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The Combined Effects of Power Imbalance and Mutual Dependence on the Relationship between IOS Diffusion and a Firm's Performance Improvement

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A B S T R A C T

This paper draws on the interdependence theory to examine the role of power and mutual dependence on the relationship between internal/external diffusion and performance improvement within a supply chain. The results from a survey of 375 respondents show that two patterns of IOS diffusion – internal diffusion and external diffusion – have different impacts on a firm's performance improvement according to differences in power and mutual dependence between two parties in the supply chain.

Keywords: Internal Diffusion, External Diffusion, Power Imbalance, Mutual Dependence, Interdependence Theory, IOS

Ⅰ. Introduction

Companies implement supply chain management (SCM) solutions to integrate their manufacturing plants all the way through the supply chain to shorten cycle time, increase productivity, and obtain more visibility. The trend relying on an increasing number of suppliers which perform better than a focal organization has accelerated the adoption and implementation of supply chain solutions. For instance, Airbus created a smart sensing solution that can detect any deviations of inbound shipments from their intended path. This solution, the largest of its kind in the manufacturing sector, has significantly reduced the number and severity of incorrect shipments and deliveries, as well as the costs associated with correcting these problems (p. 391, Rainer et al., 2015).

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Although SCM solutions offer many benefits, they still have certain drawbacks, as can be seen with the just-in-time (JIT) inventory system. Since suppliers are expected to respond instantaneously to requests in JIT, they have to carry more inventory than they otherwise would. As JIT simply shifts excess inventory from a focal manufacturing firm to the supplier rather than eliminating it, many SCM solutions cannot generate benefits for all the parties involved throughout the supply chain (p. 391, Rainer et al., 2015). The same is true for the case of Airbus above. Airbus adopted RFID for its smart sensing solution so that RFID readers could communicate with each tag at each stop along the supply chain. While not all of their suppliers could afford the costs of RFID, they had no choice but to adopt it in order to continue supplying parts to Airbus. In this sense, not all of the organizations are motivated to find innovative solutions but are forced to adopt and implement solutions by large manufacturers or retailers which are more influential in the supply chain. This leads us to wonder if this sort of SCM solution could improve the performances of both firms which are influenced by a more powerful firm.

Imbalances in 'power' stem from differences between firms in terms of asset, market share, and resources (Bala and Venkatesh, 2007), and can be one of the external environmental variables influencing supply chain solutions such as Inter-organizational systems (IOS) adoption and diffusion, where IOS is defined as the information system that spans organizational boundaries (Gregor and Johnston, 2001). According to the resource dependence theory (RDT), firms are viewed as coalitions that alert their structures and patterns of behavior to acquire and maintain necessary external resources. Acquiring the external resources needed by a firm comes with either increasing or decreasing dependence of that firm on others. When the need for a resource is critical, a firm may adopt various countervailing strategies－it may associate more with suppliers, or integrate vertically or horizontally. That is, RDT focuses on modifying a firm's power with other firms through various means such as M&A, alliances, joint ventures etc. (Hillman et al., 2009). Hence, a large firm which has more resources creates a virtuous cycle in which it can keep its dominant and advantageous position in the supply chain in terms of power because of its abundant resources. However, the RDT does not involve mutual dependence. In other words, the existence of abundant resources does not mean that reciprocal relationship is mutually depended nor power is balanced in supply chain.

In reality, when a large portion of revenue is from a particular buyer or the supplier pool is very restricted, mutual dependence may increase, making it impossible to integrate either vertically or horizontally. The reason is that a power dominant firm in terms of assets and market share may not necessarily exert power over a non-dominant firm, such as pushing to adopt or diffuse IOS for business activities, maybe because of the non-dominant firm's distinctiveness. Even though RDT explains how a firm reduces its uncertainty by reducing competition, managing interdependence and diversifying operations (Hillman et al., 2009), still the RDT lacks the discrimination of power imbalance and mutual dependence (Casciaro and Piskorski, 2005; Hillman et al., 2009).

Although this distinction between power dominance and mutual dependence and/or the consideration of both are necessary in IOS research, prior research clearly did not discriminate these two dyadic power constructs of power imbalance and mutual dependence (Casciaro and Piskorski, 2005). Most prior research has focused solely on power imbalance without examining mutual dependence. Moreover, a firm's motivation to manage external dependencies does not necessarily coincide with its ability to do so (Casciaro and Piskorski, 2005). Mutual dependence which creates both the incentive and the ability to form links between firms to benefit resources control and to reduce uncertainty becomes increasingly successful as mutual dependence between two firms increases. Conversely, under power imbalance conditions, a dependent firm is likely to be more motivated but less able to link one another to control critical resources and to reduce uncertainty. Thus, in contrast with the predictions presented in the original formulation of RDT, power imbalance may actually act as an obstacle to do so (Casciaro and Piskorski, 2005) when we take both power imbalance and mutual dependence in a dyadic relationship into consideration.

In this study, this dyadic relationship is to be examined with the diffusion of IOS. IOS diffusion is classified into two types: internal and external. External diffusion is defined as the extent to which a focal company uses the IS for activities such as communication and transactions with its trading partners (Premkumar et al., 1994; Ramamurthy et al., 1999), while Internal diffusion is defined as the extent to which the company uses the IS for activities such as procurement and order-processing to integrate EDI interfaces into other key internal applications within the firm (Premkumar et al., 1994; Ramamurthy et al., 1999). Thus, when it comes to IOS, the first path is that IOS is more likely to be adopted and implemented mainly due to the partners, whereas the second path is that the IOS is adopted and implemented mainly due to internal considerations, with both paths having a common goal of improving SCM. These two individual paths have yet to be separately studied under the conditions of differing power and mutual dependence between parties in the dyad in the supply chain.

Hence, this study investigates how two different types of IOS diffusion will affect the focal firm's performance in the different power and mutual dependence structures. More specifically, this study aims to explore the following critical questions in SCM research which have yet to be explored:

1. Do the impacts of external and internal diffusion of IOS on a firm's performance differ by power difference of two firms? If so, how?
2. Do the impacts of external and internal diffusion of IOS on a firm's performance differ by the degree of mutual dependence of two firms? If so, how?
3. Do the impacts of external and internal diffusion of IOS on a firm's performance differ by both power and mutual dependence? If so, how?

In order to understand these questions, this study employs concepts from the interdependence theory which are significant in understanding the dyad of individuals because the pattern of interdependence summarizes the consequences for the pair of both the abilities, needs, and evaluative criteria, and the kinds and degrees of power they have over each other (Kelley and Thibaut, 1978). This study argues that the same can occur in the interaction processes between two organizations as Pfeffer and Nowak (1976) stated that the focus on interdependence of organizations contributes an effective analytical perspective to manage sources of purchase or sales.

Based on the findings in this research, managers of a firm can 1) determine what kind of IOS diffusion strategy is suitable for improving performance based on the position of a firm in terms of power (im)balance and mutual dependence, and 2) come up with alternatives for improving its position by transforming the structure of power (im)balance and mutual dependence in the dyad. For instance, suppliers are typically dependent on buyers that provide them with a large portion of their sales revenue (Hart and Saunders, 1998). However, such dependence can be offset when the supplier provides a relatively unique product or service or invests in assets needed by a buyer that are not possessed by other potential suppliers. This is precisely why research in this field must simultaneously consider both power (im)balance and mutual dependence in the dyad. This study aims to fill this gap, which has previously rarely been explored, if at all.

Ⅱ. Literature Review

The concept of IOS diffusion is defined as using technology in a comprehensive and integrated manner in order to support organizational work and transferring this technology both inside and outside the organization (Gregor and Johnston, 2001). IOS diffusion is classified into internal and external diffusion. External diffusion is defined as the extent to which a focal company uses the IS for activities such as communication and transactions with its trading firms (Premkumar et al., 1994; Ramamurthy et al., 1999). Massetti and Zmud (1996) claimed that volume, diversity, breadth, and depth are the components of external diffusion. Volume is the amount of documents exchanged through EDI, diversity is the different types of documents dealt with EDI, breadth is the EDI connections that a firm developed with its partners, and depth is the business processes of a firm that are involved with those of other trading partners through EDI. In addition, internal diffusion is defined as the extent to which the focal company uses the IS for activities such as procurement and order-processing to integrate EDI interfaces into other key internal applications within the company (Premkumar et al., 1994; Ramamurthy et al., 1999).

