

## **THE RELATIONSHIP AMONG CONTROL, SUPPLY CHAIN COLLABORATION AND BUSINESS PERFORMANCE**

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### **ABSTRACT**

Effective control is crucial to improve business performance. However, there is a contradictory conclusion in the previous studies. In this paper, based on the data collected from 240 enterprises in China, the relationship among control, supply chain collaboration and business performance is empirically studied using factor analysis, structural equation modelling and multi-group analysis (by LISREL8.7). The results indicate that output control and informal control have a significant and positive effect on supply chain collaboration, but behaviour control not. Output control and informal control influence business performance through supply chain collaboration being as a mediator. A further analysis of the moderation effect of firm size reveals that there is a trend from output control to the combination of output control and informal control. The business performance of small and medium-sized enterprises is significant and positive affected by supply chain collaboration, but large enterprises are not.

**Key words:** control; supply chain collaboration; business performance; firm size

### **INTRODUCTION**

With the development of globalization and heterogeneity of customers' demands, an increasing number of firms seek external enterprises for collaboration so as to establish various supply chains to reduce risks. Firms cooperate with each other in a variety of ways to improve competence of the whole supply chain so as to achieve their goals that the single firm can't realize. Holweg M et al. (2005) show that "in the case of quite low inventory fluctuation, enterprises such as HP, DELL, Wal-Mart can respond to the market fluctuation timely through collaborating with their partners". Additionally, Themistocleous M et al. (2004) and Myhr N et al. (2005) indicate that "firms with the higher level of collaboration are more competitive". Theoretically, supply chain collaboration can bring great benefits to firms. However, practices in recent years have indicated that the outcome of collaboration is not always very ideal. Specifically, the goals among members in the supply chain are inconsistent. Inevitably, "opportunism behaviours, disputations and insincerity appear in the process

of collaboration, all of these hinder the realization of the collaboration and goals” (Rudberg M et al 2003).

Enterprises should take corresponding control methods according to different situations in the process of achieving their goals, so is cooperation among the firms. Different control methods have different effects on the collaboration and performance in the supply chain. Otley D (1994) claims that “there are an increasing number of methods that control members’ behaviours in supply chain management”. Barratt M (2004) and Daugherty P J (2006) suggest that “establishing a reasonable control mechanism among the participants is significant to realize collaboration”. Collaboration is nearly impossible to complete if it is lack of effective control methods of restraining and supervising on members in the supply chain. In addition, quite a few of scholars have researched about the relationship between control methods and supply chain performance because of the importance of control. Many scholars support that “informal control has a positive effect on business performance and the conclusion has been verified by empirical data” (Cannon J et al., 2000; Fryxell G et al., 2002; Poppo L et al., 2002; Cousins P D et al., 2008; Liu Y et al., 2009; Li Y et al., 2010), however, the conclusions about formal control are inconsistent. Some scholars suggest “formal control has a positive effect on business performance” (Celly K S et al., 1996; Cannon J et al., 2000; Carr A S et al., 2007; Liu Y et al., 2009), but others come to the opposite conclusion (Lusch R F et al., 1996; Murry Jr J P et al., 1998; Jap S D et al., 2000).

Fryxell et al. (2002) and Joshi (2009) consider that “there are no direct and vital relationships between formal control and business performance”. This may be a perfect interpretation about the above conflicting conclusions. Most of the previous studies focus on the direct relationship between formal control and business performance: more controls bring better business performance. Das et al.(1998) claim that “some variables should be considered to make clear the relationship between control and business performance”. Collaboration is quite important to business performance and control has a significant effect on the collaboration and business performance, so an empirical study on relationships among control mode, supply chain collaboration and business performance were made in the paper, in which collaboration acts as an intermediate variable. On the one hand, we hope that conflicting conclusions of previous studies can be interpreted; on the other hand, we hope that the conclusion can provide decision basis for the firms by revealing the deeper relationships among control mode, collaboration and business performance.

## **LITERATURE REVIEW**

Based on the literature review, previous studies put more emphasis on the supply chain collaboration and its influence factors (Holweg M et al., 2005; Singh P J et al., 2009; Wenjie Zeng et al. 2010, Wenjie Zeng et al. 2012; Skelton A C H et al., 2013), literatures combining control mode with collaboration is few.

