

## **The role of mutual trust in supply chain management: deriving from attribution theory and transaction cost theory**

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**Abstract:** Information sharing practices among the supply chain partners enhance supply chain flexibility. The exchange of information sharing, however, may not ensure the expected quality outcomes of information. To test the mediating role of mutual trust between information sharing and information quality, this study uniquely examines four contexts of information sharing (receiving information from customers; receiving information from suppliers; providing information to customers; and providing information to suppliers). With two theoretical lenses, attribution theory and transaction cost theory, this study empirically investigates the interrelationships among information sharing, information quality, mutual trust, and supply chain flexibility with data from 74 Korean steel firms. The results suggest that (1) attribution error (i.e., self-service bias) is likely to happen when it comes to providing information context and (2) mutual trust plays a crucial role in transferring information sharing into information quality. Implications as well as future research opportunities are provided.

**Keywords:** information sharing; information quality; mutual trust; supply chain flexibility; attribution theory; transaction cost theory; Korean steel industry; empirical study.

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## 1 Introduction

In turbulent and competitive business environments, firms strive to achieve supply chain flexibility through implementing of information sharing practices (Zhao et al., 2002; Zhou and Benton, 2007; More et al., 2008). Since supply chain decisions involve a diverse level of information in different areas (e.g., suppliers' quality assessments, customer relationship management and order-fulfillment), it is critical for supply chain participants to provide and receive quality information from one another (Lambert and Cooper, 2000). The problem is that firms routinely sharing information may not always receive the desired outcomes from their supply chain partners (Cannon and Perreault, 1999). By synthesizing the previous literature regarding the role of mutual trust, this study suggests that mutual trust is the critical link that connects information sharing to information quality (Nyaga et al., 2010).

Supply chain management (SCM) research has offered a rich context of information sharing between supply chain partners. These contexts are: (1) receiving information from customers, (2) receiving information from suppliers, (3) providing information to customers, and (4) providing information to suppliers (Handfield and Nichols, 1999; Chopra and Meindl, 2001; Li and Lin, 2006; Zhou and Benton, 2007). Previous literature tends to mix one context or another in a single study. Obviously, what they lack is that they combine the different contexts, ignoring the diverse perspectives of each context. This results in a lack of research accuracy in measuring the impact of information sharing. To the best of our knowledge, Zhou and Benton (2007) provide a unique perspective in examining the contexts of receiving and providing information between focal firms and their customers. They examine these two concepts separately. However, they do not consider the contexts of receiving and providing information between focal firms and their suppliers.

Our primary question in this study is whether or not the four different contexts mentioned above will unanimously display the expected results: the more information is shared, the greater information quality will be. If not, what is the underlying rationale to explain such a difference? How do we understand such disparity? Attribution theory has been used to explain the personal perception of causality for events and thus their effects on subsequent behaviors (Heider, 1958; Kelly and Michela, 1980; Weiner, 1985). Attribution theory can elucidate why relationship between information sharing and information quality as well as perception of causality for this relationship shows the discrepancy in different contexts of information sharing, namely, providing and receiving information sharing. Recently, there has been growing research in regard to mutual trust in a supply chain context (McCutcheon and Stuart, 2000; Johnston et al., 2004; Ireland and Webb, 2007). Transaction cost theory in this area argues that mutual trust better describes business transactions and relationships. Mutual trust between supply chain partners helps reduce transactional costs by minimizing opportunistic behaviors (Zaheer et al., 1998) and enhances information flow across the supply chain (Cai et al., 2010).

The integration of attribution theory and transaction cost theory has two benefits. First, attribution theory helps filter out the context which provides inaccurate results in regard to the relationship between information sharing and information quality. If providing and receiving context shows different results, researchers need to explain why such a difference occurs. Attribution theory can be helpful to explain the different results of information sharing. The second question is then, what variable is needed to strengthen the link between information sharing and information quality. Transaction cost theory provides an underlying rationale for the mediating role of mutual trust on the relationship between information sharing and information

quality. By synthesizing these two theories, this study is able to explain our research focus in a more holistic way.

Figure 1 provides the conceptual framework of this study. This research empirically tests the relationships among information sharing, information quality, mutual trust and supply chain flexibility based on the data from 74 Korean steel companies. In the following sections, this study provides the underpinning theory bases. The third section develops key constructs and hypotheses based on a literature review. The fourth section offers research methods, analysis and results. Finally, discussions and conclusion are provided.

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## **2 Theory Background**

### *2.1 Attribution Theory*

Attribution theory is useful to understand how certain events or individual and organizational behaviors are systematically biased in interpreting the outcomes of the events (Heider, 1958; Lilly et al., 2003). Attribution theory suggests that people interpret their successes and failures in a way that promotes a positive self-image. For example, when people succeed at a particular task, they are likely to attribute this success to factors that are internal to them (e.g., their own efforts or abilities). When they fail, they may attribute it to the factors over which they have no control (e.g., others' faults or macro-events in life). This is called "self-serving bias" which is referred to as "a person's tendency to claim more responsibility than a partner for success and less responsibility for failure in a situation in which an outcome is produced jointly" (Bendapudi and Leone, 2003).

This study adopts Peterson et al. (2002)'s approach to explain how self-serving bias can be an underlying rationale for our context. Attribution theory is modified and applied to our study (see Table 1). In the context of information sharing between supply chain partners, the information shared by our firm to suppliers and customers will likely to be interpreted that the more we share, the greater the quality of information will be achieved. On the other hand, the information we receive from suppliers and customers may not be to be same quality that are given to them. As a result, it is expected that first two contexts (receiving information from suppliers or customers) will show no discrepancy between outcome and perception of causality, whereas the last two contexts (providing information to suppliers or customers) will have discrepancy between outcome and perception of causality. This tendency of a causal attribution can be explained by self-serving bias (Langdridge and Butt, 2004).

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### *2.2 Transaction Cost Theory*

The key idea of transaction cost theory (TCT) is that change outcomes within an organization can be explained through transaction-cost-economizing behaviors of individuals (Williamson, 1985). One crucial element of TCT is the cost of transactions in one governance structure compared

with another. It is assumed that the governance structure that best fits a particular transaction (one with low transaction costs) performs better than one that does not (one with higher transaction costs). Therefore, the higher the transaction costs in a specific governance structure, the lower its performance.

