). H1 is supported: working relationship positively affects knowledge transfer performance.

Model 3 adds interest relationship, which significantly affects performance (β=0.165, P<0.05), further improving model fit. H2 is supported: interest relationship significantly affects knowledge transfer performance. Model 4 adds friendship relationship, which significantly negatively affects performance (β=-0.151, P<0.05), with Model 4 showing higher explanatory power than Model 3. H3 is supported: friendship relationship significantly negatively affects knowledge transfer performance.

Model 5 adds the interaction between friendship and working relationships, showing no significant change in explanatory power; H3a is not supported. Model 6 adds the interaction between friendship and interest relationships, which significantly negatively affects performance (β=-0.146, P<0.05), with Model 6's explanatory power significantly improving (Adjusted R^2=0.423). H3b is supported.

Table 6 Regression Analysis Results

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Professional Title	-0.032	-0.002	-0.009	-0.016	-0.026	-0.032
Administrative Position	0.175**	0.172**	0.146**	0.164**	0.175**	0.175**
Age	0.352***	0.352***	0.551***	0.157**	0.159**	0.102**

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
University Level	-0.018	-0.056	-0.044	-0.047	-0.037	-0.025
Experience	0.172**	0.146**	0.165**	0.160**	0.194**	0.156**
Working Relationship		0.639***	0.551***	0.572***	0.568***	0.543***
Interest Relationship			0.165**	0.160**	0.165**	0.156**
Friendship Relationship				-0.151**	-0.135**	-0.149**
Friendship × Working					-0.073	
Friendship × Interest						-0.146**
Adjusted R^2	0.147	0.365	0.327	0.375	0.423	0.392
F-value	3.739	23.176	19.130	18.383	33.827	39.218

Note: **P<0.05;** *P<0.01

5. Discussion

Based on 304 questionnaires, this study divides knowledge transfer relationships into three dimensions—working relationship, interest relationship, and friendship relationship—and integrates them into a unified framework, avoiding research fragmentation. Key findings are as follows:

First, working relationship is the most fundamental relationship in knowledge transfer, with the most significant and stable impact on performance. Across Models 2, 3, and 4, its effect on knowledge transfer performance remains significant, indicating a strict positive correlation under all conditions. During knowledge transfer, knowledge sources should penetrate recipient firms' internal operations, understand difficulties in knowledge application, and provide guidance based on both university and firm realities. When necessary, knowledge sources may assume certain departmental functions, directly exercising authority to integrate resources and create appropriate contexts for knowledge application. As Makhija and Ganesan argue, the most effective transfer method is knowledge sources' active participation in knowledge application within recipient firms [**?**].

Second, interest relationship demonstrates stable effects, indicating that both parties' interests are fundamental to successful knowledge transfer and must be valued under all circumstances.

Third, the most important finding is that friendship relationship significantly negatively affects knowledge transfer performance: closer friendship relationships lead to poorer transfer performance. This aligns with the "weak ties" perspective. We argue that the "weak ties" view applies specifically to friendship relationships, not working or interest relationships. While weak ties scholars explain that loose relationships can eliminate redundant information, we propose an alternative explanation: as knowledge owners, knowledge sources have independent thinking. Following their own plans can break organizational routines and introduce advanced concepts. However, when high-level friendships

develop, firms may unconsciously influence knowledge sources' decisions, preventing them from deviating from original development patterns and resulting in suboptimal transfer performance.

Finally, friendship relationship negatively moderates the effect of interest relationship on knowledge transfer performance. In other words, closer friendship relationships weaken interest relationships' positive impact on performance. Our interpretation is that as friendship deepens, knowledge sources' interest-based appeals become suppressed, reducing their freedom to express benefit demands. When knowledge sources' interests are constrained, their motivation decreases, negatively affecting transfer performance. Figure 2 [Figure 2: see original paper] illustrates the relationships among the three dimensions and knowledge transfer performance.

Figure 2 Relationships Between Relationship Dimensions and Knowledge Transfer Performance

6. Theoretical Contributions and Managerial Implications

This study aims to explore how collaborative relationships affect transfer performance in inter-organizational knowledge transfer to better facilitate such processes. Based on 304 university-industry knowledge transfer questionnaires, we empirically validate the hypothesized model and examine the importance of each relationship dimension, enriching knowledge transfer research.

6.1 Theoretical Contributions

First, by reviewing knowledge transfer relationship literature, we redefine the applicability contexts of "weak ties" and "strong ties" perspectives, dividing collaborative relationships into distinct dimensions to overcome the limitation of treating relationships as a monolithic construct. Results show that loose "friendship relationships" enhance knowledge transfer performance, while close "working relationships" and "interest relationships" positively affect performance, preventing confusion between the two perspectives and providing theoretical support for future research.

Second, previous literature has overemphasized single relationship dimensions, yielding partial conclusions. This study takes a different approach by proposing that knowledge transfer collaborative relationships comprise three dimensions—working, interest, and friendship—and defines each dimension's attributes. By incorporating all three dimensions into a unified framework, we obtain more comprehensive conclusions.

