

## Article

# The Effects of Interdependence and Cooperative Behaviors on Buyer's Satisfaction in the Semiconductor Component Supply Chain

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**Abstract:** The semiconductor industry is characterized by extreme competition in price and product features. Firms need to acquire or exchange resources with their supplier or buyer partners to stay at the leading edge of technology. Cooperation between buyers and suppliers is important and power is the mechanism that can explain the cooperative behaviors. This study aims to investigate how the power structure between the buyer and supplier influences the extent of suppliers' cooperative behaviors, and the effects of these on buyer satisfaction with the buyer-supplier relationship. Opinions from firms in semiconductor manufacturing supply chain were used to investigate the proposed model. It is found that mutual interdependence between a supplier and its buyer can enhance cooperative behaviors and power asymmetry hurt firms' investment in cooperative behaviors. Suggestions are then provided to semiconductor supply chain members based on the findings of this work.

**Keywords:** semiconductor industry; total interdependence; power asymmetry; cooperation; satisfaction

## 1. Introduction

The semiconductor industry is characterized by extreme competition in price and product features, in which the ability to develop niche products or technology and new technologies is central [1,2]. Firms hoping to stay at the leading edge of the industry must undertake substantial investments in product, process, and technology development, but no companies are able to do this alone [3,4]. Firms thus need to acquire or exchange resources with their supplier or buyer partners to reduce their workloads, and focus on areas of competence and flexibly adjust to environmental uncertainties [5,6]. Cooperation among supply chain members determines the efficiency and effectiveness of these resource exchanges, and therefore determines the outcomes of product and technology development efforts. Firms in the semiconductor industry need to interact with their partners much more frequently than those in other industries.

Cooperation in a supply chain refers to situations in which parties work together to achieve shared goals, leading to outcomes that exceed what any of the firms involved would achieve if they acted solely in their own best interests [7–9]. The resulting interactions between firms result in various contingencies, where the firms modify their resources to meet each other's needs and expectations. In this context, power is the mechanism that can explain the relations of the parties involved [10].

Although there has been much discussion about the need for cooperation, few studies examine how power impacts cooperative relationships from a supply chain management perspective [11–13],

with most adopting a marketing channel perspective [8,14–18]. The relationships among partners in distribution channels are different from those in component manufacturing supply chain buyer-supplier relationships. The buyers and supplier in a supply chain focusing on component manufacturing, where the buyer needs the supplier to provide manufacturing service and expertise, and thus much more cooperation and participation are required for product development, process improvement, joint problem solving, production planning, goal setting, and so on [19–21]. Because power results from resource dependency [10], the buyer and supplier depend on each other more when the buyers' output quality relies on the components or products provided by the supplier. The power structure and need for cooperation that occur in this context are quite different from those among distribution channel members. Therefore, this study aims to investigate how the power structure between the buyer and supplier influence the extent of cooperation between them in the context of the semiconductor component supply chain.

## 2. Conceptual Model and Hypotheses Development

### 2.1. Conceptual Model

Because component-manufacturing supply chains are sets of interdependent organizations involved in the process of producing a component or product for their business customers, dependence is a crucial concept in buyer-supplier relationship research. The interdependence structure of a dyad relationship encompasses the magnitude of the firms' total interdependence and the degree of power asymmetry between them [22–24]. Although some studies have examined the importance of the interdependence structure in dyad relationships, those focus on the effects of perceived interdependence on trust, commitment, conflicts or satisfaction [18,24], and few investigate how the interdependence structure affects cooperative behaviors. In particular, effects of mediators, such as cooperative behaviors, are ignored. This study thus focuses on the effects of perceived interdependence on cooperative behaviors, and the effects of these cooperative behaviors on buyer satisfaction.

Figure 1 presents the conceptual model used in this work. It is based on theoretical contributions extracted mainly from the business-to-business and marketing channel literature. The model consists of six basic constructs, namely, total interdependence, power asymmetry, communication, conflict resolution, flexibility in arrangement, and satisfaction. The proposed conceptual linkage of these constructs is as follows: interdependence (total interdependence and power asymmetry) provides the starting point of the model, and directly affects cooperative behaviors, which act as mediating variables. Three constructs of cooperative behaviors are positively related to satisfaction. The associations among the constructs are explained in more detail in the following.

