



Transfer mechanisms and knowledge transfer: The cooperative competency perspective[☆]



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ABSTRACT

This study examines the role of transfer mechanisms, including replication and adaptation, in knowledge transfer from the cooperative competency perspective. This study tests the hypotheses in a sample of 120 knowledge transfer cases. The results indicate that transfer mechanisms relate positively to cooperative competency with partnering firms, which then improves knowledge transfer performance. The results provide evidence that cooperative competency plays a mediating role between transfer mechanisms and knowledge transfer performance. The findings of this study contribute to the theoretical development of a conceptual model for explaining the interrelationships among transfer mechanisms, cooperative competency, and knowledge transfer performance. The empirical evidence of the Sobel test in line with Baron and Kenny's procedure and bootstrap analysis supports the process-oriented view and indicates that cooperative competency mediates the effects of transfer mechanisms on knowledge transfer performance. Finally, this study discusses the managerial implications and highlights future research directions.

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1. Introduction

The turbulence of the business environment renders knowledge a dominant source of firms' sustainable competitive advantage (Lyles & Salk, 1996; Tsai, 2001). The use of strategic alliances to transfer knowledge from entities outside organizational boundaries becomes central to firm success (Bresman, Birkinshaw, & Nobel, 1999; Lane, Salk, & Lyles, 2001) and affects key organizational outcomes (e.g., Lyles & Salk, 1996; Yli-Renko, Autio, & Sapienza, 2001).

The process of knowledge transfer requires commitments of resources, managerial time, attention, and effort (Chen, 2004; Easterby-Smith, Lyles, & Tsang, 2008). Since knowledge transfer is a socially collaborative construct, management scholars have long recognized its contextual nature (Björkman, Barner-Rasmussen, & Li, 2004; Cho & Lee, 2004; Foss & Pedersen, 2002; Lyles & Salk, 1996). Transfer mechanisms are the modes by which firms conduct knowledge transfer activities (Easterby-Smith et al., 2008; Mason & Leek, 2008). The transfer mechanisms affect how organizations interact and how to transfer

knowledge (Jasimuddin, 2007; Prévot & Spencer, 2006). To make the knowledge transfer effective, firms leverage their cooperative competency. Cooperative competency, in this study, is the ability of interacting units across firms between the focal firm and the exchange partners to adjust mutually through trust, communication, and coordination (Sivadas & Dwyer, 2000). Cooperative competency enables firms to accelerate knowledge access, support innovativeness and competitive advantage creation.

Prior studies empirically examine how alliance characteristics such as knowledge attributes (e.g., Blumenberg, Wagner, & Beimborn, 2009; Santoro & Saporito, 2006), social ties (e.g., Bond, Houston, & Tang, 2008; Chen, Shih, & Yang, 2009; Yli-Renko et al., 2001) and form of alliance (e.g., Björkman et al., 2004; Chen, 2004; Cho & Lee, 2004; Lee & Cavusgil, 2006; Lyles & Salk, 1996) affect knowledge transfer outcomes. These prior studies recognize the importance of these alliance characteristics to the transfer of knowledge. However, little research examines the role of transfer mechanisms and cooperative competency with their partners in terms of trust, communication, and coordination in knowledge transfer (Santoro & Saporito, 2006; Williams, 2007). Accordingly, this study investigates the impact of transfer mechanisms on the performance of knowledge transfer in the context of interfirm cooperation.

The research contributions of this study lie in three areas. First, this study adds to literature on inter-organizational knowledge transfer (Santoro & Saporito, 2006; Williams, 2007) by accentuating the roles

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of transfer mechanisms and cooperative competency. Second, the study advances prior research (Chen & Huang, 2007; Williams, 2007) by grounding the knowledge transfer debate in a more robust framework based on process-oriented view, and demonstrates that cooperative competency mediates the effects of transfer mechanisms on knowledge transfer performance. Third, this study responds to calls for a more differentiated investigation of transfer mechanisms (Williams, 2007) by investigating the separate effects of replication and adaptation.

The article has the following structure. **Background and hypotheses** section proposes a conceptual framework through Fig. 1, which posits that cooperative competency acts as an intermediate factor between transfer mechanisms and knowledge transfer performance. By doing so, this study aims to answer the following questions. Can the form of the transfer mechanisms with recipient firms provide enough cooperative competencies to transfer sending firms' knowledge? Does cooperative competency affect knowledge transfer performance between the recipient and sending firms? How do firm-specific cooperative competency such as trust, communication, and coordination affect the knowledge transfer process?

Therefore, this study proposes two directional relationships (H1 and H2) and one mediated relationship (H3) to provide further insights into how transfer mechanisms influence knowledge transfer performance through cooperative competency. This study employs formative constructs to measure transfer mechanisms and cooperative competency. This study measures transfer mechanisms through replication and adaptation (Easterby-Smith et al., 2008; Mason & Leek, 2008). Cooperative competency consists of trust, communication, and coordination (Sivadas & Dwyer, 2000). Knowledge transfer performance is the degree to which the acquired knowledge contributes to a firm's innovativeness (Chen, 2004; Chen et al., 2009; Maurer, Bartsch, & Ebers, 2011; Park, 2010; Yli-Renko et al., 2001). **Research method** section outlines the study's method based on a sample of 120 Taiwanese knowledge transfer cases. **Results** section discusses the empirical results. Finally, **Discussion and conclusion** section presents some conclusions and managerial implications.

2. Background and hypotheses

2.1. A process model of how transfer mechanisms unfold performance effects

Transfer mechanisms are the way that recipient firms involve in replicating or adapting the knowledge from the sending firms (Easterby-Smith et al., 2008; Mason & Leek, 2008). Although transfer mechanisms have no universally accepted definition, scholars agree that replication and adaptation are central elements of the concept (Jasimuddin, 2007; Prévot & Spencer, 2006; Williams, 2007). Replication indicates that the extent of the recipients uses the transferred knowledge from the senders in their operations. When using high levels of replication, the receiving units copy the practice exactly as the source performs the practice

until the practice achieves similar results. For example, Intel uses this copy exact policy when establishing new semiconductor fabs, requiring engineers to replicate fab designs and work practices with exactitude (Williams, 2007).