Both internal and external diffusion constitute the infusion stage in the overall diffusion process, which ranges from initiation through adoption, adaptation, acceptance, routinization, and infusion in the supply chain. Prior literature has mainly focused on similar environmental or situational factors which affect only one type of diffusion of IOS from a single actor's perspective. For instance, since the system creates network externalities through interorganizational transactions, Damsgaard and Lyytinen (2001) described how the diffusion reaches beyond the bilateral relationship, pointing to intermediating actors as important parts of success adoption. Only a few studies, such as the studies by Premkumar et al. (1994) and Ramamurthy et al. (1999) simultaneously examined two distinguishable types of diffusion: internal and external diffusion. For instance, what happens if a small grocery retailer's purchasing information system 'produces' a completed order form that cannot be electronically interpreted by a large supplier's order processing information system, such as Ben & Jerry's? In such a case, the grocery retailer's order form is manually 'keyed' into Ben & Jerry's order processing system, likely resulting in delays, higher costs, and higher incidences of data errors in handling orders (Sambamurthy and Zmud, 2012). Then, Ben & Jerry can push the retailer to adopt and implement an IOS which can better communicate with its systems. However, in order for the small and medium sized firms to get the best interest out of their limited resources in an efficient manner, they need to distinguish and assess the balance between internal pressures and external pressures periodically, then readjust their designs for organizing IT activities.

In the deployment of IOS, however, it is necessary to deeply understand a political mechanism that facilitates firms' internal and external diffusion of IOS by considering the dyadic relationship of two organizations in the supply chain. Most prior IOS literature has reported that power could be one of the external environmental variables influencing IOS adoption and diffusion. Some researchers have investigated competitive pressure, government pressure, business partner power, and support from the initiator (Chau and Hui, 2001; Chwelos et al., 2001; Iacovou et al., 1995; Kuan and Chau, 2001; Premkumar et al., 1997; Ramamurthy et al., 1999; Son, 2001). All of these variables predict intention to adopt EDI (electronic data interchange) (Chwelos et al., 2001; Iacovou et al., 1995; Premkumar et al., 1997), while only competitive pressure and support from the initiator are known to affect the infusion of EDI (Ramamurthy et al., 1999). Besides, although the role of power has been explored in IOS literature, the results have been mixed. Some research has reported that power-dominant firms (e.g., buyers) have used their power to motivate dependent firms (e.g., suppliers) to adopt EDI, while another study revealed a weak relationship between dominant firms' power and EDI adoption (Grover, 1993). The reasons for these mixed results may be found from three sources of ambiguity concerning the power construct.

First, as we mentioned earlier, the prior research did not clearly discriminate between the two dyadic power constructs of power imbalance and mutual dependence (Casciaro and Piskorski, 2005). These two constructs were combined into the concept of interdependence in many cases. Pfeffer (1972) claims that the lack of a distinction between these two concepts adds to the confusion surrounding this area of research.

Secondly, an organization's motivation to manage external dependencies does not necessarily coincide with its ability to do so (Casciaro and Piskorski, 2005). A key factor regarding such an ability is the extent to which the dependence to be managed is mutual or imbalanced. Mutual dependence which creates both the incentive and the ability to form links between firms to benefit resources control and to reduce uncertainty becomes increasingly successful as the mutual dependence between two organizations increases. More specifically, the higher the percentage of revenue from a particular buyer or the smaller the supplier pool from which a buyer can select, the more the mutual dependence may increase. In these situations, the dominant firms may not exert power over the dependent firms to push to adopt or diffuse IOS to dependent firms' business activities and vice versa. Conversely, under power imbalance conditions, a dependent organization is likely to be more motivated but less able to link one another to control critical resources and to reduce uncertainty. Thus, in contrast with the predictions advanced in the original formulation of the resource dependence theory, power imbalance may actually act as an obstacle to do so (Casciaro and Piskorski, 2005).

Finally, according to resource dependence theory (RDT), resources are a basis of power and are directly linked to each other (Pfeffer and Salancik 1978). That is, organization A's power over organization B is equal to organization B's dependence on organization A's resources such as labor, capital, raw material etc. Therefore, it is common for an organization with more resources (which is usually larger than the others) in a supply chain to be more actively involved in the implementation of IOS, while another which has fewer resources (which is usually smaller) is passively engaged if not forced to be engaged. Thus, even though the interdependence is dyadic, prior research on linking with others to control critical resources and reducing uncertainty has largely focused on the dependence of one actor on the other without considering reciprocal dependency.

Hence, in order to overcome the above limitations, this study introduces the theory of interdependence, which is developed to explain interpersonal relations but can be applied to any interaction, similar to inter-organizational interaction. For instance, when organizations are inevitably constrained by some of their environments, the interdependence between organizations enables them to manage some of the constraints and contingencies it encounters (Pfeffer and Nowak, 1976). An organization often can lose its independence and discretion, but can rely on the other organization's performance (Pfeffer and Nowak, 1976). Since the impacts of power imbalance and mutual dependence require simultaneous consideration in a single construct (Pfeffer and Salancik, 1978), interdependence theory is very adequate for improving existing research.

Ⅲ. Theoretical Background and Research Model

Mutual dependence creates both the incentives and the ability to form interorganizational links in order to gain control over valued resources, thereby successfully reducing uncertainty (e.g., Casciaro and Piskorski, 2005; Ramamurthy et al., 1999). Consistent with this finding, we can expect that the attempt to diffuse external IOS would become successful as the mutual dependence between two firms increases (Park and Chang, 2011). On the other hand, under the condition of power imbalance, a non-dominant firm is likely to be more motivated to form links between firms to benefit control over resources and to reduce uncertainty, but less able to externally diffuse the IOS toward its partner due to limited resources. Therefore, in contrast to predictions made according to the resource-based view (RBV) in prior literature, it is possible for the power imbalance to actually act as a trigger of internal diffusion instead of external diffusion of IOS in the supply chain. That is, any consequences of two organizations' relationship depend on both the degrees of power which each organization has over the other as well as the mutual dependence which links them. We may refer to these two critical factors in interdependence theory in particular.

Despite this important role of the interdependence theory in advancing existing theories as such and offering new insights to IOS diffusion research, this theory has rarely been examined. Even though some studies have examined the interdependence of two firms, the results of such research have been mixed because they have investigated only either one of two important aspects of the interdependence, mutual dependence or power, or the mingled concepts of two, so called just interdependence. Although some research has involved a dyadic relationship among firms, empirical tests of IOS diffusion have largely focused on the dependence of one actor on the other without considering reciprocal dependency. Since the examination of the effect of interdependence requires simultaneous consideration of reciprocal dependence in the dyad in a single research model, this study tests the effects of power imbalance and mutual dependence of related parties on the relationship between IOS diffusion and performance improvement in a single research model.

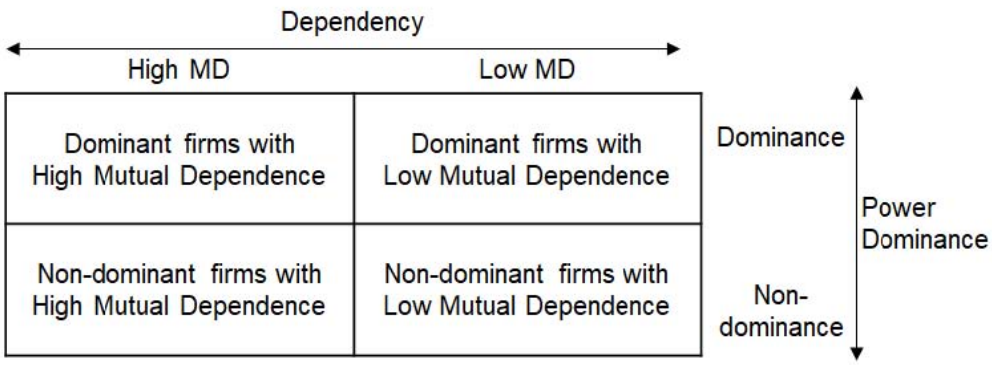
The concept of the theory of interdependence was first developed by Thibaut and Kelley (1959). The theory explains how each person acts on his or her own by taking account of what his or her partner is likely to do, in order to get the best outcomes he or she can. If a person knows (or thinks he or she knows) the contingent relations between his or her own and his or her partner's actions on the one hand, and his or her own outcomes on the other, he or she has a basis for deciding what to do himself or herself and/or what to attempt to induce the partner to do in order to beneficially affect his or her own outcomes.

Thibaut and Kelley (1959) used an outcome matrix as the main conceptual tool for the analysis of dyadic interaction. The term outcomes represent the rewards earned and costs incurred by participant from the two persons' performed behavior. The rewards and costs refer to satisfaction or fulfillment to the person and discouragement or obstruction of the performance of any behavior, respectively (Thibaut and Kelly, 1959). The degrees of these experiences from dyadic members depend on the needs and values, skills and abilities in achieving the behaviors. The outcome matrix speaks for interdependence in relationships by two columns and two rows and each cell indicates outcomes from the relationship (Thibaut and Kelly, 1959).