Trust in exchange relationships has been hypothesized to be a valuable economic asset because it is believed to: (1) lower transaction costs and allow for a greater flexibility to respond to a volatile business market (Barney and Hansen, 1994; Dyer, 1997) and (2) lead to quality information sharing that improves coordination and joint efforts to minimize inefficiencies (Clark and Fujimoto, 1991). If trust does lower transaction costs and increase quality information sharing in the ways previously described, then greater trustworthiness on the part of a buyer should reduce the buyer's total costs, thereby increasing profitability. In light of this, Williamson (1991) argues that firms that are effective at economizing on transaction costs will exhibit superior performance. Thus, all else being equal, a buyer with a "trustworthy" reputation in exchange relationships should have lower transaction costs, which in turn will translate into better performance.

### **3 Research Models and Hypotheses**

This study provides two research models: the purpose of the first model is to consider four different contexts of information sharing in the supply chain and the second model purports to examine the mediating role of mutual trust on the relationship between information sharing and information quality.

#### *3.1 Research Model 1*

Figure 2 presents research model 1 that considers four different contexts of information sharing in the supply chain. Three variables are included: information sharing, information quality and supply chain flexibility. In this study, information sharing is defined as "the extent to which critical and proprietary information is communicated among supply chain partners" (Li and Lin, 2006) and measures the extent to which inter-organizational information sharing can meet the requirements of both organizations. In order to solve the supply chain-related problems effectively, buyers and suppliers need to provide amount of information and be ready to share sensitive information such as design issues (Zsidisin, 2003).

While information sharing is important in the supply chain, supply chain performance indeed hinges on the quality of information. In fact, what type of information is shared, when and how it is shared, and with whom will be more critical than information sharing itself without consideration of the above (Li and Lin, 2006). Without ensuring the quality of the shared information, no matter how much information is shared, such information will be of little value (Zhou and Benton, 2007). The literature review reveals that three essential characteristics of information sharing are accuracy, trustworthiness (reliability or credibility), and timeliness (Monczka et al., 1998; Li and Lin, 2006; Zhou and Benton, 2007). This study includes security as one of the essential traits of information quality (Lee et al., 2002). Therefore, this study adopts four characteristics of information quality: accuracy, trustworthiness, timeliness, and security of information between a focal firm and its customers or suppliers.

Supply chain flexibility is a firm's value chain capability which enables it to effectively respond to changes in market reality such as excessive costs and time, operational disruptions, or

performance losses (Vickery et al., 1999). For the purpose of this study, we adopt four dimensions of supply chain flexibility: product variety and volume flexibility (Vickery et al., 1999; Pujawan, 2004; Fantazy et al., 2009), new product flexibility (Vickery et al., 1999; Sanchez and Perex, 2005; Fantazy et al., 2009), and responsiveness flexibility (Vickery et al., 1999). Hypotheses (H1 and H2) in regard to research model 1 are discussed next.

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Attribution theory (AT) can explain how reality (i.e., relationship between information sharing and information quality) and perception (i.e., perception of causality for reality) show discrepancies in information sharing between a firm and either its suppliers or customers. Self-serving bias is referred to as the tendency to connect successes to internal factors rather than to external factors and to link failures to external attributes rather than internal problems (Miller and Ross, 1975). In other words, people attribute positive outcomes to internal factors and negative outcomes to external factors. Drawing from AT, we argue that the pattern of the relationship between information sharing and information quality will be different in the receiving information and providing information context. Thus, we posit the following hypotheses:

- H1a-b.** The quantity of information sharing will not guarantee the quality of information a partnering firm expects. That is, no matter how much information is shared, it will not appropriately affect the quality of information in receiving information context (a firm and its supply chain partners).
- H1c-d.** The quantity of information sharing will guarantee the quality of information a partnering firm expects. That is, the more information sharing, the greater information quality in the providing information context (a firm and its supply chain partners).

It is expected that information quality through receiving information from supply chain partners will enhance supply chain flexibility (Vickery et al., 1999). In the same vein, information quality that has been improved through providing information to supply chain partners will also augment the ability of the supply chain to be flexible. Good examples can be found in the activities of Wal-Mart and Dell (Fawcett et al., 2008). These companies heavily rely on sharing vital information with their suppliers or customers to achieve supply chain flexibility. Vendor Management Inventory (VMI) has been an essential supply chain operation of Wal-Mart as VMI allows key suppliers to take responsibility for inventories such as monitoring inventory levels, planning replenishment, and suggesting new ideas. Aside a significant cost reduction, it strengthens its partnership so that supply chain flexibility can be improved. Dell's direct model that has been characterized as a build-to-order strategy requires a great deal of collaboration between Dell and its suppliers. The close relationships between Dell and its suppliers drive both parties to share sensitive information including sales performance. In order for Dell to have available specific components when needed, suppliers must be to transport the bulk of their components Dell's factories within 15 minutes (McWilliams, 1997). Through this close partnership with suppliers Dell could develop a virtual integration of its operations, enabling Dell to achieve supply chain flexibility (Kraemer et al., 2000). In sum, firms that exchange quality

information with current supply chain partners will have a better chance to make its supply chain to be more flexible. Therefore, it is hypothesized that:

**H2a-b.** The greater the information quality, the greater the supply chain flexibility in the information receiving context (a firm and its supply chain partners).

**H2c-d.** The greater the information quality, the greater the supply chain flexibility in information providing context (our firm and its supply chain partners).

### 3.2 *Research Model 2*

Figure 3 presents a research model 2, particularly examining the mediating role of mutual trust on the relationship between information sharing and information quality. By doing so, this study uncovers the obvious but often neglected and unexplored role of mutual trust in the supply chain context. In operationalizing mutual trust, two distinct features are: dependability (reliability, trustworthiness) and benevolence (goodwill) (Johnston et al., 2004; Hill et al., 2009). Dependability measures the behavioral aspect of trust in that one party believes that the other party is able to perform the anticipated duty in a dependable or reliable manner (Nyaga et al., 2010). Benevolence or goodwill assesses the moral aspect of trust in that one party in a relationship believes that the other party will benefit the partner's interest without any hidden harmful motives (Zaheer et al., 1998; Ireland, Webb, 2007). These two dimensions are important attributes of trust in inter-firm relationships. While Johnston et al. (2004) measure two dimensions of trust, which are reliability and goodwill, within two constructs, this study considers these two aspects of mutual trust in a single construct. Research model 2 considers only the information receiving context, since we hypothesize that the information providing context is excluded by attribution theory in research model 1. Hypotheses (H3, H4, and H5) are discussed next.