Therefore, replication is the change in the receiving unit's operations to be more like its partner's. In contrast, with adaptation the recipient modifies the transferred knowledge before using it. Adaptation enables receiving units to focus on potentially valuable knowledge and modify or combine practices from a source unit. In the domain of franchising, for instance, franchisees often attempt to improve on the franchise system that they join by immediately modifying operational routines in the expectation that it will be profitable in their unique situation.

Thus, adaptation is a change in operation to integrate the firm with the new context. In this study, firms should know how to utilize the transfer mechanisms if they want to enhance the cooperative competency with the alliance partners during the knowledge transfer period (H1 in Fig. 1).

Cooperative competency is the ability of interacting units across firms between the focal firm and the exchange partners to adjust mutually. This study focuses on three specific cooperative competencies: trust, communication, and coordination (Sivadas & Dwyer, 2000). Trust enables the transfer of organizational knowledge since trust increases partners' willingness to commit to helping partners absorb new external knowledge (Lane et al., 2001). Communication facilitates access to potentially useful knowledge, ideas or resources and increases the probability and amount of organizational knowledge transfer (Ghoshal & Bartlett, 1988; Gupta & Govindarajan, 1994). Coordination promotes mutual understanding and helps actors to integrate knowledge (Cohen & Levinthal, 1990). In this study, cooperative competency plays a critical role in affecting knowledge transfer performance (H2 in Fig. 1).

The process model of how transfer mechanisms reveals the effects of knowledge transfer performance through specific mediating features of cooperative competency itself. Therefore this study posits that the influence of cooperative competency seems to be more important than transfer mechanisms on knowledge transfer performance. In other words, this study argues that cooperative competency has to take place before transfer mechanisms have any performance effects. The value of transfer mechanisms seems to depend on the mediating process of cooperative competency that translates transfer mechanisms into real performance outcomes (H3 in Fig. 1).

2.2. Transfer mechanisms and cooperative competency

Replication emphasizes recipients' significant efforts towards creating an identical set of activities to those of the sending partner (Winter, 1995). Replication increases frequent and in-depth communication between recipients and senders and makes it possible to use a shared language and symbols in the interest of knowledge transfer (Herrgard, 2000). Replication ensures that the transferred

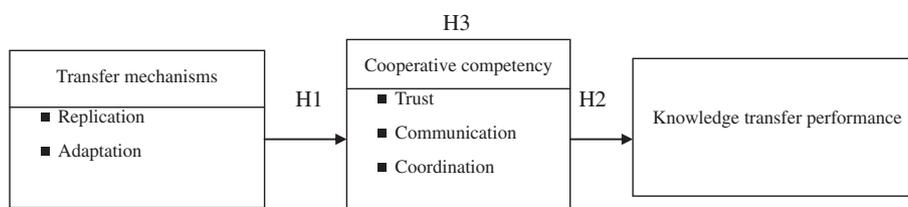


Fig. 1. The research model.

practices contain the elements of the knowledge that may turn out to be valuable to recipients (Nonaka, 1994).

Replication also leads to trust and friendship, both of which reduce opportunism. Mutual trust prevents firms from resorting to opportunism in alliance relationships when conducting resource or information exchange (Dakhli & De Clercq, 2004). In addition, firms engaging in replication activities help them to establish coordination channels with their partners in order to exchange the expertise and information (Grant, 1996; Solingen, Berghout, Kusters, & Trienekens, 2000). In other words, the replication activities in knowledge transfer enable employees of the recipient firms to work together with their partners in the sending firms and understand the knowledge that they acquire. Through replication activities, firms will be able to intensify their cooperative competency with the partners.

Adaptation is also likely to facilitate recipients' cooperative competency with the partners because adaptation needs to combine different and complementary sources of knowledge (Dussauge, Garrette, & Mitchell, 2000; Rothaermel, 2001). Adaptation coordinates knowledge transfer activities and makes communications and information exchanges between employees of the recipient and sending firms more conveniently (Dyer & Singh, 1998).

The ease and smoothness of adaptation increases openness and transparency between the partners (Doz & Hamel, 1998). In addition, adaptation activities can reduce or eliminate the protectionist constraints which partners impose (Kale, Singh, & Perlmutter, 2000) and trigger mutual trust between partners (Kale et al., 2000). Thus, when the recipient firms adapt the knowledge from their partners, they are more inclined to increase their cooperative competency with the partnering firms to exchange and share creative thoughts in making the modifications.

Accordingly, when recipient firms are aggressive in replicating or adapting the knowledge from their partners, their employees are likely to build cooperative networks with the partners to exchange and gather information in the course of knowledge transfer. Conversely, if recipient firms are relatively passive in knowledge replication or adaptation, employees are likely to perceive less of a need to cooperate with the sending firms.

As a result, transfer mechanisms of replication and adaptation are likely to strengthen cooperative competency between the recipient and sending firms.

H1. Transfer mechanisms relate positively to cooperative competency.

2.3. Cooperative competency and knowledge transfer performance

Previous studies find that the related concepts of social capital, cooperation, and interaction can accelerate knowledge access, support innovativeness and create competitive advantage (Burt, 1992; Nahapiet & Ghoshal, 1998; Wilkesmann, Wilkesmann, & Virgillito, 2009; Wu & Cavusgil, 2006). Some researchers suggest that relational capability may enable firms to gain access to external knowledge and combine it with the existing knowledge (Lane & Lubatkin, 1998; Ramasamy, Goh, & Yeung, 2006; Yli-Renko et al., 2001).

Others propose the importance of social capital for creating a context to facilitate the creation and diffusion of new knowledge (Lane & Lubatkin, 1998; Tsai & Ghoshal, 1998). This study depends on Sivadas and Dwyer's (2000) determinants of cooperative competency in terms of trust, communication, and coordination and modifies to make it suitable for assessing the role of cooperative competency in knowledge transfer through strategic alliances.

Trust is positive expectations of the goodwill and competence of an exchange partner (Nahapiet & Ghoshal, 1998). The alliance literature considers that trust facilitates knowledge transfer between recipients and senders by diminishing the risk of the partners'

opportunistic behaviors (Dakhli & De Clercq, 2004; Uzzi, 1996). In a relationship based on trust, exchange partners are more willing to share their knowledge because they trust each other to handle the knowledge carefully and use the knowledge in a form that will benefit the organization (Gulati, 1995; McEvily, Perrone, & Zaheer, 2003; Uzzi, 1997; Zaheer & Venkatraman, 1995). At the same time, trust enhances the incentives to assimilate and use knowledge (Dyer & Singh, 1998; Larson, 1992).