### **Control mode**

Control mode among enterprises can be defined that “the enterprise stimulates its partners by creating certain mechanisms, thereby achieving its expected goals” (Fisher J, 1995). According to the existing literatures, control mode can be divided into two types: formal control and informal control. Formal control is that each firm’s responsibilities, obligation and the mechanism of reward and punishment are stipulated by detailed contract based on the formal organization structure. In

addition, formal control includes output control and behaviour control. Output control is that specific goals (such as product sales, quantity, quality specifications, delivery time, etc.) are stipulated and corresponding reward and punishment are measured based on the implementation of objects. For output control, instead of interposing the implementation process, the implementation status of goal is often checked. Behaviour control focuses on the implementation process of the goal. Behaviour control is that the required activities and flow path in the process of achieving the goal are stipulated definitely, and checks if the firm carries on the production following the scheduled activities and flow path through direct examination and other information gathering systems, such as the weekly progress report, periodic congress, telephone conference, etc. For behaviour control, suggestions for improvement of production activity and flow are put forward by means of process assessment and product quality test every once in a while.

Informal control does not designate the goal and behaviours, Kirsch et al. (2002) claimed that “it focuses on cultivating the common culture and values between the firm and its partners, so that each member in the supply chain has same or similar values and takes similar measures to solve problems, thereby achieving the common goals”. Firms communicate with each other more easily in the process of collaboration because of the similarity of values and behaviour modes, they have a stronger identify with their common goals and are highly motivated to achieve the common goals so that there are less opportunism behaviours. Therefore, choosing firms that have the strongest identity with the enterprise through the comprehensive measurement (such as reputation, previous experiences of the cooperation, wishes, etc.) combining with field visits and scrum communications is essential to informal control. What’s more, informal control diminishes the differences in values and behaviour modes through seminars, mutual visits and face-to-face communications, etc.

### **Supply chain collaboration**

Manthou et al. (2004) defined supply chain collaboration that “participants in the supply chain coordinate with each other and work together to improve the overall competitiveness of supply chain”. Three interrelated dimensions (information sharing, decision synchronization and incentive alignment) are chosen to measure collaboration in the paper. Information sharing is regarded as the “heart” and “foundation” of collaboration, even it is considered as the original form of collaboration in many studies. In general, decision synchronization includes joint decision-making with partners at the planning and operational level. At the planning level, it mainly determines how to use the enterprise resources optimally. At the operational level, it involves some specific operations, such as order generation, delivery, inventory replenishment, etc. Simatupang T M et al. (2002) defined incentive alignment that “the process of sharing costs, risks, and benefits among the participating members”. The successful supply chain partnership means that each member shares benefits and losses equitably and all of them can get the benefits of collaboration, therefore the design of incentive mechanism is the core of incentive alignment.

### **Business performance**

Business performance refers to the achievement of firm’s goal. It includes the efficiency of activities, the results of activities, etc. Enterprise performance can be measured by market share of the firm, the growth of market share, return on investment, the growth of return on investment, marginal

profit, etc. The above indexes are concerned by most of stakeholders and widely used in the previous studies.

## **CONCEPTUAL DEVELOPMENT**

### **Control mode and collaboration**

In practice, supply chain collaboration doesn't achieve its expected results. The common reasons are the lack of clear arrangement of tasks of each member, opportunism, the betrayal of partners, etc. And the first key to solve the problem is formal control that regulates responsibilities, obligations of each side through contract designing. At the beginning of supply chain collaboration, formal control can integrate benefits of each side through setting goals. Then detailed regulations on roles, responsibilities, behaviours and processing flows of emergencies are used to reduce the possibilities of conflicts. In the subsequent collaborative process, formal control will inspect the implementation of objects, assess the behaviours of partners and flow paths during collaborative process and then propose the corresponding amendments. Although formal control can't take all cases into consideration, it can restrain opportunistic behaviour largely. In addition, specific rewarding and punishment mechanism can restrain short-term opportunism and promote long-term cooperation to some extent. Therefore, this study develops the following hypothesis:

H1: Output control has a positive effect on supply chain collaboration.

H2: Behaviour control has a positive effect on supply chain collaboration.

Trust is an important factor that makes supply chain collaboration hard to come true. Without trust, enterprises being used to maximizing their own benefits are hard to take on new roles and new responsibilities. Although participants have certain security due to contracts in formal control in the legal sense and participants' enthusiasm is stirred up by setting goals, with increase of depth and width that collaboration demands and difficulties in designing perfect contracts, more and more undefined situations arise that lead to conflicts inevitably. Informal control has its unique advantages under these uncertain and undefined situations. At the beginning of collaboration, the selection of participants is according to common values and similar behaviour modes, which creates a foundation of trust. And during collaborative process, seminars, trainings, etc. are held to communicate with each other. All of these can deepen trust among participating members. Therefore, mutual trust cultivated through informal control can make cooperative firms reach new agreements in all kinds of accidents rapidly. In addition, informal control enhances the flexibility of relations among partners, driving further collaboration. Therefore, the study develops the following hypothesis:

H3: Informal control has a positive effect on collaboration.