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Prior literature studied the impact of information sharing on establishing mutual trust among partners (Doney and Cannon, 1997; Kwon and Suh, 2004; Nyaga et al., 2010). Doney and Cannon (1997) examine antecedents and consequences of a buying firm's trust of a supplier firm and salesperson. Among the key antecedents, confidential information sharing has been identified. The authors also test the impact of supplier firm and salesperson trust on a buying firm's current supplier choice and future purchase intentions. The study of Kwon and Suh (2004) finds that information sharing can reduce the level of behavioral uncertainty, which, in turn, improves the level of mutual trust. Nyaga et al. (2010) argue that mutual trust becomes one of the key mediating variables between collaborative activities (information sharing, joint relationship effort and dedicated investment) and relationship outcomes (satisfaction with relationship, satisfaction with results, and performance). In sum, these studies confirm that mutual trust needs to be regarded as a product of information sharing practices among partners. Thus, we suggest the following hypotheses:

**H3a-b.** The more information is shared, the greater will be the mutual trust between our firm and its supply chain partners (suppliers and customers).

It is argued that mutual trust plays an important role in transforming quality of information shared since trust can mitigate the information asymmetry between trading partners through enabling them to share more open and honest information (Zaheer et al., 1998; McEvily and Marcus, 2005). When partners have more trust in the supply chain relationship, they are more likely to share relevant and timely information. In other words, once trust is in place among partners in the supply chain, they are likely to share quality information. Without trust during the collaborative process, information shared between the partners is likely to be inaccurate (Currall and Judge, 1995). Mutual trust can facilitate quality of information in terms of accuracy, timeliness and openness. Therefore, it is hypothesized that:

**H4a-b.** The greater the mutual trust between our firm and its supply chain partners (suppliers and customers) is in place, the greater the information quality will be.

It is hypothesized that information quality and supply chain flexibility is positively related (See H2a-d). Research model 2 considers only the information receiving context since the information providing context is excluded through attribution theory (self-serving bias). The logic and argument behind H5a-b are the same as those of H2a-b. Therefore, the following is posited:

**H5a-b.** The greater the information quality, the greater will be the supply chain flexibility in the information receiving context (our firm and its supply chain partners –suppliers and customers).

## **4 Research Methodology**

### *4.1 Data collection and the sample list*

This study involves two stages of data collection: a pilot study and a large scale survey. First, after the initial lists of the survey questionnaire, authors consulted with several practitioners who have worked more than 3 years in the area of supply chain management to ensure the relevance and clarity of the research instrument. The questionnaire items were modified and refined based on feedback from the pilot study. Second, for the large scale survey, two major Korean stock markets, KOSPI (Korean Composite Stock Price Index) and KOSDAQ (Korea Securities Dealers Automated Quotation) were used. As of 2006, the total number of publicly traded steel-related companies was 130 in Korea.

For three months, from August 2006 to October 2006, a total of 130 managers from the above companies were contacted. The purpose of the research was explained. Then, questionnaires were sent to those who showed interest through faxes, email, and regular mail. Among 130 steel-related companies, 81 managers responded to the survey questionnaire (62.3%), among which 7 were incomplete, and 74 were used for the test and analysis in this study. The response rate was approximately 57%. If the size of the company was too small, those companies are excluded because the context of very small companies is different from those of large companies, and it is difficult to achieve a generalization.



The sample descriptions are displayed in Table 2. Small-and Medium-sized enterprises (SMEs) are dominant in our respondents (<500) (n=58) while large companies account for 21.6% (n=16). 35 companies (47.3%) were collected from the KOSPI and 39 companies are from the KOSDAQ (52.7%). Half of the industry participants are from basic metals (n=37), fabricated metal products (n=19), followed by motor vehicles, trailers and semi-trailers (n=18). Finally, more than half of the respondents (n=46) have more than 5 years of working experience. The average of working years of the respondent was 9.55 years in the industry which show that they have enough experience and knowledge and are reliable respondents.

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#### 4.2 *Measurement scales*

Descriptive statistics, factor loadings, and average variance extracted (AVE) are provided in Appendix A (Table 1-1 and Table 1-2). Table 1-1 provides survey questionnaire related to receiving information from customers and suppliers. Table 1-2 includes survey items regarding providing information to its customers and suppliers. Since this study assumes that the providing information context can be excluded because of the self-serving bias of attribution theory (Peterson et al., 2002), mutual trust is only included in the receiving information context, which is in Table 1-1.

A 5-point Likert scale was used to measure each variable. For *information sharing*, four different types were measured: (1) receiving information from customers (RPIC1, 2, 3), (2) receiving information from suppliers (RSIS1, 2, 3), (3) providing information to customers (PPIC 1, 2, 3), and (4) providing information to suppliers (PTIC 1, 2, 3). Relevant items are adapted from Li and Lin (2006) and Zhou and Benton (2007). In this study, information sharing is operationalized as a second-order construct. For receiving information, plan-related and sales-related information are measured while for providing information, plan-related and trend-related information are measured. These items are designed to measure the level of information sharing among supply chain partners (our firm and its customer and suppliers) in regard to either plan-related and sales-related or plan-related and trend-related information. *Information quality* represents the extent to which accurate, secure, reliable, and timely information is shared among the supply chain partners. Four items (information accuracy, information security, information reliability, and information timeliness) are adopted to measure the level of information quality occurred between our firm and its customers both in receiving (RIQC 1, 2, 3, 4) and providing information context (PIQC 1, 2, 3, 4) (Lee et al., 2002; Li and Lin, 2006; Zhou and Benton, 2007). To measure the level of information quality, three items, excluding information security, have been adopted (RIQS 1, 2, 3 and PIQS 1, 2, 3) (Li and Lin, 2006; Zhou and Benton, 2007). As for *mutual trust*, three items each (MTC 1, 2, 3 and MTS 1, 2, 3) were designed to measure two aspects of mutual trust that occur between our firm and its customers and suppliers. These are behavioral aspect (dependability) (MTC 2, 3 and MTS 2, 3) and moral aspect (benevolence) (MTC1 and MTS1). Three items each were adapted from Johnston et al. (2004). Supply chain performance was measured by *supply chain flexibility* (SCF 1, 2, 3, 4). Items were from Vickery et al. (1999) which measured four aspects of supply chain flexibility such as product variety (SCF1) and volume flexibility (SCF2), responsiveness flexibility (SCF3) and new product flexibility (SCF4).