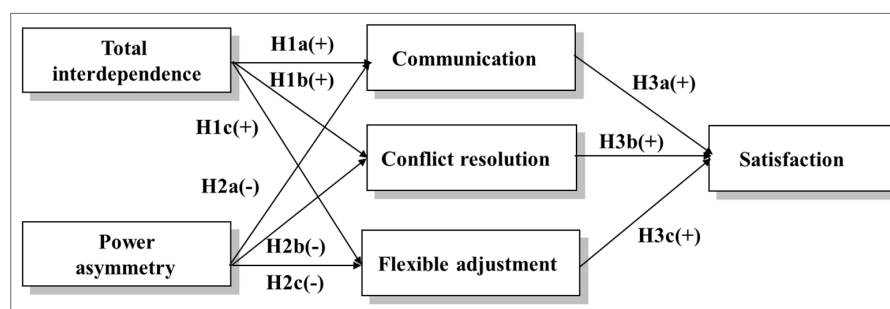


Figure 1. Conceptual framework.

### 2.2. Total Interdependence and Cooperative Behaviors

Firms always depend on their trading partners, and total interdependence refers to the intensity of this relationship [25]. When firms enter into buyer-supplier relationships to achieve mutually beneficial goals, they acknowledge that each is dependent on the other, and this perspective flows directly from

an exchange paradigm. A high level of total interdependence is an indicator for a strong, cooperative, long-term relationship, in which both parties have invested time, effort, and money [24–27] to maintain the relationship.

There are three forms of cooperative behaviors—communication, conflict resolution and flexible adjustment. *Communication* can be defined broadly as the formal as well as informal sharing of meaningful and timely information between firms [7]. In order to achieve the benefit of collaboration, effective communications between partners are essential [28]. Communication is also a critical element with regard to cooperative competency, and is related to the ability of a firm to assimilate and make use of new information or technologies, as well as to forge, develop, and govern partnerships [29,30]. Cooperative competency manifests itself through the effective exchange of information, which is a source of a firm's sustainable competitive advantage [29], and successful partnerships are characterized by exhibiting better communication and information sharing [28].

Communication captures the utility of the information exchanged, and information/knowledge exchanges are accepted as a key component of cooperative behavior. Two aspects of communication behavior are discussed here: communication quality and extent of information sharing between buyer and supplier. Communication quality is a key aspect of information transmission [28,31], and includes aspects such as the accuracy, timeliness, adequacy, and credibility of the information that is exchanged. Timely, accurate, and relevant information is essential if the mutual goals of the buyer and supplier are to be achieved, and research demonstrates the importance of honest and open lines of communication to the continued growth of close ties between trading partners [28].

Information sharing refers to the extent to which critical, often proprietary, information is communicated to one's partner [28,32]. Huber and Daft [33] report that closer ties result in more frequent and relevant information exchanges, by enabling partners to be more knowledgeable about each other's business, and to maintain their relationship over time. A system that increases the availability of useful information allows people to complete their tasks more effectively [32], is associated with increased levels of satisfaction, and is an important predictor of buyer-supplier relationship success [8].

*Conflict resolution* refers to ability to mitigate conflict through mutual efforts [12] and this is necessary for the long-term survival of a relationship. Two dimensions are used to capture conflict resolution [18], one is joint responsibility between firms, and the other one is the extent of conflict resolution that occurs [12,34]. These two dimensions can lead to higher supply chain integration [5], and greater success with regard to achieving mutual goals.

*Flexible adjustment*, the third form of cooperative behavior, is a willingness to vary fixed contractual terms as conditions change [34], such as when there are new volume or cost pressures, or when the buyer agrees to provide services beyond what has been specifically contracted. The willingness to deal flexibly with unexpected situations is a critical cooperative behavior that distinguishes truly collaborative exchange relationships from traditional arm's length ones [35].