Given this definition, let us assume the simultaneous presence of power and mutual dependence in a dyad in IOS diffusion. Power imbalance and high mutual dependence exert two competing forces on the relationship between actors. For instance, a firm with a higher power is reluctant to form links between firms to benefit resources control and to reduce uncertainty, since doing so would eliminate its power advantage. On the other hand, a higher-power firm can remain dependent on its partner firm which has lower power, and is then motivated to somewhat stabilize the flow of IOS resources. Since the effect of power imbalance requires concurrent consideration of dependence and is reciprocal, we therefore need to theoretically explain and empirically justify the effect of power imbalance under the different levels of mutual dependence simultaneously.

According to Casciaro and Piskorski (2005), power imbalance can capture the difference between the dependencies of two actors, while mutual dependence captures the sum of actor i's dependence on actor j and actor j's dependence on actor i. Following their reformulations of both power imbalance and mutual dependence, we therefore present a 2 × 2 matrix as shown in <Figure 1>, which gives two possible levels of dependencies for each actor on the other.

According to Emerson (1962)'s work, dependence



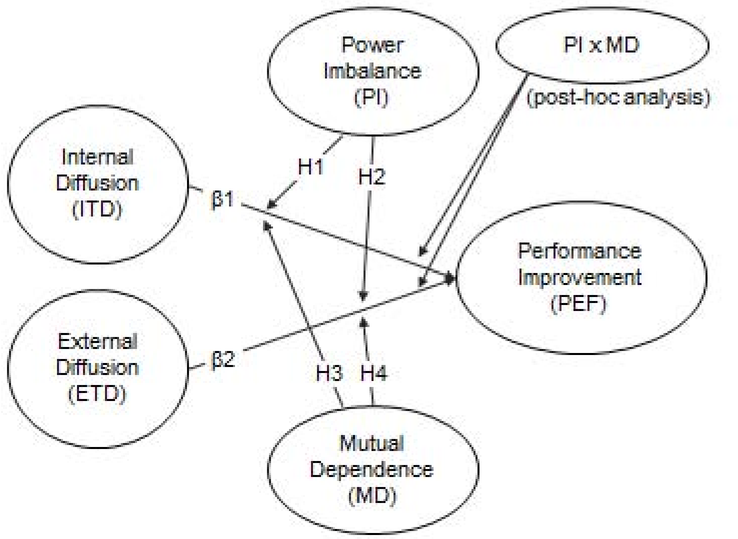
<Figure 1> Configuration of Power Imbalance and Mutual Dependence

refers to a function of the proposition of the dependent organization's need for resources or services that the other organization can provide. In addition, it refers to the inverse proportion of the ability of an alternate organization to provide the same resource or service. Heide and John (1988) suggest that a firm's inability to change its business partner can be considered as a representative indication of the firm's dependence on its partner. A firm's dependence on its partner has been typically defined in channels as the firm's need to maintain a relationship with the partner in order to achieve its goals (Beier and Stem, 1969; Frazier, 1983). Hence, high mutual dependence means both firms face greater uncertainty if they do not exchange with each other, while low mutual dependence means that they can procure resources from other firms with only slightly worse terms, even if the corresponding firms do not exchange one another (Casciaro and Piskorski, 2005).

Thus far, relevant research has largely dealt with the dependence of one actor on the other, without any consideration of reciprocal dependency. According to Piskorski and Casciaro (2005)'s argument, although some research has discussed the distinct effects of power imbalance and mutual dependence, it is possible for power imbalances to exist under differing levels of mutual dependence. Therefore, in order to examine the simultaneous impacts of both power imbalance and mutual dependence on performance improvement by implementing IOS, we examine all four quadrants of the 2 × 2 matrix shown in <Figure 1>.

Ⅳ. Research Model and Hypotheses

Drawing upon the interdependence theory (Kelley and Thibaut, 1978), the proposed research model in <Figure 2> explores whether and how the relationships between internal/external diffusion and performance improvement are moderated by both power imbalance (dominant firms vs. non-dominant firms) and mutual dependence (high mutual dependence and low mutual dependence). While prior studies



<Figure 2> Research Model

have examined the main effects of power usage in the channel (e.g., Boyle et al., 1992; Frazier and Summers, 1986; John, 1984; Morgan and Hunt, 1994; Scheer and Stern, 1992), the present study aims to investigate the moderating effect of power imbalance. It explains the relationship between IOS diffusion and performance improvement because prior research has suggested that the effects of power usage upon channel member commitment are moderated by the symmetry of power within the channel relationship (e.g., Brown et al., 1983).

Therefore, we expect there to be an interaction effect between power imbalance and IOS diffusion on firms' performance. The same is expected for mutual dependence. Furthermore, the interaction between the power imbalance and the mutual dependence would make the understanding of such relationships more sophisticated. In this study, we examine this interaction effect which has yet to be examined as the post-hoc analysis.

Prior work has suggested that the presence of a dominant firm in a supply chain stimulates innovations (Inderst and Wey, 2007). More specifically, a dominant firm tends to use its technology to influence the supply chain which necessitates changes to a partner's innovation process in order for that partner to sustain their business success (Lettice et al., 2010). Based on previous assertions, we believe that the types of diffusion of IOS (e.g., internal diffusion and external diffusion) in the context of the supply chain will unfold differentially for dominant versus non-dominant firms. For example, dominant firms typically exhibit greater resources that catalyze their ability to invest in innovations (Nohria and Gulati, 1996). Furthermore, these firms may have greater inertia (i.e., willingness to maintain status quo – current market share and profits) that may inhibit their motivation to invest in innovations that can potentially disrupt their existing practices or routines (Tushman and O'Reilly, 1996). The existing resource and routine rigidities may lead to a firm's inability to establish internal changes in the face of a significant external change (Bala and Venkatesh, 2007). The routine is the repeated patterns of behavior bounded by the organizations' ongoing activity. The routine becomes rigidi when it is self-enforcing and tightly embedded in the environment, and therefore difficult to change (Bala and Venkatesh, 2007).

From the non-dominant firms' standpoint, as they have less market share and resource dependencies, they have relatively flexible acceptance to changes in resource investment patterns compared to dominant firms. The acceptance of internal change then faces a significant external change. Even though they have to inevitably adopt IOS and diffuse their external business activities regardless of their IOS strategy, non-dominant firms still acclimatize the innovation technology internally more than dominant firms. Therefore, we predict that the power imbalance (asymmetry of power) will moderate the relationship between internal diffusion and performance improvement such that the impact of internal diffusion on the performance improvement is greater for the non-dominant firms. Based on this logic, we propose the following hypothesis:

H1: Power imbalance will moderate the positive relationship between internal diffusion and performance improvement such that the relationship is stronger for the non-dominance groups than for dominance groups.

Further, previous work on IOS adoption (e.g., Webster, 1995) and relationship marketing (e.g., Jap and Ganesan, 2000) has suggested that dominant partners often require non-dominant partners to make significant relation-specific investments (e.g., IOS implementation) in order to improve inter-organizational coordination. These studies have commonly proposed that standard developments tend to be controlled by dominant firms that often impose their own standards on their non-dominant counterparts (Jakcobs, 2000). Therefore, we argue that a dominant firm exerts its power to its non-dominant partners to adopt its innovation technology (i.e., IOS). Accordingly, dominant firms tend to invest in the external diffusion.

H2: Power imbalance will moderate the positive relationship between external diffusion and performance improvement such that the relationship is stronger for the dominance groups than for non-dominance groups.

Previous studies have documented that, for some firms, high mutual dependence is conductive to creating and maintaining strategic channel alliances, whereas other firms under low mutual dependence may not want to get locked into such a relationship. This involves switching costs and/or a lack of alternative partners (Woolthuis et al., 2005). Therefore, low mutual dependence firms reduce interactions with others and tend to operate closely along the lines of classic economic relationships, such as a firm's transactions only (Kumar et al., 1998).

Based on this logic, we propose the following hypothesis:

H3: Mutual dependence will moderate the positive relationship between internal diffusion and performance improvement such that the relationship is stronger for the low MD groups than for high MD groups.

IOS is the system manifestation of inter-organizational relationships that institutionalizes asymmetric interdependency between firms (Kumar et al., 1998). It can be influenced by the firm's status in the channel, that is, according to its degree of relative mutual dependency. For example, Zaheer et al. (1998) have suggested that the more dependent supply chain members are with each other, the more enthusiastic members are in sharing a high degree of information, which leads to high performance in the supply chain.