Because each sample was gathered from a single respondent, a common method bias needs to be tested. Harman's single method test was used. Confirmatory factor analysis (CFA) did not produce a single factor or one general factor that explains the majority of the variance because each factor accounted for more than the cut-off value of 5% variance (Lederer et al., 2000). Also, each model fit<sup>1</sup> shows that a single factor model does not represent the dataset well (Model 1a<sup>i</sup>:  $\chi^2=349.781$ ,  $df=77$ ,  $GFI=0.567$ ,  $RMSEA=0.220$ ,  $SRMR=0.160$ ; Model 1b<sup>ii</sup>:  $\chi^2=301.508$ ,  $df=54$ ,  $GFI=0.594$ ,  $RMSEA=0.251$ ,  $SRMR=0.185$ ; Model 1c<sup>iii</sup>:  $\chi^2=284.714$ ,  $df=77$ ,  $GFI=0.617$ ,  $RMSEA=0.192$ ,  $SRMR=0.160$ ; Model 1d<sup>iv</sup>:  $\chi^2=347.452$ ,  $df=65$ ,  $GFI=0.553$ ,  $RMSEA=0.244$ ,  $SRMR=0.170$ ; Model 2a<sup>v</sup>:  $\chi^2=420.535$ ,  $df=119$ ,  $GFI=0.574$ ,  $RMSEA=0.186$ ,  $SRMR=0.148$ ; Model 2b<sup>vi</sup>:  $\chi^2=360.052$ ,  $df=90$ ,  $GFI=0.600$ ,  $RMSEA=0.203$ ,  $SRMR=0.162$ ). This result indicates that common method bias is not a problem.

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**Put Appendix A: Note Appendix A should be placed after Reference Section**

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## 5 Analysis and results

AMOS<sup>2</sup> is used to analyze both measurement model and structural model. We follow Anderson and Gerbing's (1988) recommended two-step approach to interpret the AMOS results: (1) measurement model and (2) structural model. In the first step of our analysis we test the measurement model.

### 5.1 Measurement model

The confirmatory factor analysis (CFA) was performed to assess the validity of the measurement model. In line with Shah and Goldstein (2005) and Hu and Bentler (1999), the goodness of fit index (GFI), comparative fit index (CFI), incremental fit index (IFI), non-normed fit index (NNFI), and root mean square error of approximation (RMSEA) were used to assess the goodness of fit. Six second-order CFA models (See Figure 2 and Figure 3) were examined. All six second-order CFA models generated acceptable fit. The first CFA model (Models 1a, 2a) –  $\chi^2=83.685$ ,  $df=72$ ,  $RMSEA=0.047$ ,  $GFI=0.861$ ,  $NNFI=0.975$ ,  $IFI=0.981$ ,  $CFI=0.980$ ,  $SRMR=0.062$ ; The second CFA model (Models 1b, 2b) –  $\chi^2=68.912$ ,  $df=49$ ,  $RMSEA=0.075$ ,  $GFI=0.871$ ,  $NNFI=0.938$ ,  $IFI=0.956$ ,  $CFI=0.954$  and  $SRMR=0.076$ ; The third CFA model (Models 1c, 2c) –  $\chi^2=93.153$ ,  $df=72$ ,  $RMSEA=0.065$ ,  $GFI=0.860$ ,  $NNFI=0.946$ ,  $IFI=0.959$ ,  $CFI=0.957$ , and  $SRMR=0.075$ ; the fourth CFA model (Models 1d, 2d) –  $\chi^2=82.765$ ,  $df=60$ ,  $RMSEA=0.072$ ,  $GFI=0.859$ ,  $NNFI=0.941$ ,  $IFI=0.956$ ,  $CFI=0.955$ , and  $SRMR=0.065$ ; the fifth CFA model (Models 3a, 4a, and 5a) –  $\chi^2=126.569$ ,  $df=111$ ,  $RMSEA=0.044$ ,  $GFI=0.836$ ,  $NNFI=0.971$ ,  $IFI=0.977$ ,  $CFI=0.976$ , and  $SRMR=0.070$ ; the sixth CFA model (Models 3b, 4b,

<sup>i</sup> Model 1a refers to the context where our firm receives information from customers.

<sup>ii</sup> Model 1b refers to the context where our firm receives information from suppliers.

<sup>iii</sup> Model 1c refers to the context where our firm provides information to customers.

<sup>iv</sup> Model 1d refers to the context where our firm provides information to suppliers.

<sup>v</sup> Model 2a refers to the context where our firm receives information from customers.

<sup>vi</sup> Model 2b refers to the context where our firm receives information from suppliers.

<sup>2</sup> It is not unusual to use AMOS with a small sample size (Shah and Goldstein, 2005).

and 5b) –  $\chi^2=108.348$ ,  $df=82$ ,  $RMSEA=0.066$ ,  $GFI=0.842$ ,  $NNFI=0.933$ ,  $IFI=0.950$ ,  $CFI=0.948$  and  $SRMR=0.078$ .

Table 3 reports descriptive statistics (mean and standard deviation), correlations, Cronbach's  $\alpha$ , and composite reliability for models 1a-d, models 2a-d, models 3a-b, models 4a-b, and models 5a-b (refer to the note). *Convergent validity* is assessed by how well the items load on its posited underlying latent variable in the measurement model. According to Bagozzi and Yi (1988), 0.60 or above of item-factor loadings show good convergent validity. All item-factor loadings are above 0.60, indicating good convergent validity (see Appendix A). For *discriminate validity*, the square root of the average variance extracted (AVE) values for each factor should normally be greater than the correlations between the focal factor and other factors (Fornell and Larcker, 1981). An examination of Table 3 shows that all the values of diagonal elements (i.e., the square root of AVE) are far greater than the values of non-diagonal elements (i.e., the correlations between the focal factor and other factors), suggesting adequate discriminant validity. *Reliabilities* are assessed using Cronbach's alpha and composite reliability (Fornell and Larcker, 1981). All the values of Cronbach's alpha are 0.7 or above on each latent variable. The composite reliability of each construct is between 0.722 and 0.913 which is higher than 0.7, Nunnally (1978)'s recommendation. The results show that these models have an acceptable level of reliability.

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## 5.2 Structural model results and hypothesis testing

In the second step of our analysis we evaluate the structural model. Overall, ten hypotheses (H1c-d, H2a-d, H3b, H4b, H5a-b) are supported at both  $p < 0.01$  and  $p < 0.05$  while four hypotheses (H1a, H1b, H3a, and H4a) are not supported. Figure 4 and Figure 5 show the structural model with path coefficients. Figure 4 displays the results of structural model without mutual trust. Four different contexts of information sharing are considered.