In buyer-supplier relationships, high total interdependence makes it increasingly dangerous for the supply chain partners to engage in opportunistic behavior and negative tactics or coercion [24]. Because both firms receive valued contributions from each other, each partner has strong motivation to build, maintain, strengthen, and perhaps even deepen, the relationship [21,25]. In case in which both parties know that the other has considerable power, it is unlikely that either side is going to use this in an aggressive manner, as the risk of retaliation is often seen as being too high [36]. Transaction cost theory (TCT) suggests that total interdependence reduces behavioral uncertainty. On the other hand, mutual dependence means the supplier undertakes cooperative behaviors in order to get valuable information from the buyer based on social exchange theory (SET). The hypothesized relationships are proposed as:

*Hypothesis 1a: Total interdependence between a buyer and its supplier is positively related to communication.*

*Hypothesis 1b: Total interdependence between a buyer and its supplier is positively related to conflict resolution.*

*Hypothesis 1c: Total interdependence between a buyer and its supplier is positively related to flexible adjustment.*

### 2.3. Power Asymmetry and Cooperative Behaviors

Power asymmetry (relative dependence) determines the extent to which a firm will have influence over, and be influenced by, its partner. Relative dependence can be defined as the difference a firm perceives between its own and its partner firm's dependence on the working partnership [2]. As the buyer-supplier relationship becomes more asymmetrical, the interests of supply chain members diverge. Increasing asymmetry in interdependence increases the structural impediments that can encourage the more powerful firms' opportunistic actions [24], and the TCT suggests that a dependence advantage will lead to exploitative tendencies [27]. In such situations, the stronger supplier will invest less in cooperative power, because it perceives the buyer's dependence, and understands that the buyer cannot afford to lose them. Even when the supplier acts opportunistically, the buyer will need to accept this behavior.

On the other hand, the more powerful firm does not need to cultivate its relationship with its partner to encourage the exchange of resources, because it can use its greater power to obtain the latter's compliance or cooperation [27,37]. Therefore, imbalanced relationships are characterized by less cooperation and greater conflict [25], and the more powerful a firm is, the less need it has to be cooperative. Hence, we hypothesize:

*Hypothesis 2a: Power asymmetry between a buyer and its supplier is negatively related to communication.*

*Hypothesis 2b: Power asymmetry between a buyer and its supplier is negatively related to conflict resolution.*

*Hypothesis 2c: Power asymmetry between a buyer and its supplier is negatively related to flexible adjustment.*

### 2.4. Cooperative Behaviors and Buyer's Satisfaction

Satisfaction is the overall evaluation of the relationship between a buyer and supplier [2]. The level of satisfaction is critical to understand the outcomes of an inter-organizational relationship [18,38]. Cooperative behaviors are viewed as actions that are undertaken in the expectation of receiving a reward from the other party, based on the SET perspective. For example, when the supplier invests more cooperative efforts, the buyer will demonstrate and invest much more cooperative efforts in return. Therefore, friction between the parties can be reduced, conflicts can be decreased, and efficiency will be increased. This causes a rise in buyer satisfaction, and greater satisfaction results in higher productivity within an inter-firm relationship, and vice versa, leading to a healthy relationship. Satisfaction is therefore critical for any successful buyer-supplier relationship [16].

Previous researchers have suggested that a positive relationship exists between cooperative behaviors and satisfaction [2,18]. Cooperative efforts should result in greater operational efficiency and the achievement of goals, and may make the buyer more interested in developing and extending its relationship, and thus we posit that cooperative behaviors lead to higher buyer perceptions of satisfaction with the supplier's role in the buyer-supplier relationship [35]. Based on the preceding discussion, the following hypotheses are proposed:

*Hypothesis 3a: The extent of communication between a buyer and its supplier is positively related to buyer satisfaction.*

*Hypothesis 3b: The extent of conflict resolution between a buyer and its supplier is positively related to buyer satisfaction.*

*Hypothesis 3c: The extent of flexible adjustment between a buyer and its supplier is positively related to buyer satisfaction.*

The relationships between constructs are presented in Figure 1.

### 3. Methodology

#### 3.1. Target population and Data Collection

The population firms were listed in the 2013 Semiconductor Industry Year Book 2013 [39], and included 13 IC manufacturing, 34 IC packaging, and 36 IC testing companies, 261 IC design houses, and companies providing other materials and services. Data were collected via a questionnaire. Questionnaires were sent to companies in the semiconductor industry in Taiwan. The target informants were the managers with experience of supply chain management or supplier interaction, and these were mostly in the departments of R&D, sourcing, supply chain management, and production planning and control.

Target informants were selected from companies in semiconductor industry. 223 informants agreed to receive the questionnaire and a total of 156 usable responses were received. Response rate was 58.22%. The responses came from various different kinds of companies, as shown in Table 1.