For instance, Hart and Saunders (1998) argue that a supplier is dependent on the buyer if the buyer is responsible for a large portion of its sales volume and ultimate profitability. On the other hand, the buyer may be dependent on the supplier if the supplier provides unique products or has invested in specified assets that other potential suppliers do not possess. In the first case, the supplier has an incentive to integrate systems as a way to managing its dependence on the buyer. In the latter case, the buyer may be motivated toward pursuing integration in order to manage its dependence on the supplier. Thus, we believe that in both cases, the firms will move toward managing dependence by establishing integrated IOS.

Thus, we posit that under conditions of high mutual dependence, the effect of external diffusion on performance is strengthened, and therefore we should see an increase of the level of performance improvement under high mutual dependence. Based on this logic, we propose the following hypothesis:

H4: Mutual dependence will moderate the positive relationship between external diffusion and performance improvement such that the relationship is stronger for the high MD groups than for the low MD groups.

Ⅴ. Data Analysis and Results

The survey was administered to managers in Chinese companies which have implemented IOS in their supply chain. We requested a market research firm to randomly distribute our questionnaire to IT managers or directors in a variety of Chinese companies. All survey items regarding the constructs in our model were measured on a seven-point Likert scale, which ranged from "strongly disagree" (1) to "strongly agree" (7).

Our data analysis proceeded in three stages. The first stage involved a descriptive analysis of our dataset and the test of our data quality, the second stage was directed at testing the psychometric properties of our measurement scales, and the third stage focused on hypotheses testing and model analyses. Our data was analyzed using PLS (partial least square) as well as the SPSS 18.0 software.

5.1. Construct Operationalizations

All of our constructs were reflectively modeled. In order to increase the reliability, established measures were used and each construct was assessed using multiple measurement items. The actual measurement items are shown in <Appendix A>.

Reference to benefits realized after deploying IOS such as customer service, inventory control, operations costs, cycle time, relationship with partners, and competitive advantage can be taken as measurement items of performance improvement (Zhang and Dhalilwal, 2009). Using the six measurement items (OI1 ~ OI6) developed by Zhang and Dhalilwal (2009), performance improvement was therefore operationalized by capturing the extent to which the firm realized benefits from the IOS deployment. Internal diffusion was assessed using ten measurement items (ITD1 ~ ITD10) adopted from Zhang and Dhalilwal (2009), which were designed to capture the extent to which web-based applications are used in supplier selection, purchase-ordering processing, procurement from suppliers, invoicing and payment processing, and demand management, may have influenced the performance improvement. External diffusion was operationalized using a three-item scale (EXD1 ~ EXD3) adopted from Zhang and Dhalilwal (2009) and designed to assess the extent of the deployment of IOS to enhance inter-organizational operations with supply chain partners. We operationalized it as a proposition of total suppliers that interact with firms via IOS, a proposition of total supplier transactions conducted via IOS, and a proposition of overall interactions with suppliers carried out via IOS.

As for the moderating variables in this study, both power imbalance and mutual dependence are dyadically considered by taking into account each firm's dependence on the other. Thus, in our research, the mutual dependence was manipulated by the sum of partner dependence and my firm's dependence, while power imbalance was designed by the absolute value of differences between the partner dependence and my firm's dependence, according to Casciaro and Piskorsk (2005)'s arguments.

5.2. Sample Profiles

From an initial sampling frame of 400 respondents, usable responses were obtained from 375 respondents after screening for missing values (an overall response rate of 93.75%). The sample had a heterogeneous representation in terms of industry categories. <Table 1> shows the sample profiles.

The firms in the sample were fairly distributed across different industry groups in manufacturing

<Table 1> Sample Profiles

Category	Items	Freq	Ratio	Category	Items	Freq	Ratio
Number of Employees	Less than 100	115	30.67%	Time elapsed since IOS deployment	< 1 yr	30	8.00%
	100 - 499	111	29.60%		1 yr	194	51.73%
	500 - 999	49	13.07%		2 yrs	64	17.07%
	1,000 - 4,999	37	9.87%		3 yrs	76	20.27%
	5,000 - 10,000	33	8.80%		4 yrs	11	2.93%
	> 10,000	30	8.00%		> 5 yrs	0	0.00%
Main operating Industry	Manufacturing/engineering	84	22.40%	Annual revenue level (US million dollars)	1.1 - 5	30	8.00%
	Chemical	25	6.67%		5.1 - 10	194	51.73%
	Finance/banking/ insurance	16	4.27%		10.1 - 50	64	17.07%
	Computer/IT	45	12.00%		50.1 - 100	76	20.27%
	Medical/healthcare	14	3.73%		> 100	11	2.93%
	Oil/Gas/Energy	9	2.40%	Organizational age	0 - 5 yrs	30	8.00%
	Business Service	40	10.67%		6 - 10 yrs	194	51.73%
	Real estate/property	23	6.13%		11 - 15 yrs	64	17.07%
	Publishing/information/ news	3	0.80%		> 15 yrs	76	20.27%
	Transportation/logistics	18	4.80%	Number of IT employees sales/trading	Mean	5,242	
	Retailing/whole	60	16.00%		Max	1,000,000	
	Hotel/travel/tourism	19	5.07%		Min	0	
	Others	19	5.07%		Std	55,417	

and service-related sectors (e.g., manufacturing/engineering: 83 (22.40%), computer/ IT: 45 (12%), business service: 40 (10.67%) among others). About two-thirds of the firms had annual revenues in excess of $50 million (e.g., 5.1 - 10 million: 194 (51.73%), 10.1 - 50 million: 64 (17.07%), 50.1 million-100 million: 76 (20.27%), more than 100 million: 11 (2.93%)). Since the research sought to assess the benefits of IOS deployment in SCM, data were obtained regarding the period in which the firm deployed IOS. All the firms in the final sample had already implemented IOS in SCM. Nearly half of the firms in the sample had deployed IOS less than two years prior to when the survey was administered, while the others had deployed it much earlier. The CIO or the senior IT executive responded in most cases.

5.3. Construct Validation and Reliability

Prior to testing construct validity and reliability, we initially evaluated the validations of each scale in order to determine whether measurement scales on both power imbalance and mutual dependence, which are manipulated by both partner dependence and my firms' dependence, could be accurately explained. Therefore, we conducted principle component factor analysis (hereafter PCA) regarding a partner's dependence and my firm's dependence by using varimax rotation and then extracted the factors over an eigen-value of 1. The eigen-value criterion results in two factors; the factor loadings range from .772 to .869, which exceed the acceptable level of .50. Having established construct validity for mutual dependence, we again employed the factor analysis including all constructs. The factor loadings are from 0.681 to 0.864, which exceed the acceptable level of 0.50 (Hair et al., 1998)

After conducting the PCA, we then turn to test our measurement model. The measurement model was tested by examining convergent and discriminant validity (Hair et al., 1998). Two different assessments were made for convergent validity: (1) individual item reliability and (2) construct reliability. Individual item reliability was assessed by examining the item-to-construct loadings for each construct that was measured with multiple indicators. In order for the shared variance between each item and its associated construct to exceed the error variance, the standardized loadings should be greater than 0.70. As can be seen in <Appendix B>, all of our item to-construct loadings exceeded the desired threshold.

The next step in establishing measurement reliability was to examine the internal consistency for each block of measures (i.e., construct reliability). This was done by examining the composite reliability and Cronbach's alpha of the average variance extracted (AVE) for each block of measures, as shown in <Appendix C>. Both composite reliability scores and Cronbach's a scores measure the internal consistency within a given construct's items. The threshold values for composite reliability and Cronbach's alpha are not absolute, but our measures appear to be more than acceptable by established criteria. Bearden et al. (1993) claim that a score of 0.7 indicates 'extensive' evidence of reliability while a score of 0.8 or higher provides 'exemplary' evidence. As shown in <Appendix C>, the constructs in our measurement model all exhibited composite reliabilities of 0.85 or higher and Cronbach's alpha of 0.795 or higher.

The guideline threshold for AVE is 0.5, indicating that 50% or more variance of the indicators is accounted for (Chin, 1998). As indicated by <Appendix C>, all of the constructs in our measurement model exceeded the established criteria for AVE. All of the constructs in our measurement model exceeded the threshold and thus were judged to be acceptable for construct reliability.

Having established convergent validity, we then turned to discriminant validity. We conducted two tests for discriminant validity: First, we calculated each indicator's loading on its own construct and its cross-loading on all other constructs (see <Appendix B>). In the columns in <Appendix B>, the loadings for the indicators for each construct are higher than the cross-loadings for other constructs' indicators. In addition, going across the rows, each indicator has a higher loading with its construct than a cross-loading with any other construct. This provides good evidence of discriminant validity (Fornell and Larcker, 1981). As a second test of discriminant validity, we considered whether the AVEs of the latent constructs were greater than the square of the correlations among the latent constructs (see <Appendix C>). When this was true, more variance was shared between the latent construct and its block of indicators than with another construct. As can be seen by reading across the rows of the Tables in <Appendix C>, our measures passed this test, thus providing additional evidence of discriminant validity.