In a trusting relationship, recipients assume a high level of reliability and quality of knowledge transfer. In this way, trust also reduces the costs for searching and verifying each other's knowledge resources (Dyer & Singh, 1998; Larson, 1992), increasing both likelihood and efficiency of their subsequent use. Accordingly, the establishment of a high level of mutual trust is likely to enhance knowledge transfer.

In terms of communication, the amount and extent of transferred knowledge may depend on the quality of the communication between the partners (Björkman et al., 2004; Tsai, 2001; Tsai & Ghoshal, 1998). Communication, in this study, includes the formal and informal sharing of timely, adequate, critical, and proprietary information among alliance partners (Sivadas & Dwyer, 2000). Frequent communications support recipients in mobilizing, assimilating, and using senders' knowledge resources. Good communication promotes a long-term perspective between exchange partners (Larson, 1992) and helps to develop cooperative routines (Uzzi, 1997) that make knowledge transfer easier (Dyer & Nobeoka, 2000). Frequent communications over time establish rich interaction channels and common understandings and provide feedback loops that enhance recipients' ability to evaluate, understand, and accurately use the transferred knowledge (Tortoriello & Krackhardt, 2010). Strong communications thus enhance recipients' ability to engage in knowledge transfer, and make the knowledge transfer easier (Reagans & McEvily, 2003) because they augment recipients' absorptive capacity (Cohen & Levinthal, 1990). In sum, communication facilitates the knowledge transfer.

In addition, coordination is arguably another critical element in successful knowledge transfer (Gupta & Govindarajan, 2000; Hansen, 2002). Coordination is the extent to which activities, people, routines, and assignments work together to accomplish objectives (Van de Ven, Delbecq, & Koenig, 1976). The more coordination among actors, the more opportunities they have to share knowledge. With an increasing amount of coordination, it becomes easier for experts from several organizations to interact (Reagans & McEvily, 2003). Through coordination, senders can inform recipients about the existence and location of relevant knowledge (Smith, Collins, & Clark, 2005). Additionally, coordination supports the assimilation of knowledge resources by allowing senders and recipients to exchange and combine each other's information (Tsai & Ghoshal, 1998).

Finally, with a greater amount of coordination, the likelihood of finding a fit between the knowledge required by one actor and provided by another increases. This outcome likely causes actors to be able to use the transferred knowledge resources for their purposes and thus transform them into a concrete output. Therefore, a greater amount of coordination between senders and recipients not only grants potential access to organizational knowledge resources, but also increases the ease and extent of knowledge transfer (Koka & Prescott, 2002; McFadyen & Cannella, 2004).

Accordingly, cooperative competency in terms of trust, communication, and coordination likely makes positive contributions to knowledge transfer. Through cooperative competency, firms may be able to strengthen the willingness and involvement of the partners in the knowledge transfer process and implement transfer activities more effectively, thus leading to a better knowledge transfer performance.

H2. Cooperative competency relates positively to knowledge transfer performance.

2.4. The mediating role of cooperative competency in knowledge transfer

The earlier hypotheses link the relationships among transfer mechanisms with cooperative competency and cooperative competency with knowledge transfer performance. These hypotheses imply that transfer mechanisms will indirectly influence knowledge transfer performance through cooperative competency. Knowledge transfer is a process that first and foremost takes place on the individual level and requires commitment not only of resources but also of managerial time, attention, and efforts in interacting between employees of the recipient and those of sending firms (Argote, McEvily, & Reagans, 2003; Easterby-Smith et al., 2008; Grant, 1996).

In knowledge transfer, replication activities strengthen the firms' trusting relationships with the partners, increase communication in a shared language and symbols and establish the consensus on the operation with their partners through coordination so that the recipients use the identical information as the senders. Then the established cooperative competency will facilitate the contact reliability and faithfulness in the knowledge transfer process, which help firms learn and acquire knowledge from their partners (Moran, 2005).

Similarly, cooperative competency plays the mediating role between adaptation activities and knowledge transfer performance. In the knowledge transfer setting, adaptation activities can trigger and increase the cooperative competency to integrate potentially valuable knowledge from the senders into the new context of the recipient firm, increase the openness and transparency between the partners, accelerate the learning of different and complementary information from senders, and modify the transferred knowledge for their own use (Dussauge et al., 2000; Dyer & Singh, 1998; Kale et al., 2000; Rothaermel, 2001). Accordingly, it will increase the willingness and involvement of both parties in engaging in knowledge transfer activities and thus leading to a better outcome.

Replication and adaptation are valuable mechanisms to promote favorable cooperative competency with partners, which, in turn, enhance knowledge transfer. Thus, this study proposes that cooperative competency plays a mediating role in the relationships between independent variables of transfer mechanisms and the dependent variable of knowledge transfer performance.

H3. Cooperative competency mediates the effect of transfer mechanisms on knowledge transfer performance.

3. Research method

3.1. Data collection and sample

This study employs a questionnaire survey approach to collect data for testing the validity of the model and research hypotheses. Variables in the questionnaire include background information, transfer mechanisms, cooperative competency, and knowledge transfer performance. All independent and dependent variables require seven-point Likert-type responses ranging from strongly disagree (1) to strongly agree (7), except for background information. If the subject company has more than one knowledge transfer project in the last five years, this study asks the company to choose the most significant one. In the survey, this study chooses the knowledge transfer projects in the top 5000 Taiwanese firms listed in the China Credit Information Service Incorporation database as the survey population in 2008. Thus, the knowledge transfer project is the unit of analysis in this study. This study uses a stratified random sampling method to select 100 firms in each of the five 1000 levels.

This study included distributing 500 questionnaires and follow-up letters, e-mails, and phone calls to non-respondents two weeks

after the first mailing to appeal for participation. After the follow-up, this study dispatches an additional questionnaire in the fifth week. During the survey, this research repeatedly guarantees confidentiality and anonymity to reduce the fear of disclosure of company information.

Multiple informants were used to capture both independent and dependent variables to minimize common method variance problem. Thus, the research design divides the questionnaire into two parts and different persons answer each part. Project leaders fill out independent variables and mediating variables, while top executives (i.e., presidents, vice presidents, directors, or general managers) answer dependent variables and control variables. To ensure the legitimacy of the collected data, this study conducts quality checks to verify the provided information. First, all survey pairs contain identifying codes so that this study can subsequently identify the dyads of project leaders and top executives. Second, this study compares the handwriting on all questionnaires to ensure that no project leaders (or top executives) fill out the entire questionnaires.