Interestingly, while the relationship between information sharing and information quality in the receiving information context is not significant (H1a,b), this relationship in the providing information context is significant (H1c,d). This result supports the notion of self-serving attribution error (Peterson et al., 2002). Therefore, it is appropriate to eliminate the providing information context because it contains an error in interpreting and the context of receiving information is examined only. The path coefficients from information quality to supply chain flexibility are statistically significant, supporting H2a-d: H2a (0.579,  $p < 0.01$ ), H2b (0.521,  $p < 0.01$ ), H2c (0.578,  $p < 0.01$ ), and H2d (0.520,  $p < 0.01$ ).

Figure 5 shows the results of the structural model with mutual trust. This model examines the mediating role of mutual trust on the relationship between information sharing and information quality. Mediation can be examined by specifying the direct paths between independent and dependent variables and the indirect paths from independent to mediating variables to dependent variable simultaneously (Baron and Kenny, 1986; MacKinnon et al., 2002; Shrout and Bolger, 2002; James et al., 2006). The purpose of examining the mediating variable is to clarify the nature of the relationship between the independent and dependent variables (MacKinnon, 2008) by including a third variable, i.e., mediator. The addition of a mediator will strengthen the relationship between an independent variable and a dependent variable. It is regarded as a partial

mediation when the relationship between independent and dependent variables still remains significant after adding the mediating variable. Figure 5 presents the results of a direct model with an additional direct path between information sharing and information quality in both contexts. In the context of receiving information from customers, there is no mediation effect of mutual trust (the estimates of  $\beta$  for direct paths between information sharing and information quality and the indirect paths from information sharing to mutual trust to information quality are not significant) while in the context of receiving information from suppliers, the estimate of  $\beta$  alone for direct paths between information sharing and information quality is not significant, indicating support for full mediation of the effect of information sharing on information quality by mutual trust. Total, direct and indirect effects associated with the paths among the latent factors are reported in Table 4. The proposed structural models achieve a fairly good model fit (Models 3a, 4a, and 5a:  $\chi^2=127.303$ ,  $df =113$ ,  $RMSEA=0.042$ ,  $GFI=0.834$ ,  $NNFI=0.973$ ,  $IFI=0.979$ ,  $CFI=0.978$ , and  $SRMR=0.071$ ; Models 3b, 4b, and 5b:  $\chi^2=108.383$ ,  $df =84$ ,  $RMSEA=0.063$ ,  $GFI=0.843$ ,  $NNFI=0.940$ ,  $IFI= 0.954$ ,  $CFI=0.952$ , and  $SRMR=0.079$ ).

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**Put Figures 4 and 5 here**

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**Put Table 4 here**

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## **6 Implications and conclusion**

The research model suggested in this study was tested based on the empirical results of 74 Korean steel companies. The Korean context displays a unique situation. Over the years, Korean steel companies such as POSCO, one of the global steel giants, have vigorously exploited information sharing practices within an organization as well as an inter-organizational context through developing integrated information systems. Improved information systems enabled them to share critical and sensitive information with their important suppliers and customers and therefore enhancing mutual trust among them. Such endeavors are instrumental in increasing both firm-level and supply chain-level performance outcomes. For example, facing the global challenge of the competitive business environment, POSCO initiated an organization-wide project called, ‘process innovation (PI)’ in 1999 to enhance the functional integration from the sourcing of raw materials to the final steel production in the supply chain (Lee and Lee, 2009). One of the major projects that were developed under the name of PI was POSPIA, an integrated ERP system. Since the adoption of POSPIA, POSCO has experienced a drastic improvement of its entire information system – namely, all disconnected and fragmented functions in the supply chains, such as purchasing, sales, production, finance, HR, and technology, were interconnected. Moreover, this enhanced information system allowed POSCO to facilitate intra- and inter-organizational information sharing activities and thus POSCO could manage major suppliers and customers more effectively.

Extending the unique situation of the Korean context, this study can be applicable to many other global contexts. The followings are implications drawn from the results of this study. First, in order to increase the accuracy of supply chain research scholars need to consider four different contexts of information sharing between supply chain partners simultaneously – (1) receiving information from customers, (2) receiving information from suppliers, (3) providing information to

customers and (4) providing information to suppliers. Considering the difficulty of data gathering in supply chain studies, however, this approach is often costly and even hard to implement. This study found that attribution error – especially, self-serving bias – is very likely to occur (Peterson et al., 2002) when it comes to a focal company's providing information to its customers and suppliers. It would significantly reduce the reliability of the result. Future research may need to focus on the receiving context only, which will increase the efficiency of the research.

Second, the result also suggests that the relational capability of a firm, characterized as mutual trust, is a critical link that connects information sharing to information quality, which, in turn, improves supply chain flexibility. A strong trust among partners becomes a source of competitive advantage (Barney and Hansen, 1994). Such trust can be established through sharing of critical information such as new product development plans and sales-related information (Kwon and Suh, 2004). When information is shared, firms enhance the understanding of each other's routines and can develop conflict resolution mechanisms, which will lead to improved information quality in the short-term and eventually the competitiveness of a firm and its supply chain. Another finding shows that mutual trust becomes an important mediating variable in the relationship between information sharing and information quality when a firm receives information from suppliers, but not when a firm receives information from customers. This result is not in line with our expectation. This result can be explained by the difference of governance between focal firms and their suppliers and customers. From a focal firm's perspective suppliers are relatively easy to be controlled by them compared to customers. Therefore, mutual trust can be more quickly established in the relationship between focal firms and their suppliers.

While this research offers a useful insight that can help to better understand the context of the competitiveness of the Korean steel industry, this study may be helpful for future studies of information sharing practices of other countries such as China and Southeastern Asian countries (Indonesia, Vietnam, Thailand) (Hitomi, 2002, 2003). Other future studies may further evaluate other factors that determine the effectiveness of information flows such as organizational culture, nature of decisions, and other business process practices.

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APPENDIX A.