### **Control mode and performance**

Effective control mode is one of the key sources of achieving the goals of enterprise and gaining competitive advantages. According to the relevant literatures about organization theory, the main purpose of control between organizations is to create an effective mechanism to encourage participants to fight for the common goals so as to achieve their expected goals and dreams. Effective control modes should be taken based on different situations. Relation network in China has

a long history, so informal control may have an advantage over formal control on the achievement of performance; However, the rule of law is firmly established in western, so firms in western mainly rely on formal control. But with the process of Chinese economy integrating into the world, “formal control also becomes an important mean for Chinese enterprises to achieve the goals of firm” (Poppo L et al., 2002; Li Y et al., 2010; Luo Y. et al., 2002). Therefore, the study develops the following hypothesis:

H4: Output control has a positive effect on performance.

H5: Behaviour control has a positive effect on performance.

H6: Informal control has a positive effect on performance.

### **Collaboration and performance**

Participants in the supply chain regard collaboration as an important mean of improving performance. Close collaborative relations among participants improve the level of information visualization so that firms can concentrate on what partners need and how to create more customized products and services so as to improve service levels and customer satisfaction. Therefore, Stank et al. (2001) suggested that “both inner collaboration and exterior collaboration have a positive effect on improving performance.”

The studies show that “higher levels of collaboration can bring better performance” (Mohr J et al., 1994; Duffy R et al., 2004). Themistocleous M et al. (2004) and Myhr N et al. (2005) have shown that “firms in the supply chain with a high level of collaboration have more competitive advantages than firms with a low level of collaboration.” However, there is no simple linear relationship between collaboration and performance improvement. With the increasing degree of performance improvement, marginal inputs into collaboration increase rapidly. But collaboration always has a positive effect on performance. Therefore, this study develops the following hypothesis:

H7: Collaboration has a positive effect on performance.

### **The moderating effect of firm size**

The mutual effects among control mode, collaboration and performance may be affected by various latent factors. To maintain consistency with previous studies, firm size acts as a moderating variable to analyse the mutual influences among control mode, collaboration and performance in this paper. The division of firm sizes is based on the number of staff. Enterprises of varying sizes are different in selecting control mode and emphasis on collaboration, which leads to different performances. This study develops the following hypothesis:

H8a-g: Firm size moderates the relationships among control mode, collaboration and performance.

In conclusion, the research model was proposed in this study, which is as shown in Fig.1.