**Table 1.** Basic information of informants.

Items	Types	No.	Cumulative %	Items	Types	No.	Cumulative %
Business of focal companies	IC design house	71	45.51%	Employees	Less than 100	8	5.13%
	IC manufacturing	9	51.28%		100–200	25	21.15%
	Packaging/Testing	37	75.00%		201–500	37	44.87%
	Integrated Device Manufacturer (IDM)	20	87.82%		501–800	18	56.41%
	Others	19	100.00%		801–1000	20	69.23%
Annual Sales	Less than 1 billion NT	11	7.05%	Years in the current position	1001–2000	27	86.54%
	1–10 billion NT	43	34.62%		More than 2000	21	100.00%
	10–50 billion NT	31	54.49%		Less than 1 year	8	5.13%
	50–100 billion NT	30	73.72%		1–3 years	27	22.44%
	More than 100 billion	41	100.00%		3–5 years	42	49.36%
Department	Purchasing	47	30.13%	Business of suppliers	5–8 years	49	80.77%
	Supply chain management	39	55.13%		More than 8 years	30	100.00%
	Production control/planning	38	79.49%		IC manufacturing	42	26.92%
	R&D	24	94.87%		Packaging/Testing	37	50.64%
	Others	8	100.00%		Designer service provider	15	60.26%
Position	General manager	17	10.90%		Mask provider	7	64.74%
	Division manager	41	37.18%		Equipment provider	13	73.08%
	Department manager	52	70.51%		Chemical provider	10	79.49%
	Engineer or planner	42	97.44%		Materials (probing care, lead frame, ... )	21	92.95%
	Others	4	100.00%		Others	11	100.00%

#### 3.2. Questionnaire Design

This study investigates the effects of inter-firm interdependence on cooperative behaviors and those of cooperative behaviors on satisfaction. There are six constructs in this model, and they are total interdependence between buying and supplying firms, power asymmetry, communication, conflict resolution, flexibility, and buyer satisfaction. The measurement items for the constructs used in this study are shown in Table 2.

Scale items to measure total interdependence and power asymmetry were adopted from an earlier work [25]. Buyer dependence and supplier dependence are measured first, with total interdependence defined as the sum of these, and power asymmetry as the difference between them, and this is a widely-used method in the literature [24,27].

As mentioned above, there are three forms of cooperative behaviors, communication, conflict resolution, and flexibility. Communication includes communication quality and information sharing [28,29,34], while communication quality captures the quality of information exchanges, and information sharing refers to the extent of information communication. Scale items were adopted from an earlier study [28] to capture the buyer's perception of the supplier's efforts with respect to communication.

Conflict resolution includes joint responsibility and conflict resolution. Joint responsibility refers to the extent of joint problem solving within both firms, and conflict resolution indicates the ability to overcome disputes by mutual consent [12]. The items used to measure conflict resolution are adopted from prior studies [12,34]. Flexibility refers to the supplier's willingness to cooperate when conditions changes, and the related scale was adopted from an earlier work [34].

Satisfaction refers to the overall evaluation of the relationship between the buyer and supplier [18], and is of fundamental importance in understanding the relationship between two firms [38]. In the present study, this is the buyer's overall evaluation of its relationship with the supplier. The scale used to measure satisfaction was adopted from an earlier work [38]. The questionnaire design is shown in Tables 2 and 3. All the Cronbach's alpha values of the items are higher than the rule of thumb value of 0.7, and thus assessed as having adequate reliability and unidimensionality.

**Table 2.** Constructs measures.

Constructs		Measurement Items
Communication	Communication quality	CB1: Your communication with the supplier is timely.
		CBC2: Your communication with the supplier is accurate.
		CBC3: Your communication with the supplier is adequate.
		CBC4: Your communication with the supplier is complete.
		CBC5: Your communication with the supplier is credible.
	Information sharing	CBI6: The supplier shares propriety information with us.
		CBI7: The supplier informs us in advance of changing needs.
		CBI8: In this relationship, it is expected that any information which might help the other party will be provided.
		CBI9: The parties are expected to keep each other informed about events or changes that may affect the other party.
Conflict resolution	Joint responsibility	CBJ1: In most aspects of the relationship, the parties are jointly responsible for making sure that tasks are complete.
		CBJ2: Problems that arise in the course of this relationship are treated as joint rather than individual responsibilities.
		CBJ3: The responsibility for making sure that the relationship works for both the other party and us is shared jointly.
	Conflict resolution	CBR1: The discussions we have with the supplier in areas of disagreement are usually very productive.
		CBR2: Our discussions in areas of disagreement with the supplier create more problems than they solve. (R)
		CBR3: Discussions in areas of disagreement increase the strength of our relationship.