Finally, if this study finds either multiple project leaders (or top executives) questionnaires or missing information, this study contacts again by email or phone to check the information. As a result of these quality checks, this study deems 10 pairs of questionnaires either to be questionable or to contain too much missing data and removes them from further analysis. The final sample therefore contains 120 valid and complete questionnaires. It represents a useable response rate of 24%.

Subsequently, this study assesses the possibility of non-response bias by using an extrapolation method comparing late and early respondents (Armstrong & Overton, 1977). The calculated t-statistics for the age of the company ($t = 0.064$, $p = 0.865$), capital ($t = -1.083$, $p = 0.279$), annual sales ($t = 0.254$, $p = 0.800$), and the number of employees ($t = 0.264$, $p = 0.900$), and the chi-square test for the industry affiliation of the company ($\chi^2 = 3.476$, $p = 0.809$) are all statistically insignificant. In addition, this study conducts t-statistics to check the possibility of non-response bias concerning all main constructs – knowledge transfer performance, transfer mechanisms, and cooperative competency. The calculated t-statistics for replication ($t = 1.326$, $p = 0.252$), adaptation ($t = 1.587$, $p = 0.210$), trust ($t = 0.254$, $p = 0.615$), communication ($t = 0.002$, $p = 0.965$), coordination ($t = 0.043$, $p = 0.835$), and knowledge transfer performance ($t = 0.455$, $p = 0.501$). This study detects no differences across either demographic or substantive variables, suggesting no substantive non-response bias.

3.2. Measures

3.2.1. Dependent variable

Following prior studies (Chen, 2004; Chen et al., 2009; Maurer et al., 2011; Park, 2010; Yli-Renko et al., 2001), this study includes a four-item scale to measure the degree to which the acquired knowledge contributes to firm's innovativeness in terms of facilitating the innovation ability, shortening innovation time period, inducing many innovation activities, and achieving many innovation results for the firms ($\alpha = 0.90$). The Cronbach's alpha coefficients in the parentheses indicating the internal consistency reliability of the measures in the factors of dependent and independent variables are all above the suggested value of 0.70 (Hair, Anderson, Tatham, & Black, 1998).

3.2.2. Independent variables

This study assesses transfer mechanisms with eight items reflecting the extent of mechanisms used by organizations to accomplish knowledge transfer. According to Williams (2007), this study categorizes transfer mechanisms into two dimensions of replication and adaptation. Replication refers to changing the receiving unit's operations to be more

like its partner's. On the other hand, adaptation stresses on changing its operations to integrate it with the new context.

This study includes replication via a four-item scale aimed at measuring the extent that firms try to manage their business exactly like their partner, to implement practices from their partner exactly as they exist, to copy practices from their partner down to the smallest details, and to spend substantial time in making sure practices they adopt from their partner work just as they do there ($\alpha = 0.84$). The adaptation measure includes four items, with respondents indicating the extent that firms usually implement modified practices from the partner into their own business, combine ideas from the partner with other ideas, spend substantial time in modifying practices from the partner, and carefully select practices from the partner ($\alpha = 0.74$).

Cooperative competency, in this study, refers to an ability of interacting units across firms between the focal firm and the exchange partners to adjust mutually through trust, communication, and coordination (Sivadas & Dwyer, 2000). This study derives from Sivadas and Dwyer's (2000) determinants of cooperation competency in terms of trust, communication, and coordination and modifies to make it suitable for assessing the role of cooperative competency in knowledge transfer through strategic alliances. According to Sivadas and Dwyer (2000), these sixteen items are categorized into three factors including trust, communication, and coordination. The trust factor is reflected by six items indicating how much the informants agree with the following statements: (1) our alliance partners have the ability to contribute to the knowledge transfer efforts, (2) our alliance partners are capable of doing their parts, (3) our alliance partners have high integrity, (4) our alliance partners can be counted on to do the right thing, (5) our alliance partners' motives can never be questioned, and (6) we trust that our alliance partners will act in the company's best interests ($\alpha = 0.90$).

The communication measure includes five items: (1) our alliance partners inform us of changing project needs, (2) our alliance partners share proprietary information with us, (3) our alliance partners provide information that will help us, (4) our alliance partners provide us with adequate information, and (5) our alliance partners provide us with timely information ($\alpha = 0.89$). The coordination measure includes five items to reflect whether the respondents agree that: (1) the different job and work activities around the knowledge transfer activities fit together very well, (2) in the knowledge transfer activities, people from different organizations work together to do their jobs properly and efficiently, (3) in the knowledge transfer activities, all related things and activities are well timed in the everyday routine of the process, (4) in the knowledge transfer activities, the work assignments of the people from different organizations who work together are well planned, and (5) in general, the routines of the different organizations that have to work with one another are well established in the knowledge transfer activities ($\alpha = 0.93$).

3.2.3. Control variables

Firm size and firm age may influence knowledge transfer performance because different sizes and ages may exhibit different organizational characteristics, resource deployment, and knowledge transfer capabilities. Firm age is related, to a certain extent, to the level of experience and managerial competences that an organization has in doing businesses and thus may affect organizational performance (Bierly & Daly, 2007; Chandler & Hanks, 1994; Zhan & Luo, 2008). Firm size may influence firm performance because different sizes may exhibit different organizational characteristics and resource deployment (Aral & Weill, 2007; Blau & Schoenherr, 1971; Weigelt, 2009). A firm with limited resources will find it beneficial to collaborate in order to get access to the resources and social opportunities it needs to achieve higher firm performance from the alliance (Wu & Cavusgil, 2006).

Therefore, this study includes these variables as controls to measure potential effects. This study measures firm size by two variables, that is, the amount of capital (in million NT dollars) and the number of employees (in log). Firm age is the number of years from the founding date. This study also controls RandD intensity as it may affect knowledge transfer performance. This study measures RandD intensity as the ratio of RandD expenditure to a firm's total annual sales.