In addition, due to the nature of our survey approach, common method bias (CMB) was still a threat to the internal validity of our findings, since most of our independent variables were measured at a single point in time using perceptual Likert scales. In order to test for this bias, we conducted several tests for effects of CMB. First, we performed

Harmon's one factor test recommended by Podsakoff and Organ (1986) after collecting data. A factor analysis including all variables revealed no sign of a single factor accounting for the majority of covariance. Second, following the recommendation of Podsakoff et al. (2003) and Liang et al. (2007), we added a common method factor to our PLS model, and allowed the indicators of all constructs to be associated reflectively with this factor. As shown in <Appendix C>, all substantive factor loadings were both significant and high (average 0.855; lowest 0.653), while the method factor loadings were low and non-significant (average 0.036; highest 0.068). The average substantive explained variance for the hypothesized indicators was 0.855, compared to the average common method-based variance of 0.036.

5.4. Hypotheses Testing

Having established the validity of our measurement model, we next perform subgroup analysis in order to evaluate our hypotheses. In order to perform the subgroup analysis, we therefore split the sample into two respective subgroups. The high mutual dependence (MD) and the low MD subgroups were created by splitting the sample at the mean value of MD (7.934), after which we also tested the validity and reliability by subgroup. We also split the sample into two groups by centering on the dominant and non-dominant groups.

Referring back to <Appendix B> and <Appendix C>, all items in the dominant group (n = 185) show an acceptable range having acceptable loadings (0.742 - 0.940), as do all items in the non-dominant group (n = 190) (0.764 - 0.964). We can also see that all items in the high MD subgroup (n = 227) demonstrate an acceptable range having acceptable loadings (0.487 - 0.955), as do all items in the low mutual dependence subgroup (n = 148) (0.543 - 0.999). In addition, the reliability indicators in all subgroups are all well above accepted thresholds, and the AVEs are greater than 0.5.

Following Carte and Russell (2003)'s suggestion, we assessed whether the latent constructs were perceived in a similar fashion between the high MD and low MD subgroups. We also investigated whether the latent constructs were perceived in a similar pattern between the dominant firm and non-dominant firm subgroups. An examination of <Appendix B> suggests that the loading patterns are the same and the factor loadings are very similar, thus permitting between-group path comparison.

In addition, a measurement invariance analysis was performed to further validate the similarity of measurement models between the two subgroups. The results in <Appendix E> provide additional support for measurement invariance and also provide further support for conducting a meaningful path coefficient comparison across subgroups.

As the measurement model appeared to be stable and adequate across the subgroups, we proceeded to analyze the research model for each subgroup. Consistent with the Sharma et al. (1981) approach for analyzing a homologizer, we tested the moderating effect of power imbalance by estimating two separate regression models, namely, the dominant firm subgroup and the non-dominant subgroup. We also examined the moderating effect of mutual dependence by estimating two separate models: high MD subgroup and low MD subgroup.

This approach is similar to a test of the moderation effect of composite index on the path strength across groups (Hsieh et al., 2008). We tested the differences across these two models using the approach suggested by Chin et al. (2003) and used by Keil et al. (2000), by computing a t-statistic as follows:

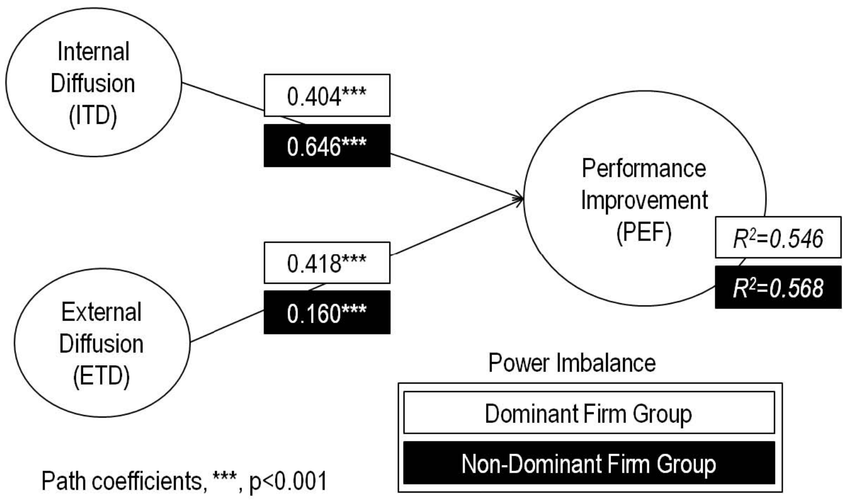
$$S_{pooled} = \sqrt{\{[(N-1)/(N_1+N_2-2)]\times[(N_2-1)/(N_1+N_2-2)]\times SE_2^2\}}$$

$$t = (PC_1 - PC_2)/[S_{pooled} \times \sqrt{(1/N_1+1/N_2)}]$$

As shown in <Figure 3>, the path coefficient from internal diffusion to performance improvement is larger for the non-dominant firm subgroup (β = 0.646, $p < 0.001$) than that of external diffusion, whereas the path coefficient from external diffusion to performance improvement is larger for the dominant firm subgroup (β = 0.418, $p < 0.001$) than for the non-dominant firm subgroup (β = 0.160, $p < 0.001$).

As shown in <Table 2>, a comparison of the path coefficients for internal diffusion to performance improvement across the two subgroups reveals that the strength of the relationship between internal diffusion and performance improvement is significantly greater in the non-dominant firm subgroups than it is in the dominant firm subgroup. We also found that the strength of the relationship between external diffusion and performance improvement is much greater in dominant firm subgroups than it is in the non-dominant firm group. In other words, external diffusion has a greater impact on performance improvement when a firm exerts its dominant power to the partners, thus supporting both H1 and H2.

A similar subgroup analysis was conducted in order to test the moderating effect of mutual dependence on the relationship between our two independent variables (internal diffusion and external diffusion) and our dependent variable (performance improvement). As shown in <Figure 4>, the path coefficient from external diffusion to performance improvement



<Figure 3> Comparison of Path Coefficients by Power Imbalance

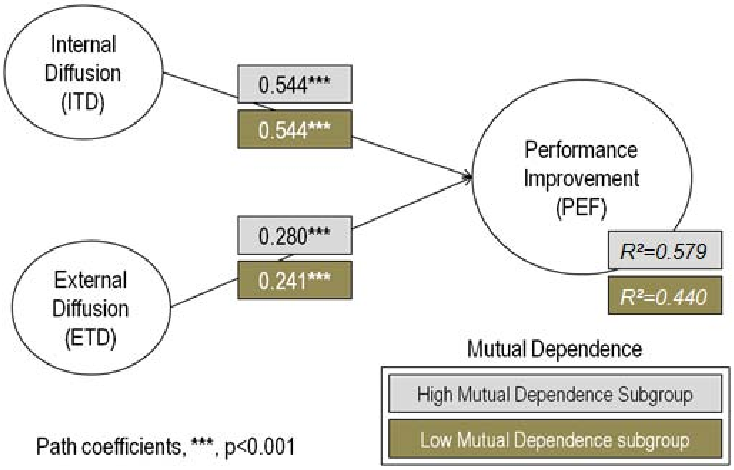
<Table 2> Results on Testing H1 and H2

	Dominance groups (n = 185)		Non-dominance groups (n = 190)		t-statistics
	Path coefficient	s.e.	Path coefficient	s.e.	
ITD (PEF (β1))	0.404	0.073	0.646	0.063	34.396
ETD (PEF (β2))	0.418	0.058	0.160	0.052	45.380
Note: Legend: ITD=internal diffusion, ETD= external diffusion, PEF=performance improvement					

is larger for the high MD subgroup (β = 0.280, p < 0.001) than for the low MD subgroup (β = 0.241, p < 0.001). Thus, H3 was supported. In the case of H4, there is no significant difference between the high MD subgroups (β = 0.544, p < 0.001) and low MD subgroups (β = 0.544, p < 0.001) in the relationship between internal diffusion and performance improvement. Thus, H4 was not supported.

In summary, our results show that both internal and external diffusion of the IOS can improve firms' performance in a supply chain, and also that the relationship between two types of diffusion and performance improvement is moderated by both power imbalance and mutual dependence. In particular, we found that the strength of the relationship between internal diffusion and performance improvement is significantly greater in the non-dominant firm subgroups than it is in the dominant firm subgroup, whereas the strength of the relationship between external diffusion and performance improvement is much greater in dominant firm subgroups than it is in the non-dominant firm group.