Table 2. Cont.

Constructs	Measurement Items
Flexible adjustment	CBF1: A characteristic of this relationship is flexibility in response to requests for changes
	CBF2: When some unexpected situation arises, the supplier would rather work out a new deal than to hold each other to the original terms.
	CBF3: It is expected that the supplier will be open to modifying their agreements of unexpected events occur.
Satisfaction with relationship	SA1: We are pleased with our relationship with the supplier.
	SA2: We wish more of our suppliers were like this one.
	SA3: We would like our relationship with the supplier to continue in the future.
	SA4: We are pleased to deal with the supplier.
	SA5: We are pleased with the support and service provided by the supplier.
Buyer's dependence	BD1: The reliability of delivery of the product from the supplier is important for an uninterrupted flow of manufacturing.
	BD2: We need the technological expertise of the supplier.
	BD3: The product can not be bought from other suppliers. (R)
	BD4: We will incur a high switching cost replacing the supplier.
Supplier's dependence	SD1: We an important customer for the supplier, considering the volume of trade.
	SD2: The supplier needs the technological expertise of our company.
	SD3: The products of the supplier can be sold to other customers. (R)
	SD4: The supplier will incur high switching cost, replacing us by other buyers.
R: Reversed scored.	

Table 3. Questionnaire design.

Constructs	Components and Measurements	References
Communication	Communication quality (five items) Information sharing (four items)	Mohr & Fearne [29]
Conflict resolution	Joint responsibility (three items) Conflict resolution (three items)	Maloni & Benton [12]; Johnson <i>et al.</i> [34]
Flexible adjustment	Three items	Johnson <i>et al.</i> [34]
Satisfaction	Five items	Lee [38]
Supplier's dependence	Four items	Caniëls & Gelderman [25]
Buyer's dependence	Four items	Caniëls & Gelderman [25]
Total interdependence	Four items	Buyer's dependence + Supplier's dependence
Power asymmetry	Four items	Buyer's dependence – Supplier's dependence
Demographic variables	Demographic data of respondent companies (seven items).	

#### 4. Data Analysis and Hypotheses Testing

Constructive reliability was tested first and the partial least squares (PLS) method was then used to verify the research framework. The loadings of measurement items on their constructs, and the loadings of predictor constructs on outcomes were also provided. In the PLS model, the industry of the focal company and number of employees are used as control variables to control for the effects of different industries and firm scale.

Bootstrapping [40] was used to test the statistical significance of the links in the model. This procedure entailed generating 500 sub-samples of randomly selected cases, with replacement, from the original data. Path coefficients were then generated for each randomly selected subsample. *t*-statistics were calculated for all coefficients, based on their stability across the subsamples, indicating which links were statistically significant. We first discuss the results related to the measurement model, which are the tests of the convergent and discriminant validity of the constructs' measures. The results for the structural model are then interpreted.

##### 4.1. Convergent and Discriminant Validity

The convergent and discriminant validity of the scales are both tested. Table 4 shows a summary of the results of the tests of convergent validity. There are three indices to determine whether the scales has validity. First, individual item reliability is assessed using the item's loading on the construct. A loading of 0.7 indicates that about one-half of the item's variance can be attributed to the construct, and thus 0.7 is the suggested minimum level for item loadings [41]. Second. Composite reliability assesses the inter-item consistency Results indicated that composite reliabilities ranged from 0.77 to 0.94. Composite reliabilities were greater than the recommended value (0.7). The third standard is that the average variance extracted (AVE) estimates for each underlying construct should exceed 0.50. All constructs performed acceptably on this standard. Hence, the measures in this study demonstrated adequate support for convergent validity.