3.3. Measurement model: reliability and validity

Estimating the measurement model includes a confirmatory factor analysis for all of the multi-item scales of the dependent and independent variables simultaneously to provide evidence of both internal consistency and convergent validity (Gerbing & Anderson, 1988). All of the constructs show satisfactory levels of reliability in terms of the composite reliabilities, ranging from 0.88 to 0.98. Convergent validity, the extent to which different means of measuring a construct agree, can be judged by looking at the item loadings. Each loading for each construct shown in the Appendix A (Table A1) significantly relates to its underlying factor, and all of the standardized item loadings are well above the cutoff of 0.50 (see Appendix A), thus supporting convergent validity.

The chi-square statistic for the combined model is insignificant ($p > 0.05$). The comparative fit index (CFI = 0.96) and normal fit index (NFI = 0.91) both indicate an acceptable fit. The root-mean-square error of approximation (RMSEA) is a respectable 0.07. These fit statistics are acceptable for a complex and multidimensional model.

Discriminant validity, the extent to which a construct differs from others, is assessed for the multi-item dependent and independent scales. This study examines the pairwise discriminant validity by merging the constructs into one and then examines the difference in chi-square values between the constrained and unconstrained models. The test statistics for each pair are highly significant ($p < 0.05$), thus suggesting discriminant validity. It is particularly important that discriminant validity is achieved among the constructs for cooperative competency, transfer mechanisms, and knowledge transfer performance.

The significant difference in the chi-square (cooperative competency vs. transfer mechanisms, $\Delta\chi^2 = 40.1$, $\Delta df = 1$, $p < 0.001$; cooperative competency vs. knowledge transfer performance, $\Delta\chi^2 = 55.5$, $\Delta df = 1$, $p < 0.001$; transfer mechanisms vs. knowledge transfer performance, $\Delta\chi^2 = 46.7$, $\Delta df = 1$, $p < 0.001$) indicates pairwise discriminant validity of the constructs (Gerbing & Anderson, 1988). This study also compares the goodness-of-fit indexes between each constrained and unconstrained model and finds the difference to be moderately large, again suggesting sufficient discriminant validity (Bagozzi & Yi, 1990).

The tables of the principal component factor analysis with varimax rotation confirm the dimensions of the construct shown in Appendix B, Tables B1–B3.

4. Results

This study attempts to understand the relationships among transfer mechanisms, cooperative competency, and knowledge transfer performance. Table 1 displays the means, standard deviations, and correlations of all measured variables in this study. This study uses variance inflation factors (VIFs) to examine the effect of multicollinearity. The values of the VIF associated with the predictors show a range from 1.10 to 3.27, with a mean of 2.29. The effects of multicollinearity fall within acceptable limits, suggesting no need for concern with respect to multicollinearity (Hair et al., 1998).

Table 2 presents the results of regression analysis predicting cooperative competency and knowledge transfer performance. Overall, it

Table 1
Means, standard deviations, and correlations.^a

Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	VIF
1. Firm age	28.27	16.07	1.00									1.20
2. Capital	4.82	1.81	0.20	1.00								2.63
3. Employees (log)	3.77	2.06	0.08	0.76	1.00							2.47
4. RandD intensity	8.22	9.68	-0.17	-0.13	-0.01	1.00						1.10
5. Replication	4.58	1.16	0.03	-0.21	-0.21	0.12	1.00					1.47
6. Adaptation	5.11	0.94	-0.16	-0.12	-0.13	0.14	0.46	1.00				2.21
7. Trust	5.38	0.86	-0.19	-0.11	-0.08	0.15	0.46	0.71	1.00			3.05
8. Communication	5.33	0.84	-0.31	-0.23	-0.14	-0.01	0.29	0.58	0.68	1.00		3.27
9. Coordination	5.09	0.96	-0.14	-0.11	-0.05	0.10	0.41	0.56	0.72	0.77	1.00	3.19
10. Knowledge transfer performance	5.49	0.85	-0.23	-0.16	-0.07	0.10	0.29	0.29	0.47	0.57	0.65	

^a N = 120 (two-tailed test). Correlations with absolute value greater than 0.18 are significant at p < 0.05, and those greater than 0.28 are significant at p < 0.01.

suggests that the variables are largely related in the theoretically predicted manner. Models 1a, 2a, 3a, and 4a in Table 2 are the base models that include the four control variables. The results indicate that this combination of variables does not have significant impact on the dependent variables (F = 1.52, R² = 0.05, F = 4.22, R² = 0.13, F = 0.89, R² = 0.03, and F = 1.97, R² = 0.06, respectively). Models 1b, 2b, and 3b capture the direct effects of transfer mechanisms on cooperative competency.

These three models are significant at the p < 0.001 level (R² = 0.53, 0.42, and 0.35, respectively) and explain an additional 48.0, 29.0 and 32.0% of variance over what the control variables alone explain. Coefficients of replication are positive and significant for trust (p < 0.05), communication (p < 0.05), and coordination (p < 0.05).

These findings indicate that firms achieve a higher level of cooperative competency if they do the replication activities in the knowledge transfer projects. Similarly, adaptation has positive and significant effects on trust (p < 0.001), communication (p < 0.001), and coordination (p < 0.001). These findings also indicate that firms achieve a higher level of cooperative competency with their partners if they do the adaptation activities in the knowledge transfer projects. Accordingly, the findings support H1, which

states that the transfer mechanisms relate positively to cooperative competency.

Next, consider how cooperative competency affects knowledge transfer performance. Model 4c in Table 2 presents the effects of the three cooperative competency factors, trust, communication, and coordination, on knowledge transfer performance. The model is significant at the p < 0.001 level and yields an R² of 0.44. The results for trust (p < 0.05), communication (p < 0.05), and coordination (p < 0.001) in Model 4c suggest that they are significant determinants of knowledge transfer performance. The positive and significant coefficients indicate that firms achieve a higher level of knowledge transfer performance when they trust their partners, communicate and coordinate more frequently and effectively with their partners. In summary, three factors of cooperative competency have the expected signs and significant effects on knowledge transfer performance. Accordingly, this study supports H2.

This study applies a sequential procedure that Baron and Kenny (1986) recommend to test the mediating role of cooperative competency in affecting the relationships between independent variables of transfer mechanisms and dependent variable of knowledge transfer performance. The first step is to examine the effects of the

Table 2
Results of regression analyses of cooperative competency and knowledge transfer performance.