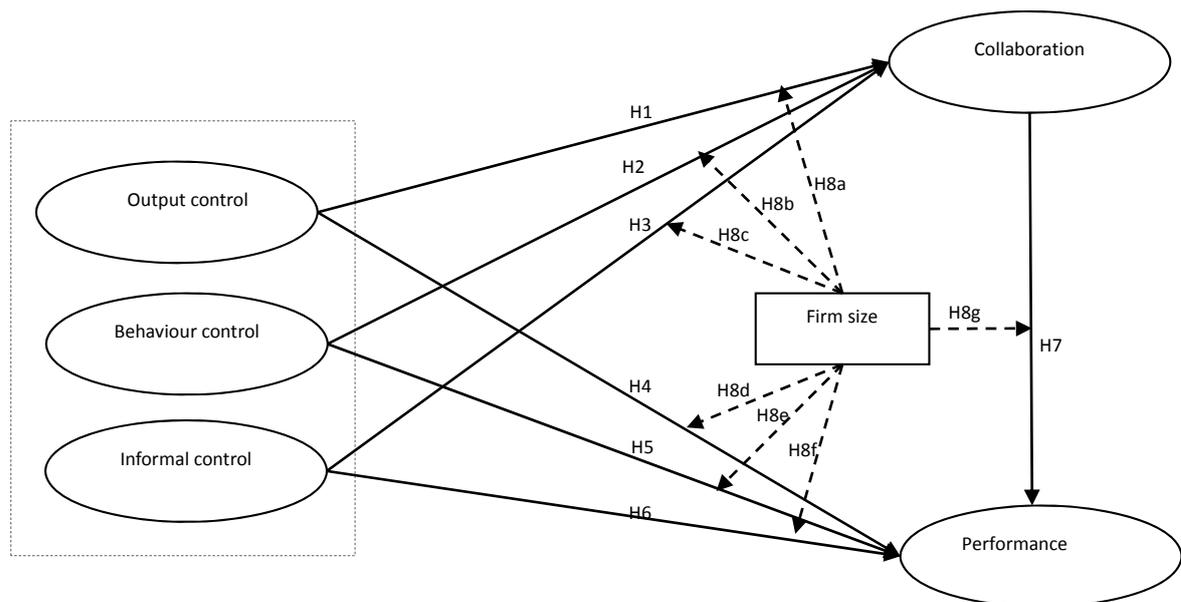


Fig 1: Research model in the study

## INSTRUMENT DEVELOPMENT

### Scale design

Data is collected by questionnaires and hypothesis model is tested by structural equation modelling method in the study. To ensure the study's reliability and validity, the items mainly learn from previous relevant literatures. To ensure the accuracy of translation, this paper took a back and forth translation method. This paper uses Likert 5 point scale for scoring to measure the questions, 1 represents entirely disagree and 5 represents entirely agree. Appendix A, Table 1 lists all the variables and their measurements of the questions, and gives the relevant literature sources.

### Small sample survey and scale correction

Small sample survey was conducted after establishing the scale. We distributed 120 questionnaires to the MBA and EMBA of Huazhong University of Science and Technology and 87 of 120 was returned, 83 questionnaires were valid. Data is analysed by Exploratory Factor Analysis using SPSS18. Firstly, Kaiser-Meyer-Olkin and Bartlett's test of sphericity were conducted. Then maximum variance rotation method was used to analysis principal component. Subsequently, is the reliability test by cronbach's  $\alpha$ . Because of low CICT-Values and the being of cross Load, three items (IC4, IS2, DS5) were removed from their corresponding constructs.

### Data collection

Sampling was taken nationally in Chinese using questionnaires modified by small samples. Samples of empirical research were distributed mainly over Hubei, Henan, Guangdong, Yunnan, Beijing and Shanghai. The target respondents were CEOs, presidents, vice presidents, directors, or managers in the Chinese manufacturing firms. Investigation was conducted from March to May in 2013. We got 278 returned from 1000 questionnaires. Finally we got 240 valid questionnaires after eliminating

some questionnaires. Manufacturing industries accounted for 32.1%, service industries accounted for 45.4%, high-tech industries accounted for 8.3% of the firms that responded to the survey. And senior managers accounted for 31.3%, middle-level managers accounted for 45.4%, others accounted for 23.3% of all respondents. Respondents were familiar with situations of firms, so they could fill in questionnaires accurately and objectively, thus the reliability of questionnaires could be ensured to a large extent.

Non-response bias may be produced by using face-to-face interviews. We compared the essential features (such as firm size, geographic distribution, etc.) between firms interviewed early and firms interviewed later. Results of two Independent-Samples T tests indicate that there is no significant difference in above essential features of two kinds of samples. Therefore, there was no significant non-return deviation in this survey. And Harman's single-factor test recommended by Podsakoff and Organ (1986) was used to examine if there is the common method bias. All items were examined by principal component and factor analysis. The result revealed 7 factors with eigenvalues above 1. There is no common factor that explains the majority of variance of all items, so it is reasonable to conclude that there is no common method bias in samples.

## DATA ANALYSIS AND DISCUSSION

### Reliability and validity

Principal component analysis was conducted and principal component was rotated by Varimax in this paper. KMO-value of sample data is 0.903, P-value of Bartlett's test of sphericity is 0.000. The result showed that data was suitable to conduct principal component analysis. Factors are extracted by the standard of eigenvalue above 1. Results of analyses of control mode, collaboration and business performance are listed from Table 2 to Table 4, which indicates variables have perfect convergent validity and discriminant validity. In addition, accumulated variance contributes of all variables are above 60%.