We also found that the strength of the relationship between external diffusion and performance improvement is greater for the high mutual dependence groups than for low mutual dependence groups, while there is no difference between high and low mutual dependence groups in the relationship between internal diffusion and performance improvement. According to previous research by Woolthuis et al. (2005), when the connectivity among firms and complementary technologies is poor, fruitful learning and



<Figure 4> Comparisons of Path Coefficients by Mutual Dependence

<Table 3> Results on Testing H3 and H4

	High MD Group (n = 227)		Low MD Group (n = 148)		t-statistics
	Path coefficient	s.e.	Path coefficient	s.e.	
ITD (PEF (β1))	0.544	0.066	0.544	0.067	0.000
ETD (PEF (β2))	0.280	0.055	0.241	0.053	6.810
Legend: ITD=internal diffusion, ETD= external diffusion, PEF=performance improvement					

<Table 4> Summary of Hypotheses Testing Results

#	Hypothesis	Results	Support
H1	**Power imbalance** will moderate the positive relationship between **internal diffusion** and performance improvement such that the relationship is stronger ***for the non-dominant groups than for dominant groups.***	**β1 in dominant groups < β1 in non-dominant groups**	Supported
H2	**Power imbalance** will moderate the positive relationship between **external diffusion** and performance improvement such that the relationship is stronger ***for the dominant groups than for non-dominant groups.***	**β2 in dominant groups > β2 in non-dominant groups**	Supported
H3	**Mutual dependence** will moderate the positive relationship between **internal diffusion** and performance improvement such that the relationship is stronger ***for the low MD groups than for high MD groups.***	**β1 in high MD groups = β1 in low MD groups**	Not Supported
H4	**Mutual dependence** will moderate the positive relationship between **external diffusion** and performance improvement such that the relationship is stronger ***for the high MD groups than for the low MD groups.***	**β2 in high MD groups > β2 in low MD groups**	Supported

innovation may be interrupted. Low mutual dependence results in the lack of a shared vision of forthcoming technology development and makes for frustrating coordination of performance (Woolthuis et al., 2005).

Given our empirical findings, <Table 4> provides a summary of the results for all of the hypotheses that were tested.

5.5. Post-hoc Analysis

Having shown the distinct impacts of power imbalance and mutual dependence on a firm's performance, this study also simultaneously examined the importance of the previously presented 2 × 2 matrix. In the post-hoc analysis, the simultaneous effects in a single construct on the relationship between IOS diffusion and performance improvement were examined.

This is done in order to fill the gap which has rarely been explored before, and it reveals some unexpected findings. First, we previously found out that two variables, high mutual dependence and dominant groups, moderate the positive relationship between external diffusion and performance improvement. However, when examining the two variables simultaneously, beta is found to be higher in internal diffusion (β = 0.447) than external diffusion (β = 0.381). When dominant firms with high mutual dependence diffuse IOS internally, performance improves more than with the external diffusion of IOS. Dominant firms exert existing power differences to use IOS such as EDI, but when the sum of both firms' dependence is high, dominant firms may not just unilaterally force non-dominant firms for the external diffusion of IOS.

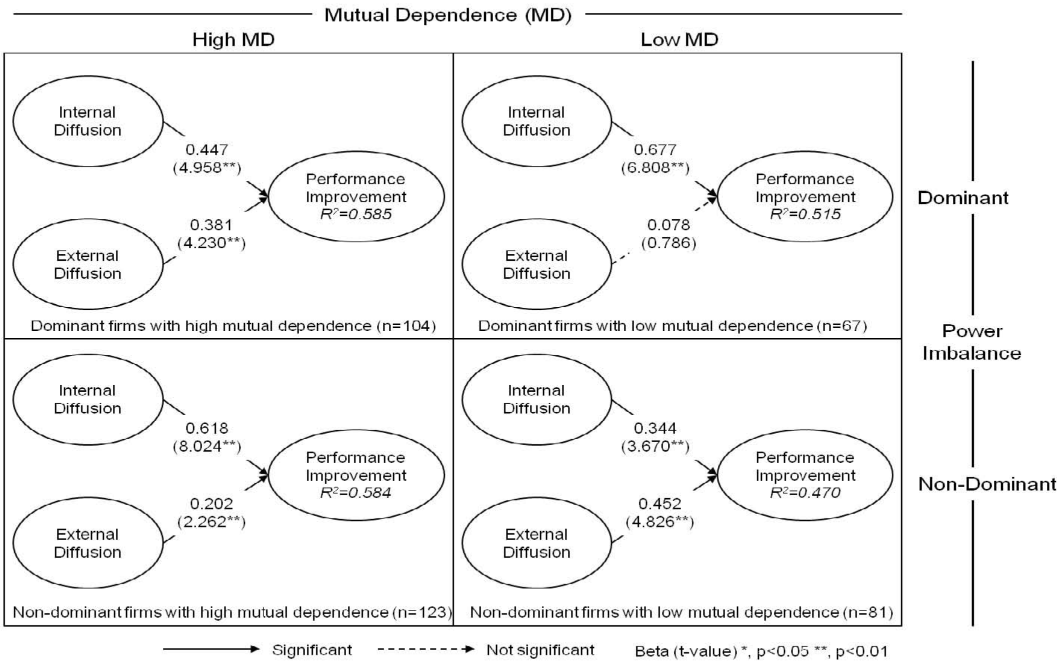
Second, for dominant firms with low mutual dependence, external diffusion has no significance (β = 0.078) while internal diffusion is significant at β = 0.677. Earlier, the idea that dominant firms moderate external diffusion and performance improvement was significantly supported, and low mutual dependence showed no differential moderating effect between internal and external diffusion, but interesting, when the two variables are modified at once, a different outcome appears. Dominant firms with low mutual dependence are internally diffuse IOS for higher performance improvement. Diffusing external IOS is not of major importance to dominant firms with low mutual dependence. Then, the dominant firms are likely to invest in internal diffusion of IOS for performance improvement by strengthening its position in the market.

Third, for non-dominant firms with high mutual dependence, internal IOS diffusion influences performance more (β = 0.618) than external diffusion (β = 0.202), with both effects being significant. The relationship between high mutual dependence and external diffusion turned out to be significantly positive, and non-dominant firms' performance improvements are also significant with internal diffusion. However, the reason for why the internal diffusion is stronger than external diffusion in post-hoc analysis is that internally digesting partners' IOS is more important for non-dominant firms with high mutual dependence.

Lastly, for non-dominant firms with low mutual dependence, external IOS diffusion has a greater influence (β = 0.452) than internal diffusion (β = 0.344). Low mutual dependence has no significant difference between internal and external diffusion on performance improvement. Moreover, non-dominant firms positively moderate internal diffusion of IOS and performance improvement. However, external diffusion is more significant than internal diffusion when non-dominant firms have low mutual dependence. Relevant firms may use such a strategy to communicate with many low dependent partners in order to effectively improve performance.

Ⅵ. Conclusions and Implications

In this study, we attempt to examine how firms' internal and external IOS diffusions influence their performance improvements depending on power imbalance as well as on the degree of mutual dependence among their supply chain partners based on the inter-



<Figure 5> Results of Each Subgroup Analysis

dependence theory. This theoretical view allowed us to generate insights into one possible mechanism underlying performance improvement, by focusing on our attention on both power imbalance and mutual dependence.

This study will contribute to this area of research theoretically as well as practically. Theoretically, this research 1) is the first study which clearly distinguishes between power and mutual imbalance which have been mingled into one concept, and subsequently led to mixed findings, and 2) empirically examines the impacts of both power and mutual imbalance in relation to two types of diffusion, namely external diffusion and internal diffusion, and a firm's performance in a single research model considering reciprocal relationships of both.

Despite the very intriguing findings of our study, the results should be interpreted in light of the following limitations: First, despite the given dyadic relationships among firms, we did not collect pair-wised data (one buyer matching with a supplier). In future research, taking a true dyadic perspective in the data collection would improve the measures and enhance confidence in the results. Second, since the data was collected only from Chinese firms, we may need to consider unique inter-organizational practices in China, if any exist. In order to deeply drill down the unique practices in Chinese firms, future research needs to pay more attention to interpreting power imbalance and dependence by considering the characteristics of industry types in China to strengthen generalization of the results in our study. Third, there are, of course, other antecedents for internal diffusion and external diffusion, which are beyond the scope of this study. Due to the theoretical perspective and research focus in question, we only focused on the relationship between two types of IOS diffusion (e.g., internal diffusion and external diffusion) and performance improvement. Despite the aforementioned limitations, we believe that our work has important implications for both research and practice.