Variables	Model 1: trust		Model 2: communication		Model 3: coordination		Model 4: knowledge transfer performance				Sobel test ^a	Sobel test ^b	Sobel test ^c	
	1a	1b	2a	2b	3a	3b	4a	4b	4c	4d				
Control variables														
Firm age	-0.17	-0.10	-0.28	-0.21**	-0.11	-0.07	-0.19	-0.18*	-0.10	-0.11				
Capital	-0.04	-0.02	-0.22	-0.22	-0.12	-0.10	-0.17	-0.15	-0.08	-0.05				
Employees (log)	-0.04	-0.06	0.05	0.12	0.05	0.14	0.07	0.12	0.03	0.02				
RandD intensity	0.10	0.02	-0.07	-0.12	0.05	0.01	0.03	0.01	0.01	0.02				
Transfer mechanisms														
Replication		0.19*		0.05*		0.22*		0.22*		0.08	2.94**	1.66*	2.76**	
Adaptation		0.61***		0.53***		0.45***		0.16**		0.21	4.92***	4.99***	4.62***	
Cooperative competency														
Trust									0.04*	0.04*				
Communication									0.12*	0.18*				
Coordination									0.56***	0.54***				
R ²	0.05	0.53	0.13	0.42	0.03	0.35	0.06	0.16	0.44	0.46				
F value	1.52	21.50***	4.22***	13.47***	0.89	10.24***	1.97	3.62***	12.73***	10.57***				

N = 120 (two-tailed test). Standardized coefficients are reported.

* p < 0.05.

** p < 0.01.

*** p < 0.001.

^a Sobel tests of trust.

^b Sobel tests of communication.

^c Sobel tests of coordination.

independent variables on the dependent variable. As shown in Model 4b of Table 2, coefficients of replication ($p < 0.05$) and adaptation ($p < 0.01$) positively and significantly relate to knowledge transfer performance. Second, this study regresses the mediator, cooperative competency, on the independent variables, transfer mechanisms.

The results, shown in Model 1b, 2b, and 3b of Table 2, indicate that replication and adaptation have significant effects on cooperative competency. The third step is to examine the relationships between the mediator and the dependent variable. The results, shown in Model 4c of Table 2, indicate that cooperative competency has a positive and significant effect on knowledge transfer performance.

Lastly, this study includes the mediator, cooperative competency, in the models to examine whether it reduces the effects of the antecedents to non-significance. Mediation occurs if the effects of antecedents on knowledge transfer performance are reduced in the presence of the mediator and the overall fit is improved. The results of Model 4d in Table 2 show that the effects of the transfer mechanisms factors are significantly reduced to non-significance in the presence of the mediators of cooperative competency, and the overall fit of the model is improved ($\Delta R^2 = 0.30$).

This study further tests the significance of the indirect effects of the independent variables on knowledge transfer performance by Sobel test, which is a more direct test of the mediation hypotheses because it examines the combined effects of the path between the dependent variable and the mediator and the path between the mediator and the independent variable (Sobel, 1982). As shown in the final three columns of Table 2, this study finds that replication ($p < 0.01$, $p < 0.05$, and $p < 0.01$, respectively) and adaptation ($p < 0.001$, $p < 0.001$, and $p < 0.001$, respectively) have significant and indirect effects on knowledge transfer performance.

The results of the Sobel test provide further support to the mediating role of cooperative competency in affecting the relationships between transfer mechanisms and knowledge transfer performance. Accordingly, this study supports H3, which states cooperative competency mediates the effect of transfer mechanisms on knowledge transfer performance.

In addition, this study implements the bootstrap analysis, using the graphical interface of Amos 5.0, that Mallinckrodt, Abraham, Wei, and Russell (2006) and Zhao, Lynch, and Chen (2010) recommend to test the mediation effects. This study selects the bootstrap option from the “View/Set” menu under the “Analysis Properties” submenu and requests 5000 bootstrap samples, drawn by default with replacement from the full data set of 120 cases.

This study selects both bias-corrected and uncorrected options with 95% confidence intervals and requests bootstrap estimates of indirect, direct, and total effects through the Output submenu. Bootstrapped estimates of the TM→CC, CC→KTP, and TM→CC→KTP path coefficients appear in Table 3.

The last two columns of Table 3 show the upper and lower limits for the 95% confidence intervals calculated with both bias-corrected and uncorrected methods. The first set of confidence intervals shows the results of the bootstrapped percentile without bias correction. These values correspond to the 2.5th and 97.5th percentiles from lowest to highest rank-ordered estimates of the indirect effect derived from the 5000 samples. As the percentile confidence interval does not include zero and the corresponding p value is 0.002 for the bootstrap method without bias correction, this study concludes that the indirect effect is statistically significant.

In addition, the results of the bias-corrected 95% confidence intervals appear in the last column of Table 3. As this assumed more accurate confidence interval (0.304, 0.583) also excludes zero and the corresponding p value is 0.001 for the bias-corrected bootstrap method, this study concludes that the indirect effect of transfer mechanisms on knowledge transfer performance through the mediator of cooperative competency is statistically significant. Accordingly, the results of the bootstrap analyses further support H3.

5. Discussion and conclusion

Strategic alliances are an important vehicle for firms to acquire outside knowledge for improving their competitive advantages. This study presents a conceptual model to examine the role of cooperative competency between transfer mechanisms and knowledge transfer performance. The results provide strong support for the arguments that transfer mechanisms and cooperative competency facilitate knowledge transfer performance. The transfer mechanisms have significant but indirect effects on knowledge transfer performance, and cooperative competency has significant effects directly on knowledge transfer performance. More specifically, transfer mechanisms relate positively to cooperative competency, which in turn relates positively to knowledge transfer performance. These findings highlight the critical roles of transfer mechanisms and cooperative competency in the process of knowledge transfer.

5.1. Implications for practice

This article has important implications for both scholars and practitioners and opens many avenues for further explorations in the field. The findings and context have important managerial implications for practitioners. A firm enters into an alliance to combine its distinctive competencies with those of a partner to create a competitive position that neither could accomplish alone. For success, each must share information with and learn from the other (Hutt, Edwin, Beth, & Peter, 2000).

Thereby, both can learn something about their previous knowledge and they can thus better evaluate which pieces of information will be useful for each other (Wilkesmann et al., 2009). For

Table 3
Bootstrap analysis to test significance of mediation effects.