Discriminant validity is used to analyze the potential problem of having measures for one construct overlap the conceptual territory of another [34]. One criterion for assessing discriminate validity is that the correlation of a construct with its measures (*i.e.*, the square root of AVE) should exceed the correlation between the construct and any other constructs [41]. Correlations between constructs are illustrated in Table 5, and it can be seen that the square roots of AVE of every construct are considerably higher than any bi-variate correlation between constructs. Therefore, there is strong discriminate validity, and each construct is more highly correlated with its own measures than any other constructs are.

Table 4. Convergent validity results.

Constructs	Factor Loadings	Composite Reliability	AVE	Constructs	Factor Loadings	Composite Reliability	AVE
Communication				Conflict resolution			
CBC1	0.876	0.83	0.548	CBJ1	0.871	0.77	0.616
CBC2	0.857			CBJ2	0.853		
CBC3	0.861			CBJ3	0.862		
CBC4	0.897			CBR1	0.891		
CBC5	0.938			CBR2	0.949		
CBI1	0.887	0.94	0.511	CBR3	0.884	0.89	0.723
CBI2	0.825			Power asymmetry			
CBI3	0.752			IA1	0.901		
CBI4	0.791			IA2	0.922		
Flexible adjustment				IA3	0.901		
CBF1	0.747	0.94	0.511	IA4	0.943	0.88	0.674
CBF2	0.985			Satisfaction			
CBF3	0.943			ST1	0.913		



Table 4. Cont.

Constructs	Factor Loadings	Composite Reliability	AVE	Constructs	Factor Loadings	Composite Reliability	AVE
Total interdependence				ST2	0.834		
TI1	0.884	0.90	0.656	ST3	0.826		
TI2	0.802			ST4	0.799		
TI3	0.862			ST5	0.854		
TI4	0.834						

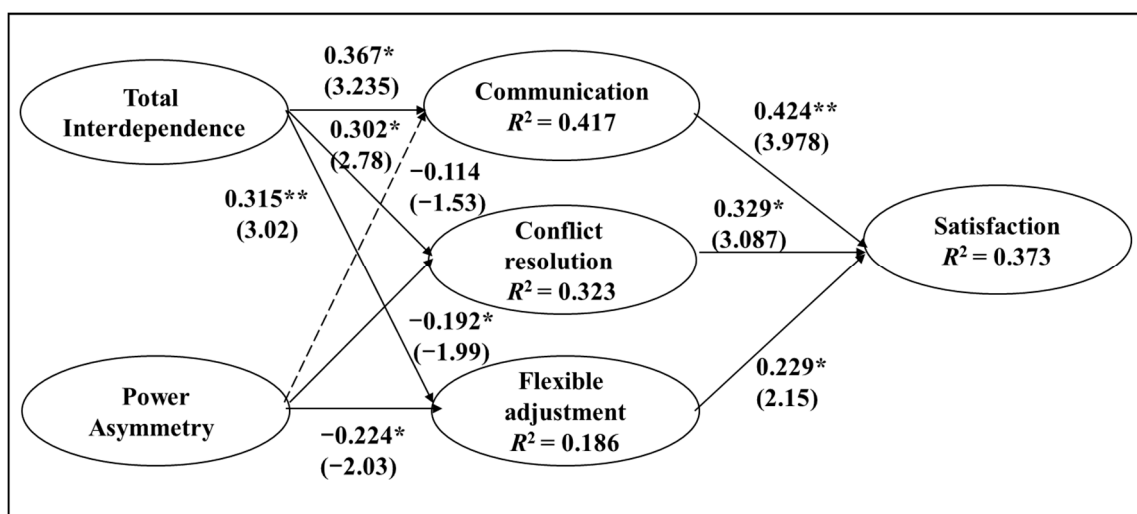
Table 5. Correlation matrix for the discriminate validity of the constructs.

Latent Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) Communication	1.000					
(2) Conflict resolution	0.431	1.000				
(3) Flexible adjustment	0.381	0.421	1.000			
(4) Satisfaction	0.269	0.347	0.366	1.000		
(5) Total interdependence	0.347	0.484	0.307	0.161	1.000	
(6) Power asymmetry	−0.156	−0.330	−0.328	−0.113	0.142	1.000
The square root of AVE	0.740	0.785	0.715	0.757	0.801	0.850

#### 4.2. Hypotheses Testing

The path coefficients of the structural model are illustrated in Figure 2. Eight paths were significant at the level of  $p$ -value  $< 0.05$ . The coefficient between the constructs of power asymmetry and communication was not significant ( $\beta = -0.114$ ,  $t = -1.53$ ).