**Table 1-1 Survey Questionnaire (Receiving Information from its customers or suppliers)**

Survey items	Mean	S.D.	Loading <sup>a</sup>	AVE <sup>b</sup>
Please indicate the level of information sharing among supply chain partners. [1: not at all, 3: moderate, 5: very much]				
<b>Receiving Information from Customers (2<sup>nd</sup> order)</b> (Adapted from Li and Lin, 2006; Zhou and Benton, 2007)				
<b>Plan-related Information</b>				0.687
RPIC1. Annual or Seasonal production plan	3.176	1.163	0.748	
RPIC2. Monthly Production Plan	3.216	1.219	0.844	
RPIC3. New Product Development Plan	3.108	1.277	0.852	
RPIC4. Production changes Plan	3.041	1.276	0.866	
<b>Sales-related Information</b>				0.783
RSIC1. Domestic sales	2.622	1.082	0.873	
RSIC2. Overseas sales	2.392	1.083	0.897	
<b>Receiving Information from Suppliers (2<sup>nd</sup> order)</b> (Adapted from Li and Lin, 2006; Zhou and Benton, 2007)				
<b>Plan-related Information</b>				0.589
RPIS1. Monthly Production Plan	3.135	1.242	0.692	
RPIS2. Product inventory levels	2.986	1.141	0.725	
RPIS3. Production changes Plan	3.068	1.090	0.873	
<b>Sales-related Information</b>				0.840
RSIS1. Domestic sales	2.608	1.156	0.947	
RSIS2. Overseas sales	2.446	1.087	0.885	
Please indicate the level of information quality. [1: not at all, 3: moderate, 5: very much]				
<b>Information quality (between our firm and its customers)</b> (Adapted from Lee et al., 2002; Li and Lin, 2006; Zhou and Benton, 2007)				
RIQC1. Information accuracy				0.686
	3.568	0.829	0.913	
RIQC2. Information security				
	3.392	0.808	0.755	
RIQC3. Information reliability (dependability, trustworthiness)				
	3.622	0.806	0.903	
RIQC4. Information timeliness (relevance, recency)				
	3.216	0.815	0.724	
<b>Information quality (between our firm and its suppliers)</b> (Adapted from Lee et al., 2002; Li and Lin, 2006; Zhou and Benton, 2007)				
RIQS1. Information accuracy				0.683
	3.662	0.745	0.911	
RIQS2. Information reliability (dependability, trustworthiness)				
	3.595	0.875	0.828	
RIQS3. Information timeliness (relevance, recency)				
	3.419	0.794	0.731	
Please indicate the level of mutual trust among supply chain partners. [1: not at all, 3: moderate, 5: very much]				
<b>Mutual Trust (Customers)</b> (Adapted from Johnston et al., 2004)				
MTC1. Our firm has strong confidence that our customers will provide the best advices in regard to our businesses for our sake (Johnston et al., 2004)				0.474
	3.311	0.992	0.685	
MTC2. Our firm is able to provide a sincere aid to our customers				
	3.730	0.880	0.679	
MTC3. Our customers keep their words to our firm				
	3.676	0.829	0.701	
<b>Mutual Trust (Suppliers)</b> (Adapted from Johnston et al., 2004)				
MTS1. Our firm has strong confidence that our suppliers will provide the best advices in regard to our businesses for our sake (Johnston et al., 2004)				0.466
	3.081	0.888	0.665	
MTS2. Our firm is able to provide a sincere aid to our suppliers				
	3.446	0.846	0.745	
MTS3. Our suppliers keep their words to our firm				
	3.432	0.778	0.632	
Please indicate the level of supply chain flexibility. [1: strongly disagree, 3: neutral, 5: strongly agree]				
<b>Supply chain flexibility</b> (Adapted from Vickery et al., 1999)				
SCF1. Our supply chain is able to produce variety of products in terms of options and size.				0.578
	3.811	0.961	0.599	
SCF2. Our supply chain is able to change (readjust) sufficient volume of products according to customer orders.				
	3.811	0.871	0.814	
SCF3. Our supply chain is able to handle change requirements of products in time.				
	3.365	0.915	0.868	
SCF4. Our supply chain is able to introduce quickly new products to the market.				
	3.068	1.011	0.733	

<sup>a</sup> Standardized coefficients: all loadings are significant at  $p < 0.01$

<sup>b</sup> AVE: Average variance extracted.

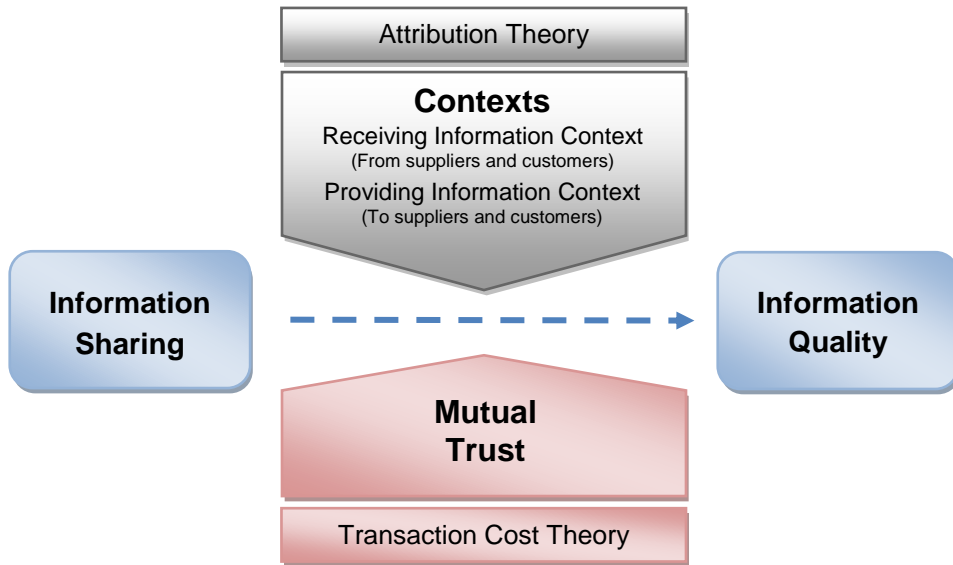
**Table 1-2 Survey Questionnaire (Providing Information to its customers or suppliers)**