Path/effect	Bootstrap estimate		95% confidence interval	
	\bar{B}	\bar{SE}	Bootstrap percentile without bias correction	Bootstrap percentile with bias correction
TM→CC	0.500	0.134	0.361, 0.623	0.353, 0.618
CC→KTP	0.560	0.063	0.426, 0.670	0.433, 0.677
TM→KTP	−0.088	0.085	−0.255, 0.079	−0.253, 0.081
TM→CC→KTP	0.280	0.082	0.299, 0.581 ^a	0.304, 0.583 ^b

Note. N = 120. TM = transfer mechanisms; KTP = knowledge transfer performance; CC = cooperative competency.

^a p = 0.002.

^b p = 0.001.

managers who want to transfer tacit and explicit knowledge from the alliance partners, this study offers useful insights and several important managerial implications. This article considers a process model of knowledge transfer. The finding that transfer mechanisms have a positive impact on knowledge transfer performance implies that, to promote knowledge transfer performance, managers need to engage actively in the establishment of transfer mechanisms and in fostering cooperative competency among alliance partners.

Doing so involves the development of trust between the alliance firms (Moran, 2005), increasing communication with each other (Tortoriello & Krackhardt, 2010), and the establishment of the consensus with their partners through effective coordination (Smith et al., 2005). The results suggest that cooperative competency consisting of mutual trust, frequent communication, and effective coordination can improve knowledge transfer performance (Hutt et al., 2000), particularly in the proper transfer mechanisms. This argument also implies that replication and adaptation of transfer mechanisms may influence cooperative competency between alliance partners. Managers therefore need to take into account the transfer mechanisms in the knowledge transfer process in making decisions about whether an exact copy with or without any modification from alliance partners is likely to be the best practice guidelines when knowledge moves from one group to another.

Managers may benefit from recognizing the importance of cooperative competency in transmitting the effects of transfer mechanisms to knowledge transfer performance. One critical challenge facing firms involved in knowledge transfer projects is how to actively allocate their efforts with regard to transfer mechanisms – in terms of replication and adaptation – to enhance their abilities to interact with their partners by building cooperative competency.

More specifically, replication activities that are aimed at capturing and using knowledge exactly from the alliance partners in the knowledge transfer setting strengthen the firms' trusting relationships with the partners, increase communication in a shared language and symbols and establish consensus on the operation with their partners through coordination in order to use the senders' transferred knowledge in the recipient's context (Nonaka, 1994; Winter & Szulanski, 2002). Similarly, adaptation activities aimed at integrating and modifying potentially valuable knowledge flexibly from the alliance partners for their own use can stimulate mutual trust, communications and coordination, thus increasing the cooperative competency to integrate potentially valuable knowledge from the senders into the new context of the recipient firm (Dussauge et al., 2000; Dyer & Singh, 1998; Kale et al., 2000; Rothaermel, 2001).

Collectively, the established cooperative competency will facilitate the ability of allied firms participating in the knowledge transfer process to acquire and make use of knowledge (Hutt et al., 2000; Moran, 2005; Prahalad & Doz, 1987). Through the utilization of transfer mechanisms, it improves firms' cooperative competency to communicate and coordinate business interactions, and increase trustworthiness within relationships, and thus leads to a more satisfied knowledge transfer performance.

5.2. Theoretical implications

The findings of this study contribute to the theoretical development of a conceptual model for explaining the interrelationships among transfer mechanisms, cooperative competency, and knowledge transfer performance. Prior studies emphasize the effects of alliance characteristics such as knowledge attributes (e.g., Blumenberg et al., 2009; Santoro & Saporito, 2006), social ties (e.g., Bond et al., 2008; Chen et al., 2009; Ramasamy et al., 2006; Wu & Cavusgil, 2006; Yli-Renko et al., 2001) and alliance form (e.g., Björkman et al., 2004; Chen, 2004; Cho & Lee, 2004; Lee & Cavusgil, 2006; Lyles & Salk, 1996) on knowledge transfer activities.

However, few studies examine the interrelationships among transfer mechanisms, cooperative competency, and the knowledge transfer performance (Santoro & Saporito, 2006; Williams, 2007). This deficiency is serious because of the increasing importance of the knowledge transfer from outside to the competitive advantages of the firms. This study therefore constructs a conceptual model and hypothesizes the mediating role of cooperative competency between transfer mechanisms and knowledge transfer performance. Second, based on the process-oriented view, this study hypothesizes that cooperative competency mediates the effects of transfer mechanisms on knowledge transfer performance.

The results join prior research (Chen & Huang, 2007; Williams, 2007) suggesting that cooperative competency becomes the necessary conduits for enhanced organizational performance, and highlights the critical roles of transfer mechanisms for the firms involved in the knowledge transfer activities.

The third contribution of this study is the derivation of empirical support for the model's prediction by using data from actual partnerships. The empirical results of Sobel's (1982) test, Baron and Kenny's (1986) procedure, and the bootstrap analysis support the mediating role of cooperative competency between transfer mechanisms and knowledge transfer performance. The empirical evidence of this study fills the gap in the literature that is lack of empirical examination of the roles of transfer mechanisms and cooperative competency in the knowledge transfer contexts.

5.3. Limitations and future research

This study has some limitations. First, respondents arbitrarily choose only one knowledge transfer case, though this study asks them to pick a typical one, so the results may not reflect all the facts since many firms have transferred knowledge more than once. Second, this study investigates only the recipients of the knowledge transfer projects in the empirical survey. Inter-organizational knowledge transfer involves at least two organizations, and thus resources and capabilities of the knowledge sender and receiver will also impact knowledge transfer. The knowledge sender needs absorptive capacity and willingness (Gupta & Govindarajan, 2000; Wang, Tong, & Koh, 2004) to appreciate the potential value of knowledge for passing to the knowledge receiver, and needed intra-organizational transfer capability if the information is to be made available to the knowledge receiver in an efficient manner (Gupta & Govindarajan, 2000; Wang et al., 2004; Zhao & Anand, 2009). This one-sided investigation may lead to possible bias and overlook some important facts since the other partner is not able to express opinions on the knowledge transfer activity. Future research on the knowledge transfer issue can investigate both senders and recipients, to avoid the possible bias and obtain complete information about the alliance.

Third, the not invented here syndrome may exist in the knowledge transfer activity. In knowledge transfer, at times, the not invented here syndrome can crop up when recipients are not motivated. This syndrome entails the rejection of the use of external knowledge, as it has not been created within the firm, considering it, among other things, as a threat (e.g., Katz & Allen, 1982; Lichtenthaler & Ernst, 2006). To examine the role of cooperative competency between recipients' motivations and knowledge transfer performance should be strongly encouraged for future research.