*Table 1 : Results of exploratory factor analysis of control modes*

Item	Output control	Behaviour control	Informal control
OC1	0.724		
OC2	0.676		
OC3	0.603		
OC4	0.775		
BC1		0.768	
BC2		0.738	
BC3		0.740	
BC4		0.838	
IC1			0.764

Item	Output control	Behaviour control	Informal control
IC2			0.806
IC3			0.726
IC5			0.626
<b>Total (%)</b>	12.989	55.235	63.888

*Table3: Results of exploratory factor analysis of collaboration*

Item	Information sharing	Decision synchronization	Incentive alignment
IS1	0.719		
IS3	0.740		
IS4	0.838		
IS5	0.862		
IS6	0.835		
IS7	0.752		
DS1		0.627	
DS2		0.758	
DS3		0.791	
DS4		0.780	
IA1			0.593
IA2			0.685
IA3			0.812
IA4			0.812
IA5			0.709
<b>Total (%)</b>	43.511	51.867	65.324

*Table4: Results of exploratory factor analysis of business performance*

Item	Business performance
OP1	0.815
OP2	0.782
OP3	0.874
OP4	0.855
OP5	0.855
<b>Total (%)</b>	70.022

The hypothesized research model is tested by structural equation modelling method. First is validating measurement model then validating structure model. Measurement model is tested by confirmatory factor analysis using LISREL8.7. Results are listed in the appendix B, Table5. As is shown in Table 5, standard loads of all items are over 0.6, CITC- Values are over 0.5, Cronbach's Alpha Values and CR Values of all variables are over 0.7, which indicates items have perfect convergent validity and discriminant validity.

### **Hypothesis testing and discussion**

The hypothesized research model was tested by structural equation modelling. A LISREL model is run to test the hypotheses developed in the framework. The averages of information sharing, decision synchronization and incentive alignment act as the indicators of supply chain collaboration. The six main fit indexes are listed in Table 6. As is shown in Table6, indicators (except GFI and AGFI below 0.9) reach the ideal level. The model fit indices NNFI = 0.97, CFI = 0.98, RMSEA= 0.057 are good. The final structural equation model and path coefficients are listed in Figure 2.

*Table6 :The main fit index*

Fit index	$\chi^2$	Df	$\chi^2/df$	GFI	AGFI	CFI	NFI	NNFI/TLI	RMSEA
<b>Value</b>	282.68	160	1.77	0.89	0.86	0.98	0.95	0.97	0.057

As is shown in Figure 2:

In the hypothesis testing of the effect of control mode on collaboration: Output control (H1) and informal control (H3) have significant positive effects on supply chain collaboration. Path coefficients are 0.43 and 0.41 respectively, which are statistically significant at the level of 0.01. Therefore, hypothesis H1 and hypothesis H3 are acceptable. However, behaviour control (H2) has little direct effect on collaboration. Path coefficient is 0.09, which is not statistically significant. Therefore, hypothesis H2 is rejected. The reason of rejecting hypothesis H2 may be that validity of the effect of behaviour control on collaboration moderated by other factors, such as behaviours of suppliers, extent of process being observed, etc. In addition, if a firm doesn't have a thorough understanding of behaviours of supplier or the firm can't provide a proper behaviour control mode to guide

suppliers' behaviours, it may effects the validity. The rejection of hypothesis is consistent with the results of certain studies (Kirch L J, 1996; Das T K et al., 2001; Stouthuysen K et al., 2012).

In the hypothesis testing of the effect of business performance on collaboration: the direct effects of output control (H4), behaviour control (H5) and informal control (H6) on business performance don't reach the significant level. However, the path coefficients of indirect effects of output control and informal control on performance are 0.172(0.43\*0.4) and 0.164(0.41\*0.4) respectively through supply chain collaboration, which reach the significant level. This indicates that effects of output control and informal control on business performance need collaboration act as an intermediary.