Survey items	Mean	S.D.	Loading <sup>a</sup>	AVE <sup>b</sup>
Please indicate the level of information sharing among supply chain partners. [1: not at all, 3: moderate, 5: very much]				
<b>Providing Information to Customers (2<sup>nd</sup> order)</b> (Adapted from Li and Lin, 2006; Zhou and Benton, 2007)				
<b>Plan-related Information</b>				0.635
PPIC1. Annual or Seasonal production plan	2.973	1.158	0.703	
PPIC2. Monthly Production Plan	2.932	1.296	0.856	
PPIC3. Production changes Plan	2.973	1.375	0.824	
<b>Trend-related Information</b>				0.651
PTIC1. Domestic Industry Trends	3.068	0.998	0.914	
PTIC2. International Economic Trends	2.757	0.962	0.876	
PTIC3. Sales policy changes	2.905	0.939	0.591	
<b>Providing Information to Suppliers (2<sup>nd</sup> order)</b> (Adapted from Li and Lin, 2006; Zhou and Benton, 2007)				
<b>Plan-related Information</b>				0.635
PPIS1. Annual or Seasonal production plan	3.568	1.061	0.897	
PPIS2. Monthly Production Plan	3.568	1.217	0.868	
PPIS3. New Product Development Plan	2.959	1.128	0.629	
PPIS4. Production changes Plan	3.162	1.282	0.766	
<b>Trend-related Information</b>				0.842
PTIS1. Domestic Industry Trends	3.162	1.098	1.079	
PTIS2. International Economic Trends	2.959	0.985	0.721	
Please indicate the level of information quality. [1: not at all, 3: moderate, 5: very much]				
<b>Information quality (between our firms and its customers)</b> (Adapted from Lee et al., 2002; Li and Lin, 2006; Zhou and Benton, 2007)				
PIQC1. Information accuracy	3.568	0.829	0.913	0.686
PIQC2. Information security	3.392	0.808	0.755	
PIQC3. Information reliability (dependability, trustworthiness)	3.622	0.806	0.903	
PIQC4. Information timeliness (relevance, recency)	3.216	0.815	0.724	
<b>Information quality (between our firms and its suppliers)</b> (Adapted from Lee et al., 2002; Li and Lin, 2006; Zhou and Benton, 2007)				
PIQS1. Information accuracy	3.662	0.745	0.911	0.683
PIQS2. Information reliability (dependability, trustworthiness)	3.595	0.875	0.828	
PIQS3. Information timeliness (relevance, recency)	3.419	0.794	0.731	
Please indicate the level of supply chain flexibility. [1: strongly disagree, 3: neutral, 5: strongly agree]				
<b>Supply chain flexibility</b> (Adapted from Vickery et al., 1999)				
SCF1. Our supply chain is able to produce variety of products in terms of options and size.	3.811	0.961	0.599	0.578
SCF2. Our supply chain is able to produce sufficient volume of products according to customer orders.	3.811	0.871	0.814	
SCF3. Our supply chain is able to handle change requirements of products in time.	3.365	0.915	0.868	
SCF4. Our supply chain is able to introduce quickly new products in the market.	3.068	1.011	0.733	

<sup>a</sup> Standardized coefficients: all loadings are significant at  $p < 0.01$

<sup>b</sup> AVE: Average variance extracted.

**Figure 1** Conceptual framework

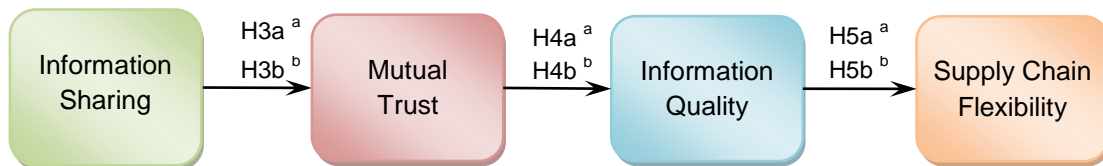


**Figure 2** Research model 1



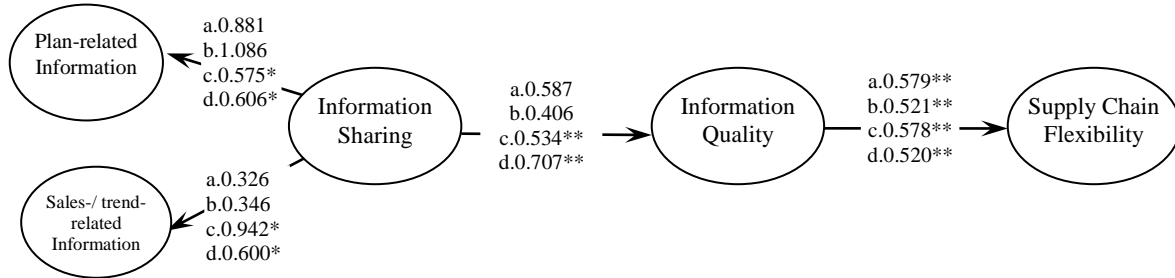
<sup>a</sup> H1a/ H2a refer to the context where our firm receives information from customers.  
<sup>b</sup> H1b/ H2b refer to the context where our firm receives information from suppliers.  
<sup>c</sup> H1c/ H2c refer to the context where our firm provides information to customers.  
<sup>d</sup> H1d/ H2d refer to the context where our firm provides information to suppliers.

**Figure 3** Research model 2



<sup>a</sup> H3a/ H4a/ H5a refer to the context where our firm receives information from customers.  
<sup>b</sup> H3b/ H4b/ H5b refer to the context where our firm receives information from suppliers.

**Figure 4** Structural model results (Providing and receiving information between our firm and its supply chain partners without mutual trust)



\*\* Significant at  $p < 0.01$  \* Significant at  $p < 0.05$ .

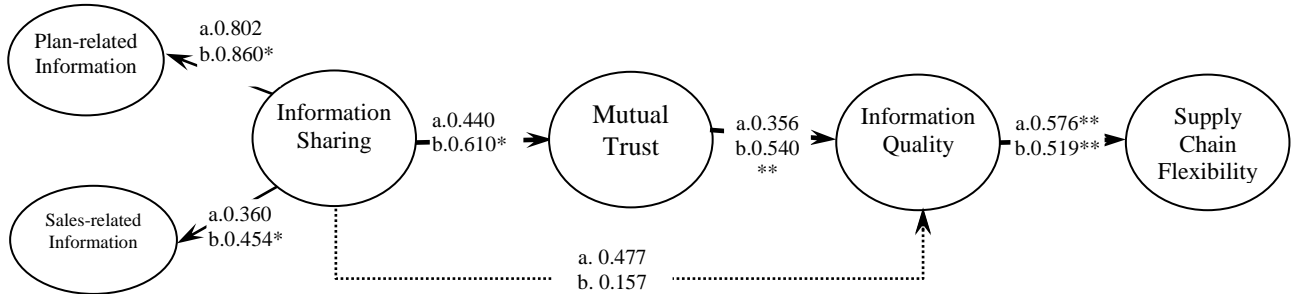
a. Receiving information from customers ( $\chi^2 = 84.034$ ,  $df = 73$ ,  $Cmin/df = 1.151$ ,  $CFI = 0.981$ ,  $GFI = 0.861$ ,  $RMSEA = 0.046$ ,  $NNFI = 0.977$ ,  $IFI = 0.982$ )

b. Receiving information from suppliers ( $\chi^2 = 69.143$ ,  $df = 50$ ,  $Cmin/df = 1.383$ ,  $CFI = 0.956$ ,  $GFI = 0.871$ ,  $RMSEA = 0.072$ ,  $NNFI = 0.942$ ,  $IFI = 0.957$ )

c. Providing information to customers ( $\chi^2 = 93.536$ ,  $df = 73$ ,  $Cmin/df = 1.281$ ,  $CFI = 0.958$ ,  $GFI = 0.860$ ,  $RMSEA = 0.062$ ,  $NNFI = 0.948$ ,  $IFI = 0.960$ )

d. Providing information to suppliers ( $\chi^2 = 82.784$ ,  $df = 61$ ,  $Cmin/df = 1.357$ ,  $CFI = 0.957$ ,  $GFI = 0.859$ ,  $RMSEA = 0.070$ ,  $NNFI = 0.945$ ,  $IFI = 0.958$ )