Given these loadings, H1a, H1b and H1c are supported. Total interdependence between supplier and buyer is a strong predictor of the supplier's tendency to engage in cooperative behaviors in terms of communication ( $\beta = 0.367$ ,  $t = 2.235$ ), conflict resolution ( $\beta = 0.302$ ,  $t = 2.78$ ), and flexibility ( $\beta = 0.315$ ,  $t = 3.02$ ). The higher the mutual interdependence, the greater the level of cooperative behaviors that will be conducted by the supplier, as anticipated. Total interdependence has the highest loading on communication and the lowest on conflict resolution. It can thus be inferred that communication is the first priority for firms that seek to act cooperatively.

Figure 2. Empirical model with path loadings. Note: \*:  $p < 0.05$ ; \*\*:  $p < 0.01$ .

Given the loading between power asymmetry and cooperative behaviors, not all of the behaviors were significantly related to inter-firm power asymmetry. H2a was not supported statistically,

and although the direction (negatively related) is consistent with the hypothesis, power asymmetry does not have significant impact on communication. H2b ( $\beta = -0.192$ ,  $t = -1.99$ ) and H2c ( $\beta = -0.224$ ,  $t = -2.03$ ) were supported. Higher power asymmetry leads to lower cooperation in term of flexibility. Within this model, the variations of communication, conflict resolution, and flexibility can be explained by total interdependence and power asymmetry, with  $R^2$  values of 0.417, 0.323, and 0.186, respectively.

All of the cooperative behaviors were significantly related to the buyer's perceptions of satisfaction. Supplier's cooperative behaviors improve buyer satisfaction. H3a ( $\beta = 0.424$ ,  $t = 3.9783$ ), H3b ( $\beta = 0.329$ ,  $t = 3.087$ ), and H3c ( $\beta = 0.229$ ,  $t = 2.15$ ) are all supported. These three forms of cooperative behaviors provide an  $R^2$  of 0.373. Cooperative behaviors did explain a considerable amount of variance in satisfaction. The direct and indirect effects of total interdependence and power asymmetry on dependent constructs were shown in Table 6. The results show that cooperative behaviors (communication, conflict resolution, and flexible adjustment) mediate the effect of total interdependence and power asymmetry on buyers' satisfaction. The hypotheses testing results are summarized in Table 7.

**Table 6.** Direct and indirect effects of total interdependence and power asymmetry on dependent constructs.

Independent Construct	Mediator	Satisfaction		
		Direct Effect	Indirect Effect	Total Effect
Total interdependence		0.387 *	0.327 *	0.714 *
	Communication		0.156 *	
	Conflict resolution		0.099 *	
	Flexible adjustment		0.072	
Power asymmetry		−0.374 *	−0.162 *	−0.536 *
	Communication		−0.048	
	Conflict resolution		−0.063	
	Flexible adjustment		−0.051	

\*:  $p < 0.05$ .

**Table 7.** Result of hypotheses testing.

	Hypotheses	Outcome
H1a	Total interdependence between a buyer and its supplier is positively related to communication.	Supported
H1b	Total interdependence between a buyer and its supplier is positively related to conflict resolution.	Supported
H1c	Total interdependence between a buyer and its supplier is positively related to flexibility in arrangement.	Supported
H2a	Power asymmetry between a buyer and its supplier is negatively related to communication.	Not supported
H2b	Power asymmetry between a buyer and its supplier is negatively related to conflict resolution.	Supported
H3c	Power asymmetry between a buyer and its supplier is negatively related to flexibility in arrangement.	Supported
H3a	The extent of communication between a buyer and its supplier is positively related to buyer satisfaction.	Supported
H3b	The extent of conflict resolution between a buyer and its supplier is positively related to buyer satisfaction.	Supported
H3c	The extent of flexibility between a buyer and its supplier is positively related to byer satisfaction.	Supported

## 5. Discussion

This study provides empirical evidence of the effects of inter-firm interdependence on cooperative behaviors, which have been relatively neglected in the literature, and has thus answered the calls of researchers for more work in this area, such as Ramasehan *et al.* [17].