Third, we empirically validate the negative moderating effect of friendship relationship on interest relationship. Conventional wisdom suggests that close friendships dilute interest relationships and reduce benefit demands. However, our research confirms this view is mistaken, as reducing either party's interests affects cooperative motivation and hinders knowledge transfer. This study

reveals the true nature of interest and friendship relationships, supplementing existing theory.

6.2 Managerial Implications

This study offers important practical implications for knowledge transfer parties and government agencies.

For universities, knowledge transfer should not be limited to superficial knowledge dissemination. Instead, universities should actively engage in recipient firms' internal operations, understand difficulties in knowledge application, and provide guidance based on both parties' realities. When necessary, knowledge sources may replace certain firm departments, directly exercising authority to integrate resources and create appropriate application contexts. As recipients, firms should welcome knowledge sources' deep involvement and even management roles.

For firms, it is crucial to understand knowledge sources' primary objectives. Although cooperation agreements specify interests, some potential goals (e.g., research achievements, graduate student training) cannot be quantified. These require in-depth communication between firms and knowledge sources. Only by understanding and respecting each other's needs can motivation be mobilized. However, while traditional views emphasize friendship's importance in cooperation, our findings show that in university-industry knowledge transfer, overly close friendships negatively affect performance. Firms should shift their mindset, develop appropriate friendship levels, avoid excessive closeness that may negatively impact knowledge sources, and maintain their independence.

For government, agencies should protect transfer parties' interests through institutional constraints and strict penalties for contractual violations. They should also strengthen the functions of knowledge transfer intermediaries to facilitate communication, especially during initial cooperation stages, enabling both parties to fully understand each other's intentions and establish foundations for smooth collaboration.

7. Research Limitations

This study has three main limitations: (1) Sample data come from university faculty without fully considering firm factors, potentially limiting generalizability to firms; (2) No mature, systematic scale exists for knowledge transfer relationships, so our adapted scale requires further validation; (3) Knowledge transfer performance is influenced by multiple factors (e.g., knowledge characteristics, organizational culture, cooperation type, firm features, and bilateral capabilities), which future research should examine alongside relationships, performance, and innovation outcomes.

References

[1] COHEN W M, LEVINTHAL D A. Absorptive capacity: a new perspective on learning and innovation[J]. Administrative science quarterly, 1990, 35(1): 128-152.
[2] ZAHRA S A, GEORGE G. Absorptive capacity: a review, reconceptualization, and extension[J]. Academy of management review, 2002, 27(2): 185-203.
[3] MOWERY D C, ROSENBERG N. Technology and the pursuit of economic growth[M]. New York: Cambridge University Press, 1991.
[4] AMBOS T C, MÄKELÄ K, BIRKINSHAW J, et al. When does university research get commercialized? Creating ambidexterity in research institutions[J]. Journal of management studies, 2008, 45(8): 1424-1447.
[5] MANSFIELD E. Academic research and industrial innovation: an update of empirical findings[J]. Research policy, 1998, 26(7): 773-776.
[6] VAN WIJK R, JANSEN J J P, LYLES M A. Inter- and intra-organizational knowledge transfer: a meta-analytic review and assessment of its antecedents and consequences[J]. Journal of management studies, 2008, 45(4): 830-853.
[7] REAGANS R, MCEVILY B. Network structure and knowledge transfer: the effects of cohesion and range[J]. Administrative science quarterly, 2003, 48(2): 240-267.
[8] LAI W H. Willingness-to-engage in technology transfer in industry-university collaborations[J]. Journal of business research, 2011, 64(11): 1218-1223.
[9] ANKRAH S N, BURGESS T F, GRIMSHAW P, et al. Asking both university and industry actors about their engagement in knowledge transfer: what single-group studies of motives omit[J]. Technovation, 2013, 33(2): 50-65.
[10] DHANARAJ C, LYLES M A, STEENSMA H K, et al. Managing tacit and explicit knowledge transfer in IJVs: the role of relational embeddedness and the impact on performance[J]. Journal of international business studies, 2004, 35(5): 428-442.
[11] ZHAO Y, LAVIN M. An empirical study of knowledge transfer in working relationships with suppliers in new product development[J]. International journal of innovation management, 2012, 16(2): 1-26.
[12] LEE Y S. 'Technology transfer' and the research university: a search for the boundaries of university-industry collaboration[J]. Research policy, 1996, 25(6): 843-863.
[13] SIEGEL D S, WALDMAN D A, ATWATER L E, et al. Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: qualitative evidence from the commercialization of university technologies[J]. Journal of engineering and technology management, 2004, 21(1): 115-142.
[14] BATTISTELLA C, DETONI A R, PILLON R. Inter-organizational technology/knowledge transfer: a framework from critical literature review[J]. The journal of technology transfer, 2016, 41(5): 1195-1234.
[15] RAMASAMY B, GOH K W, YEUNG M C H. Is Guanxi (relationship) a bridge to knowledge transfer?[J]. Journal of business research, 2006, 59(1): 130-139.
[16] GRANOVETTER M S. The strength of weak ties: a network theory