6.1. Implication for Research

This study has several implications for research. First, we have distinguished power imbalance and mutual dependence from interdependence, which has brought about confusion and contrasting results into this area of research. In our study, we found that the relationships between two types of diffusions (e.g., internal diffusion and external diffusion) and performance improvement would be dependent upon the power imbalance as well as mutual dependence in the supply chain. Dominant groups having stronger relationships between external diffusion and performance improvement than non-dominant groups are supported, as in H1, and non-dominant groups having stronger relationships between internal diffusion and performance improvement than dominant groups also are supported, as in H2. In addition, high mutual dependent groups having stronger relationships between external diffusion of IOS and performance are supported as well. Finally, the hypothesis suggesting that mutual dependence moderates the positive relationship between internal diffusion and performance improvement would be stronger in low mutual dependent groups was not supported. Furthermore, we empirically tested these two different types of dependence towards IOS diffusion research in order to validate our hypotheses. By displaying different impacts of internal and external diffusion on performance improvement in a supply chain, this study supports the usefulness of this distinction and fills the theoretical gap regarding resource dependence theory, which has mostly been used in prior literature.

Second, as previously mentioned several times, we have identified the phenomenon of how both power difference and mutual dependence in a dyad react when they happen at the same time on post-hoc analysis. Interestingly, while every path was significant except external diffusion and performance improvement for dominant firms with low mutual dependence, beta levels show different outcomes compared to previous evaluation. This means that the significance of different patterns of IOS diffusion – internal diffusion and external diffusion – changes when the two happen at once.

Third, we demonstrate that our research model based on the interdependence theory specifies the theoretical scope of the distinct effects of mutual dependence and power imbalance in the supply chain context. Drawing the interdependence theory as theoretic lens to explain the inter-firm relationships in terms of implementations of the IOS, it makes our model applicable across a wide spectrum of interorganizatioal responses to resource dependencies in the supply chain context. Therefore, we believe that our research model can address the puzzling questions of how and why a more powerful organization would act to form links between firms to benefit resources control and to reduce uncertainty with the dependent organization and thus surrender its power and the advantageous exchange conditions it yields.

6.2. Implication for Practice

Our study also has several important implications for practice. First, based on our findings, managers should be aware that the way to implement IOS differs under various circumstances, such as power imbalance and mutual dependence. It is not always as simple as we have previously thought. For instance, a dominant firm does not always force a non-dominant firm to implement its IOS and so on. IOS implementation requires a concerted effort by all parties involved. Therefore, a dominant firm may consider providing technical and financial support to non-dominant partners while non-dominant firms need to carefully consider the relational benefits of IOS as well as regulations and competition from other competing supply chain networks. When it comes to high mutual dependence, both parties recognize mutual benefits and may accept successful technology and/or best-practices from partners in a fast-changing environment.

Second, managers in organizations need to understand a two-pronged internal diffusion/external diffusion strategy in dealing with IT challenges posed by IOS, since both of these types of diffusion can improve their own performance. Understanding such types can assist them in designing an appropriate diffusion strategy for achieving success in a supply chain.

Finally, establishing a linkage with a trading partner by adopting IOS is an important managerial decision. Our findings could help predict the outcome of the implementation of IOS decisions to some extent. Managers of firms in a supply chain could benefit from our findings by establishing a clear view on their firms' position in the supply chain when implementing IOS.

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<Appendix A> Measurement Items for Key Constructs

Construct	Items	Sources
Internal Diffusion	Please evaluate the extent to which your company uses the IOS in the following activities (Extent of use of IOS in activity- 1: None, 4: Neutral, 7: Large extent)	Zhang and Dhalilwal (2009)
	1. Supplier selection (getting quotes, bids etc)	
	2. Purchase-order processing	
	3. Procurement from suppliers (distribution, warehouse, logistics, etc.)	
	4. Invoicing and payment processing	
	5. Demand management (procurement analysis)	
	6. Pre-sales activities/services	
	7. Customer order processing	
	8. Customer payment processing (drop)	
	9. Distribution activities	
	10. Post sales service	
	11. Gathering and analyzing customer data (or marketing and sales planning)	
External Diffusion	**How would you evaluate the extent to which your organization uses IOS in supporting the relationship with partners?** (Extent of use of IOS in activity- 1: None, 4: Neutral , 7: Large extent)	Zhang and Dhalilwal (2009)
	1. Interacting with our partners through IOS	
	2. Carrying out transactions with our partners through IOS	
	3. Overall interactions with our partners through IOS	
Performance Improvement	**Please check an appropriate number for the following set of statements about benefits realized till now.** (Benefits realized until now- 1: Low, 4: Neutral , 7: High)	Zhang and Dhalilwal (2009)
	1. Improved customer service	
	2. Better inventory control	
	3. Reduced operations costs	
	4. Reduced cycle time	
	5. Better relationship with partners (B/S)	
	6. Generation of competitive advantage.	
Mutual Dependence (MD) Power Imbalance (PI)	MD= Partner's Dependence on Our firm + Our firm's Dependence on the Partner PI= Partner's Dependence on Our firm - Our firm's Dependence on the Partner <Partner's Dependence on Our firm> 1. In our trade area, there are other suppliers (buyers) that could provide **"Partner A"** with comparable products. 2. In our trade area, **"Partner A"** would incur minimal costs in replacing our firm with another supplier (buyer). 3. If we stopped supplying to **"Partner A"**, they could easily replace our volume with purchase from some other suppliers (buyers). < Our firm's Dependence on the Partner> 1. There are just few competitive buyers (supplier) for the items we supply to **"Partner A"**. 2. Our firm's total costs of switching to a competing buyer (supplier) would be prohibitive. 3. If we decided to stop supplying to **"Partner A"**, it would be difficult for us to replace their volume with sales to other buyers (suppliers).	Casciaro and Piskorski (2005)

<Appendix B> Item-factor Loadings and Cross-loadings for Full Sample and Item-factor Loadings for Subgroups

	Full sample (n = 375)					Dominant firm groups (n = 185)	Non-dominant firm groups (n = 190)	High MD group (n = 227)	Low MD group (n = 148)
	EXD	ITD	MD	OI	PI				
EXD1	0.943	0.600	-0.126	0.588	-0.521	0.934	0.952	0.955	0.782
EXD2	0.946	0.550	-0.075	0.557	-0.524	0.927	0.964	0.948	0.815
EXD3	0.942	0.576	-0.108	0.577	-0.518	0.931	0.953	0.959	0.781
ITD1	0.540	0.801	-0.095	0.603	-0.402	0.757	0.841	0.841	0.706
ITD10	0.452	0.786	-0.082	0.530	-0.325	0.779	0.796	0.821	0.718
ITD11	0.505	0.811	-0.028	0.613	-0.355	0.784	0.836	0.846	0.761
ITD2	0.494	0.802	-0.164	0.568	-0.403	0.742	0.852	0.851	0.704
ITD3	0.481	0.816	-0.166	0.565	-0.408	0.771	0.855	0.838	0.769
ITD4	0.461	0.813	-0.134	0.563	-0.371	0.796	0.827	0.843	0.755
ITD5	0.511	0.848	-0.120	0.621	-0.370	0.816	0.878	0.860	0.822
ITD6	0.490	0.816	-0.050	0.546	-0.387	0.811	0.823	0.859	0.739
ITD7	0.514	0.860	-0.160	0.568	-0.351	0.829	0.888	0.874	0.822
ITD9	0.540	0.833	-0.154	0.587	-0.360	0.846	0.823	0.874	0.749
MD1	-0.118	-0.162	0.875	-0.124	-0.047	0.940	0.793	0.978	0.543
MD2	-0.051	-0.036	0.661	-0.056	0.001	0.522	0.764	0.515	0.810
MD3	-0.090	-0.118	0.952	-0.100	-0.030	0.929	0.961	0.487	0.848
OI1	0.567	0.638	-0.106	0.856	-0.481	0.848	0.864	0.882	0.786
OI2	0.518	0.600	-0.165	0.890	-0.444	0.893	0.889	0.925	0.805
OI3	0.501	0.592	-0.142	0.881	-0.427	0.855	0.910	0.904	0.837
OI4	0.509	0.596	-0.069	0.882	-0.443	0.888	0.877	0.919	0.805
OI5	0.579	0.645	-0.065	0.882	-0.420	0.899	0.865	0.912	0.805
OI6	0.521	0.633	-0.075	0.864	-0.462	0.855	0.875	0.908	0.749
PI1	-0.548	-0.496	0.023	-0.541	0.904	0.907	0.901	0.922	0.999
PI2	-0.448	-0.335	-0.065	-0.405	0.899	0.886	0.910	0.919	0.783
PI3	-0.484	-0.376	-0.075	-0.410	0.907	0.922	0.892	0.924	0.828

Note: Legend: ITD=internal diffusion, EXD=external diffusion, MD= mutual dependence, OI=performance improvement, PI=power imbalance