**Figure 5** Structural model results (Receiving information between our firm and its supply chain partners with mutual trust)



\*\* Significant at  $p < 0.01$  \* Significant at  $p < 0.05$ .

a. Receiving information from customers ( $\chi^2 = 127.303$ ,  $df = 113$ ,  $Cmin/df = 1.127$ ,  $CFI = 0.978$ ,  $GFI = 0.834$ ,  $RMSEA = 0.042$ ,  $NNFI = 0.973$ ,  $IFI = 0.979$ , and  $SRMR = 0.071$ )

b. Receiving information from suppliers ( $\chi^2 = 108.383$ ,  $df = 84$ ,  $Cmin/df = 1.290$ ,  $CFI = 0.952$ ,  $GFI = 0.843$ ,  $RMSEA = 0.063$ ,  $NNFI = 0.940$ ,  $IFI = 0.954$ , and  $SRMR = 0.079$ )

**Table 1** Attribution theory modified to our study

Context ( <b>Event</b> ): Four different context of information sharing	Expected Outcome ( <b>Reality</b> ): The impact of information sharing on information quality	Expected Perception of Causality ( <b>Interpretation</b> )	Expected Discrepancy?
Receiving information from suppliers and customers	No impact <sup>a</sup>	No impact <sup>a</sup>	No
Providing information to suppliers and customers	No impact <sup>a</sup>	Impact <sup>b</sup>	Yes (self-serving bias)

<sup>a</sup>The amount of information sharing without mutual trust will not guarantee the quality of information a partnering firm expects.

<sup>b</sup>The amount of information sharing without mutual trust will guarantee the quality of information a partnering firm expects.

**Table 2** Summary of sample description

Classification		n	%
Firm Size	Large (>500)	16	21.6
	Small- and medium- sized (<500)	58	78.4
Data bases	KOSPI <sup>a</sup>	35	47.3
	KOSDAQ <sup>b</sup>	39	52.7
Industry Type	Basic metals	37	50.0
	Fabricated metal products, except machinery and equipment	19	25.7
	Motor vehicles, trailers & semi-trailers	18	24.3
Years of Experience	> 10 years	32	43.2
	5-10 years	14	18.9
	<5 years	23	31.0
	No response	5	6.8
	Total	74	100 %

<sup>a</sup> Korea Composite Stock Price Index

<sup>b</sup> Korean Securities Dealers Automated Quotations

**Table 3** Inter-construct Correlations (Combined), Reliability, and Discriminant validity (n=74)

Model	Constructs	Mean	SD	1	2	3	4	5	Reliability	
									Cronbach's $\alpha$	Composite reliability <sup>f</sup>
Model 1a, 2a, 3a, 4a & 5a <sup>a</sup>	1 Plan-related Information	3.135	1.078	[0.829] <sup>e</sup>					0.896	0.897
	2 Sales-related Information	2.507	1.022	0.268	[0.911]				0.878	0.905
	3 Supply Chain Flexibility	3.514	0.765	0.315	0.107	[0.760]			0.829	0.843
	4 Information Quality	3.448	0.708	0.468	0.164	0.493	[0.828]		0.892	0.896
	5 Mutual Trust	3.570	0.727	0.273	0.285	0.208	0.473	[0.688]	0.727	0.730
Model 1b, 2b, 3b, 4b & 5b <sup>b</sup>	1 Plan-related Information	3.061	0.983	[0.767]					0.803	0.810
	2 Sales-related Information	2.527	1.076	0.327	[0.917]				0.911	0.913
	3 Supply Chain Flexibility	3.514	0.765	0.196	-0.115	[0.758]			0.829	0.841
	4 Information Quality	3.559	0.713	0.312	0.138	0.463	[0.827]		0.861	0.865
	5 Mutual Trust	3.322	0.668	0.385	0.317	0.268	0.528	[0.682]	0.711	0.722
Model 1c & 2c <sup>c</sup>	1 Plan-related Information	2.959	1.108	[0.797]					0.833	0.838
	2 Trend-related Information	2.910	0.835	0.353	[0.807]				0.831	0.844
	3 Supply Chain Flexibility	3.514	0.765	0.139	0.114	[0.760]			0.829	0.843
	4 Information Quality	3.448	0.708	0.255	0.138	0.493	[0.828]		0.892	0.896
Model 1d & 2d <sup>d</sup>	1 Plan-related Information	3.314	0.998	[0.797]					0.871	0.872
	2 Trend-related Information	3.061	0.983	0.338	[0.918]				0.872	0.911
	3 Supply Chain Flexibility	3.514	0.765	0.229	0.129	[0.759]			0.829	0.842
	4 Information Quality	3.559	0.713	0.314	0.345	0.463	[0.827]		0.861	0.865

All correlation coefficients are significant at  $p < 0.01$

<sup>a</sup> Model 1a, 2a, 3a, 4a and 5a refer to the context where our firm receives information from customers.

<sup>b</sup> Model 1b, 2b, 3b, 4b and 5b refer to the context where our firm receives information from suppliers.

<sup>c</sup> Model 1c and 2c refer to the context where our firm provides information to customers.

<sup>d</sup> Model 1d and 2d refer to the context where our firm provides information to suppliers.

<sup>e</sup> Square root of average variances extracted are on the diagonal in brackets.

<sup>f</sup> Calculated according to Fornell and Larcker (1981)

**Table 4** Decomposition of direct, indirect, and total effects for the model

	Path	Direct effect	Indirect effect	Total effect
Receiving information from customers	Information sharing →	.440		.440
	Mutual trust			
	Mutual trust →	.356		.356
	Information quality			
Receiving information from suppliers	Information sharing →	.477	.157	.634
	Information quality			
	Information sharing →	.610		.610
	Mutual trust			
	Mutual trust →	.540		.540
	Information quality			
	Information sharing →	.157	.329	.486
	information quality			