Inter-firm total interdependence results from a relationship in which both firms perceive mutual benefits from interacting, and in which any loss of autonomy will be equitably compensated through the expected gains [28]. Both parties recognize that the advantages of interdependence provide benefits greater than either could attain singly. When suppliers perceive higher interdependence between themselves and a buyer, they know they have to maintain the dyad relationship for effective resource exchange. In addition to resource exchange, suppliers cannot afford cost or risk to lose the buyers that they highly depend on, and thus will undertake more cooperative behaviors to retain them. These results are similar to those in previous studies [24,27,28]. Cooperative efforts can thus be seen as a social exchange mechanism to proactively maintain critical buyer-supplier relationships, and prevent losses from losing valuable sources of resources. In our interviews, one of the practitioners said that when his company, an IC manufacturer, is aware of mutual dependence with the buyer, it will first deal with the buyer's complaints or requirements, in addition to providing regular support and service. This helps them to build a deeper relationship. Then, when his company needs forecasts about future demand for products, the buyer will provide valuable information.

Power asymmetry occurs when independent supplier dominates the exchange mechanism, which leads to less cooperative behaviors. The independent supplier has more power, and needs less feedback or resources from the dependent buyer. Therefore, Anderson and Weitz [42] point out that imbalanced relationships are characterized by less cooperation, and this is consistent with our results.

Although power asymmetry decreases a supplier's cooperative behaviors, power asymmetry does not significantly reduce communication between supplier and buyer. In the semiconductor industry, formal and informal information exchanges are the basic services provided by a supplier to win orders. For example, IC manufacturers, such as TSMC, UMC, and IBM all provide on-line systems for buyers to login and search for useful information in terms of IC design rules, technology documents, or production progress. Furthermore, these firms report that they need to hold regular, face-to-face meetings with their customers. Therefore, suppliers have to invest in these fundamental communication efforts, regardless of how strong supplier's power is, or they will not survive in the market.

With respect to conflict resolution and flexibility, the effects of imbalanced interdependence are negative and significant. Power asymmetry implies less investment in conflict resolution and flexibility. More independent suppliers do not need to assign resources in order to obtain cooperation, as they can achieve with intimidation. This result is consistent with the findings of Dapiran and Hogarth-Scott [43], Hibbard *et al.* [44], and Kumar [37].

All three forms of cooperative behaviors are positively related to buyer perceptions of satisfaction, while power asymmetry will lower buyers' satisfaction. All the cooperative behaviors have positive effects on satisfaction, which means that the quality of relationships can be improved by the supplier's cooperative investment, and this result supports the findings in Benton and Maloni [11], Johnston *et al.* [34], and Skinner *et al.* [18]. As high satisfaction implies that there is stable motivation to maintain the relationship, once suppliers invest more in their resource exchange mechanisms, they can expect reciprocal benefits from buyers.

Dwyer *et al.* [45] suggest that the relationship between a buyer and supplier evolves through four phases, and these are awareness, exploration, expansion, and commitment. Commitment is characterized by a high level of mutual dependence, which will ensure a durable relationship. Therefore, buyers should seek to increase their suppliers' dependence by improving manufacturing technology, production quality and so forth, to raise the suppliers' cooperative behaviors. At the same time, buyers also need to invest more effort to increase the cooperative behaviors of both parties, as then mutual satisfaction can be achieved, and a deeper, long-term relationship can be established.

## 6. Conclusions

While a high level of total interdependence between the buyer and supplier results in the former's investment in cooperative behaviors (communication, conflict resolution, and flexibility), power asymmetry can reduce these efforts. The three forms of cooperative behaviors examined in this work are all positively related to buyer satisfaction, and mediate the effects of total interdependence and power asymmetry. To establish a healthy, satisfactory, and cooperative relationship, buyers should try to alter their dependence relation by minimizing their own dependence, or increasing the dependence of suppliers on them.

This work has some limitations. For example, the sample frame of this study draws data from only one side of the buyer-supplier dyad. Data should be collected from both sides of the buyer-supplier dyad to gain a more accurate understanding of inter-firm power and perceived cooperation behaviors and satisfaction. It would also be useful to collect data from both buyer and supplier perspectives to validate the concepts of proposed model. It is also important to further explore the power exercised in different contexts and understand various aspects of it, such as how this power is formed, under what conditions it is exercised, and what the optimal mixture of power derived from different sources is.

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