<Appendix C> Construct Reliability and Validity for Subgroups

<Table C1> Descriptive Statistics and Reliability of Constructs

Total Sample Group (n = 375)					
Construct	Mean	STD	Cronbachs Alpha	Composite Reliability	AVE
EXD	4.688	1.748	0.938	0.961	0.890
ITD	4.914	1.630	0.945	0.953	0.670
MD	7.934	1.344	0.795	0.874	0.703
OI	4.899	1.741	0.939	0.952	0.767
PI	-0.901	2.749	0.889	0.930	0.816
Dominant Firm Group (n = 185)					
EXD	4.633	1.743	0.923	0.951	0.866
ITD	4.853	1.624	0.934	0.944	0.630
MD	7.768	1.374	0.795	0.854	0.673
OI	4.891	1.696	0.938	0.951	0.762
PI	-1.077	2.869	0.891	0.931	0.819
Non-dominant Firm Group (n = 190)					
EXD	4.615	1.755	0.953	0.970	0.914
ITD	4.880	1.672	0.954	0.961	0.710
MD	8.096	1.298	0.791	0.880	0.712
OI	4.989	1.637	0.942	0.954	0.775
PI	-0.536	2.887	0.886	0.928	0.812
High Mutual Dependence Group (n = 227)					
EXD	4.601	1.778	0.950	0.968	0.910
ITD	4.814	1.717	0.958	0.963	0.724
MD	8.827	0.937	0.697	0.717	0.584
OI	4.855	1.769	0.958	0.966	0.825
PI	-0.552	2.902	0.912	0.944	0.850
Low Mutual Dependence Group (n = 148)					
EXD	4.101	1.911	0.732	0.835	0.629
ITD	5.072	1.541	0.916	0.930	0.571
MD	3.367	4.130	0.739	0.726	0.597
OI	5.090	1.475	0.886	0.913	0.637
PI	1.291	3.091	0.927	0.906	0.766
Note: Legend: ITD=internal diffusion, EXD=external diffusion, MD= mutual dependence, OI=performance improvement, PI=power imbalance					

<Appendix C> Construct Reliability and Validity for Subgroups (Cont.)

<Table C2> Squared Pairwise Correlations and Assessment of Discriminant Validity

Total Sample Group (n = 375)					
Construct	Mean	STD	Cronbachs Alpha	Composite Reliability	AVE
	EXD	ITD	MD	OI	PI
EXD	**0.944**				
ITD	0.610	**0.819**			
MD	-0.110	-0.141	**0.838**		
OI	0.609	0.706	-0.118	**0.876**	
PI	-0.552	-0.456	-0.036	-0.510	**0.903**
Dominant Firm Group (n = 185)					
	EXD	ITD	MD	OI	PI
EXD	**0.931**				
ITD	0.616	**0.794**			
MD	-0.104	-0.084	**0.820**		
OI	0.667	0.665	-0.126	**0.873**	
PI	-0.520	-0.396	-0.105	-0.512	**0.905**
Non-dominant Firm Group (n = 190)					
	EXD	ITD	MD	OI	PI
EXD	**0.956**				
ITD	0.606	**0.842**			
MD	-0.118	-0.202	**0.844**		
OI	0.553	0.745	-0.129	**0.880**	
PI	-0.584	-0.517	0.034	-0.516	**0.901**
High Mutual Dependence Group (n = 227)					
	EXD	ITD	MD	OI	PI
EXD	**0.954**				
ITD	0.670	**0.851**			
MD	-0.105	-0.169	**0.764**		
OI	0.645	0.734	-0.092	**0.908**	
PI	-0.663	-0.527	0.058	-0.597	**0.922**
Low Mutual Dependence Group (n = 148)					
	EXD	ITD	MD	OI	PI
EXD	**0.793**				
ITD	0.393	**0.756**			
MD	0.143	-0.196	**0.773**		
OI	0.476	0.629	-0.189	**0.798**	
PI	-0.383	0.018	-0.674	-0.062	**0.875**

<Appendix D> Common Method Bias Test

Constructs	Items	Substantive Factor Loadings (R1)	$R1^2$	Common Method Factor Loadings(R2)	$R2^2$
External Diffusion	EXD1	0.943	0.889	0.068	0.005
	EXD2	0.946	0.895	0.066	0.004
	EXD3	0.942	0.886	0.067	0.004
Internal Diffusion	ITD1	0.801	0.641	0.062	0.004
	ITD10	0.786	0.618	0.056	0.003
	ITD11	0.810	0.655	0.060	0.004
	ITD11	0.755	0.570	0.060	0.004
	ITD2	0.802	0.643	0.060	0.004
	ITD3	0.816	0.666	0.059	0.003
	ITD4	0.813	0.661	0.062	0.004
	ITD5	0.847	0.717	0.059	0.003
	ITD6	0.816	0.666	0.061	0.004
	ITD7	0.861	0.742	0.062	0.004
	ITD9	0.834	0.695	-0.014	0.000
Mutual Dependence	MD1	0.880	0.774	-0.007	0.000
	MD2	0.653	0.426	-0.012	0.000
	MDA	0.951	0.904	0.066	0.004
Performance Improvement	OI1	0.852	0.726	0.065	0.004
	OI2	0.891	0.795	0.063	0.004
	OI3	0.884	0.782	0.064	0.004
	OI4	0.886	0.785	0.066	0.004
	OI5	0.880	0.775	0.065	0.004
	OI6	0.862	0.743	-0.061	0.004
Power Imbalance	PI1	0.901	0.811	-0.061	0.004
	PI2	0.900	0.810	-0.050	0.003
	PI3	0.910	0.828	-0.052	0.003
Average		0.855	0.735	0.036	0.003

<Appendix E> Measurement Invariance Analysis for Group Comparison

We conducted a supplementary measurement invariance analysis in order to determine the appropriateness of comparing path coefficients between subgroups. The measurement invariance analysis was done using AMOS 18.0. We performed configural and metric variance analyses to examine whether the measurement models are invariant across dominant firm groups and non-dominant firm groups/ the high mutual dependence groups and the low mutual dependence groups. Configural invariance means that the patterns of item loadings are congeneric across groups (Doll et al., 1998; Steenkamp and Baumgartner, 1998). When modeling configural invariance, no restrictions are imposed on metrics across groups (Doll et al., 1998). A metric invariance analysis is then used to determine whether items have equal loadings between groups. When modeling metric invariance, item loadings are constrained to be equivalent across groups. If the change in CFI between these two nested (configural and metric) models is smaller than the suggested threshold 0.01 (Cheung and Rensvold, 2002), then metric invariance is supported, allowing for path coefficient comparison between groups.

Following the above procedure, our analysis of configural invariance revealed the pattern of item loadings to be congeneric across subgroups. In terms of metric invariance, the changes in CFI ranged from 0.000 to 0.003. Since these values were all below the 0.01 level (Cheung and Rensvold, 2002), metric invariance was established, providing additional support for meaningful path coefficient comparison across groups.

Power imbalance	Fit index									
	Chi-square	*df*	*p*-value	Chi-square/*df*	CFI	NFI	RMSEA	△ CFI	△ NFI	△ RMSEA
Unconstrained	654.946	306	0.000	2.140	0.951	0.913	0.055			
Fully Constrained	681.576	326	0.000	2.091	0.950	0.910	0.054	0.001	0.003	0.001
Mutual dependence	Fit index									
	Chi-square	*df*	*p*-value	Chi-square/*df*	CFI	NFI	RMSEA	△ CFI	△ NFI	△ RMSEA
Unconstrained	630.173	270	0.000	2.334	0.940	0.901	0.060			
Fully Constrained	633.598	281	0.000	2.255	0.942	0.901	0.058	0.002	0.000	0.002

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Gee-Woo Bock joined the School of Business in Sungkyunkwan University (SKKU) in Seoul, Korea, in September 2006 where he is currently a professor. Since 2002, he has received approximately $300,000 of research grants as a PI. Gee-Woo has served 'Information and Management' as an AE since 2012. Since 2001, he has translated 3 books and published 7 book chapters, 34 journal articles and 41 conference papers, and edited 2 special issues of journals. His articles have been cited about 8000 times in total, and his MIS Quarterly paper alone has been cited about 4,000 times since 2005 according to Google Scholar in April, 2018. His h-index is 21. His current research focuses on Knowledge Management, Cross-Border E-Commerce, and Big Data Analytics. Gee-Woo won SKKU Young Fellowship, a university wide research award, in 2012, and the Mirae Asset Best Researcher Award by Korean Business Society which is the most renowned nation-wide association for business administration scholars and practitioners, in 2018.

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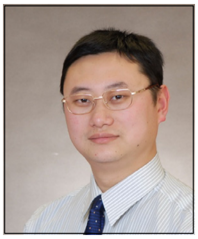

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