The last limitation is the use of a cross-sectional research design. Although the results are consistent with theoretical reasoning, the cross-sectional design may not rule out causality concerning the hypothesized relationships. Future research may address this issue by using the longitudinal design. In addition, combining Williams' (2007) studies with these findings, a valuable future project will be to study the connections among the nature of the transferred knowledge, transfer mechanisms, and cooperative competency, all of which lead to improved performance of the recipient firms.

Table A1
Results of confirmatory factor analysis of measures.^a

Construct	Operational measures of construct	Standardized factor loading	t	
Knowledge Transfer	The transferred knowledge can facilitate the innovation ability of our company	0.70	9.48	
	The transferred knowledge can shorten our innovation time period of our company	0.84	12.63	
Performance	The transferred knowledge can induce many innovation activities at our company	0.93	15.21	
	The transferred knowledge can achieve many innovation results at our company	0.88	13.30	
Trust	Our alliance partners had the ability to contribute to the knowledge transfer effort	0.74	10.41	
	Our alliance partners were capable of doing their part	0.78	12.16	
	Our alliance partners had high integrity	0.95	18.34	
	Our alliance partners could be counted on to do the right thing	0.79	12.11	
	Our alliance partners' motives could never be questioned	0.71	9.79	
	We trusted that our alliance partners would act in the company's best interests	0.86	14.55	
Communication	Our alliance partners informed us of changing project needs	0.65	8.30	
	Our alliance partners shared proprietary information with us	0.84	12.15	
	Our alliance partners provided information that would help us	0.80	11.39	
	Our alliance partners provided us with adequate information	0.82	12.11	
Coordination	Our alliance partners provided us with timely information	0.87	13.66	
	The different job and work activities around the knowledge transfer activity fit together very well	0.83	13.82	
	In the knowledge transfer activity, people from different organizations who had to work together did their jobs properly and efficiently	0.87	15.36	
	In the knowledge transfer activity, all related things and activities were well timed in the everyday routine of the process	0.84	14.25	
Replication	In the knowledge transfer activity, the work assignments of the people from different organizations who worked together were well planned	0.89	15.91	
	In general, the routines of the different organizations that had to work with one another were well established in the knowledge transfer activity	0.82	13.50	
	We tried to manage our business exactly like our alliance partners	0.61	7.00	
	We tried to implement practices from our alliance partners exactly as they existed	0.79	8.89	
	We tried to copy practices from our alliance partners down to the smallest detail	0.95	11.10	
	We spent substantial time making sure practices we adopted from our alliance partners worked just as they did there	0.70	8.54	
	Adaptation	We usually modified practices from our alliance partners when we implemented them in our business	0.56	5.84
		We usually combined ideas from our alliance partners with other ideas when we adopted them	0.91	6.87
		We spent substantial time modifying practices from our alliance partners to make them work in our business	0.81	6.92
		We carefully selected practices from our alliance partners to adopt in our business	0.55	4.47

^a Model fit indexes: $\chi^2/df = 1.63$, RMSEA = 0.07, GFI = 0.95, NFI = 0.91, NNFI = 0.96, CFI = 0.96.

Table B1
Results of factor analysis of knowledge transfer performance items.

Items	Factors	
	1	
<i>Knowledge transfer performance</i>		
The transferred knowledge can facilitate the innovation ability of our company	0.80	
The transferred knowledge can shorten our innovation time period of our company	0.88	
The transferred knowledge can induce many innovation activities at our company	0.92	
The transferred knowledge can achieve many innovation results at our company	0.90	
Eigenvalue	3.06	
Common of variance (%)	79.50	
Total variance	79.50	

Table B2
Results of factor analysis of transfer mechanisms items.

Items	Factors	
	1	2
<i>Replication</i>		
We tried to manage our business exactly like our alliance partners	0.67	0.13
We tried to implement practices from our alliance partners exactly as they existed	0.85	0.04
We tried to copy practices from our alliance partners down to the smallest detail	0.90	0.05
We spent substantial time making sure practices we adopted from our alliance partners worked just as they did there	0.76	0.18
<i>Adaptation</i>		
We usually modified practices from our alliance partners when we implemented them in our business	0.42	0.62
We usually combined ideas from our alliance partners with other ideas when we adopted them	0.33	0.79
We spent substantial time modifying practices from our alliance partners to make them work in our business	0.33	0.77
We carefully selected practices from our alliance partners to adopt in our business	0.20	0.80
Eigenvalue	3.19	2.08
Common of variance (%)	39.86	26.05
Total variance	39.86	65.91

Table B3
Results of factor analysis of cooperative competency items.

Items	Factors		
	1	2	3
<i>Trust</i>			
Our alliance partners had the ability to contribute to the knowledge transfer effort	0.18	0.73	0.38
Our alliance partners were capable of doing their part	0.22	0.79	0.37
Our alliance partners had high integrity	0.16	0.80	0.46
Our alliance partners could be counted on to do the right thing	0.32	0.79	0.17
Our alliance partners' motives could never be questioned	0.43	0.78	0.04
We trusted that our alliance partners would act in the company's best interests	0.32	0.80	0.28
<i>Communication</i>			
Our alliance partners informed us of changing project needs	0.41	0.21	0.60
Our alliance partners shared proprietary information with us	0.34	0.16	0.77
Our alliance partners provided information that would help us	0.27	0.15	0.83
Our alliance partners provided us with adequate information	0.39	0.31	0.71
Our alliance partners provided us with timely information	0.39	0.20	0.77
<i>Coordination</i>			
The different job and work activities around the knowledge transfer activity fit together very well	0.77	0.26	0.34
In the knowledge transfer activity, people from different organizations who had to work together did their jobs properly and efficiently	0.81	0.24	0.31
In the knowledge transfer activity, all related things and activities were well timed in the everyday routine of the process	0.80	0.27	0.18
In the knowledge transfer activity, the work assignments of the people from different organizations who worked together were well planned	0.73	0.38	0.31
In general, the routines of the different organizations that had to work with one another were well established in the knowledge transfer activity	0.63	0.45	0.33
Eigenvalue	4.39	3.91	3.64
Common of variance (%)	27.41	24.44	22.75
Total variance	27.41	51.85	74.60

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