revisited[J]. Sociological theory, 1983, 1(1): 201-233.
[17] LEVIN D Z, CROSS R. The strength of weak ties you can trust: the mediating role of trust in effective knowledge transfer[J]. Management science, 2004, 50(11): 1477-1490.
[18] TORTORIELLO M, REAGANS R, MCEVILY B. Bridging the knowledge gap: the influence of strong ties, network cohesion, and network range on knowledge transfer between organizational units[J]. Organization science, 2012, 23(4): 1024-1039.
[19] SZULANSKI G. The process of knowledge transfer: a diachronic analysis of stickiness[J]. Organizational behavior and human decision processes, 2000, 82(1): 9-27.
[20] NONAKA I, BYOSIERE P, BORUCKI C C, et al. Organizational knowledge creation theory: a first comprehensive test[J]. International business review, 1994, 3(4): 337-351.
[21] LIAO S H, HU T C. Knowledge transfer and competitive advantage: an empirical study of Taiwan's semiconductor industry under environmental uncertainty[J]. Technovation, 2007, 27(6): 402-411.
[22] KOGUT B, ZANDER U. Knowledge of the firm, combinative capabilities, and the replication of technology[J]. Organization science, 1992, 3(3): 383-397.
[23] SANTORO M D, CHAKRABARTI A K. Firm size and technology centrality in industry-university interactions[J]. Research policy, 2002, 31(7): 1163-1180.
[24] TSAI W. Knowledge transfer in intraorganizational networks: effects of network position and absorptive capacity on business unit innovation and performance[J]. Academy of management journal, 2001, 44(5): 996-1004.
[25] ZHOU Changhui, CAO Yinghui. Organizational learning space: tie strength, knowledge breadth, and innovation unit performance[J]. Management world, 2011(4): 84-97.
[26] JU H, ZHANG S, ZHAO S, et al. Knowledge transfer capacity of universities and knowledge transfer success: evidence from university-industry collaborations in China[J]. International journal of technology management, 2016, 71(3-4): 278-300.
[27] PAN Wen'an. Research on relationship strength, knowledge integration capability, and supply chain knowledge transfer efficiency[J]. Science research management, 2012, 33(1): 147-153.
[28] HANSEN M. The search-transfer problem: the role of weak ties in sharing knowledge across organization subunits[J]. Administrative science quarterly, 1999, 44(1): 82-111.
[29] SZULANSKI G, RINGOV D, JENSEN R J. Overcoming stickiness: how the timing of knowledge transfer methods affects transfer difficulty[J]. Organization science, 2016, 27(2): 304-322.
[30] TANG F, MU J, MACLACHLAN D L. Disseminative capacity, organizational structure, and knowledge transfer[J]. Expert systems with applications, 2010, 37(2): 1586-1593.
[31] ARVANITIS S, KUBLI U, WOERTER M. University-industry knowledge and technology transfer in Switzerland: what university scientists think

about co-operation with private enterprises[J]. Research policy, 2008, 37(10): 1865-1883.
[32] LAM A. Embedded firms, embedded knowledge: problems of collaboration and knowledge transfer in global cooperative ventures[J]. Organization studies, 1997, 18(6): 973-996.
[33] MAKHIJA M V, GANESH U. The relationship between control and partner learning in learning-related joint ventures[J]. Organization science, 1997, 8(5): 508-527.
[34] MARTIN X, SALOMON R. Knowledge transfer capacity and its implications for the theory of the multinational corporation[J]. Journal of international business studies, 2003, 34(4): 356-373.
[35] SCHULZE A, BROJERDI G J, KROGH G. Those who know, do. Those who understand, teach. Disseminative capacity and knowledge transfer in the automotive industry[J]. Journal of product innovation management, 2014, 31(1): 79-97.
[36] PARK B I. Knowledge transfer capacity of multinational enterprises and technology acquisition in international joint ventures[J]. International business review, 2011, 20(1): 75-87.
[37] CHEN Feiqiong. The role of relational capital in corporate knowledge alliances[J]. Science research management, 2003(5): 37-43.
[38] ROBBINS S P, JUDGE T A. Organizational behavior[M]. 15th ed. New Jersey: Prentice Hall, 2012.
[39] FRANCIS D H, SANDBERG W R. Friendship within entrepreneurial teams and its association with team and venture performance[J]. Entrepreneurship theory and practice, 2000, 25(2): 5-25.
[40] LI L. The effects of trust and shared vision on inward knowledge transfer[J]. International business review, 2005, 14(1): 77-95.
[41] LIU X, GAO L, LU J, et al. The role of highly skilled migrants in the process of inter-firm knowledge transfer across borders[J]. Journal of world business, 2015, 50(1): 56-68.
[42] NUNNALLY J. Psychometric methods[J]. New York: McGraw, 1978.
[43] ZHANG Wentong. SPSS statistical analysis advanced tutorial[M]. Beijing: Higher Education Press, 2004.

Author Contributions:
Ju Xiaowei: Developed the research framework and overall approach
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Note: Figure translations are in progress. See original paper for figures.