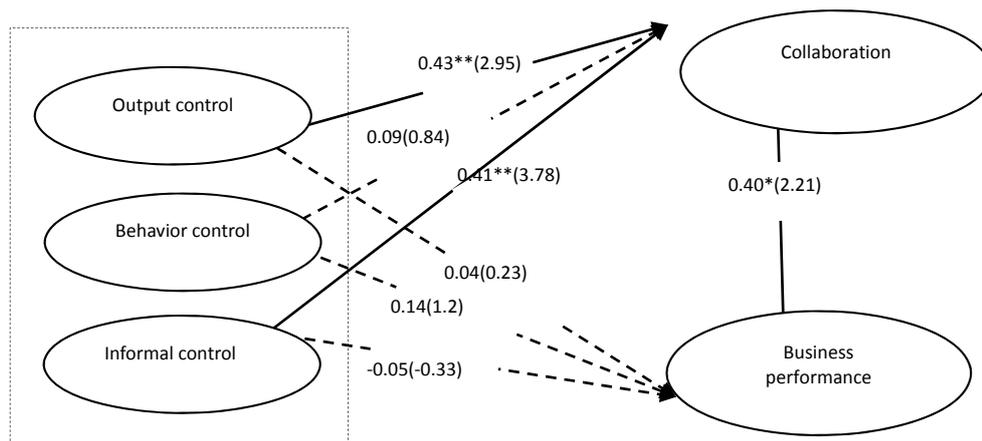


Fig 2: Structural equation model and path coefficients

In the test of hypotheses by structural equation modelling, seven hypotheses (H1-H7) are proposed in the paper, and results of 3 paths reach the significant level. Namely, output control has a positive effect on collaboration (H1), informal control has a positive effect on collaboration (H3) and collaboration has a positive effect on business performance (H7). The choices of control modes and emphasis on collaboration may be different due to different firm sizes. Therefore, samples are divided into two groups: large-scale enterprises, small and medium-sized enterprises according to the difference of number of employees. Tests are conducted between two groups based on the above 3 hypotheses, namely, H8a, H8c, H8g.

To test the moderating effect of firm size, a multi-group analysis of structural invariance across firm sizes was conducted in LISREL. Firstly, the equality of measurement model was tested. We tested for equal factor inter-correlations (M1), equal factor loadings (M2) and equal variance-covariance of factor (M3). As we can see in the Table7, the  $\chi^2$  differences between M1 and M2 are insignificant, which indicates that factor loading is consistent between two groups. The  $\chi^2$  differences between M2 and M3 are insignificant, which indicates factor loading, variance and covariance are consistent between two groups; In conclusion, measurement model is equivalent between two groups.

Then the equality of structure coefficients was tested. Model M3a, M3b, M3c was built and release path coefficients between output control and collaboration, informal control and collaboration, collaboration and business performance based on M3 respectively. Compare M3a, M3b, M3c with

M3 on the significance of  $\chi^2$  difference, results are listed in Table7. As is shown in Table7, M3a, M3b and M3c are statistically significant at the level of 0.05 comparing with M3. According to the results, firm size can moderate three paths (OC→SCC, IC→SCC, SCC→OP). Namely, H8a, H8c, H8g are supposed.

Table7 Multi-group analysis of moderating effect of firm size in LISREL

Model	$\chi^2$	df	$\chi^2/df$	CFI	NNFI	RMSEA	Nested relationship	$\Delta\chi^2$	$\Delta df$	Significant level
M1	499.92	320	1.56	0.96	0.95	0.069				
M2	518.27	335	1.55	0.96	0.95	0.068	M2-M1	18.35	15	0.245
M3	521.57	341	1.53	0.96	0.96	0.067	M3-M2	3.3	6	0.770
M3a	526.35	342	1.54	0.96	0.96	0.067	M3a-M3	4.51	1	0.034
M3b	527.93	342	1.54	0.96	0.96	0.067	M3b-M3	6.36	1	0.012
M3c	526.7	342	1.54	0.96	0.96	0.067	M3c-M3	4.32	1	0.038

To further analyse the moderating effect of firm size on three paths (OC→SCC, IC→SCC, SCC→OP), standardized path coefficients and T-values of large-scale enterprises and small and medium-sized enterprises are shown inTable8.

Table 8: T-values and Path coefficients of hypotheses for Large-scale enterprises and small and medium-sized enterprises

Firm size	H8a (OC→SCC)		H8c (IC→SCC)		H8g (SCC→OP)	
	path coefficient	t	path coefficient	t	path coefficient	t
small and medium-sized enterprise ( N=137 )	0.58	2.25	0.18	1.03	0.39	2
Large-scale enterprise ( N=103 )	0.36	2.07	0.59	4.05	0.12	0.31

As is shown in Table8:

For hypothesis H8a (OCS→CC), path coefficients for large-scale enterprises, small and medium-sized enterprises are both statistically significant, but control mode has more effect on collaboration in small and medium-sized enterprises than in large-scale enterprises. The reason may is that the use of output control in small and medium-sized enterprises is more. And small and medium-sized enterprises focus more on short-term performance and short-term goals comparing with large-scale enterprises. Therefore, small and medium-sized enterprises cooperate with suppliers frequently through setting goals and supervising the achievement of goals. Firms change suppliers instead of cooperating with them to solve problems when suppliers can't meet their requirements. Therefore,

output control becomes the control strategy that small and medium-sized enterprises use most frequently.

For hypothesis H8c (IC→SCC), path coefficient for large-scale enterprises is statistically significant, but path coefficient for small and medium-sized enterprises doesn't reach statistical significance. The reason for the difference may be that large-scale enterprises pay more attention to the relation with suppliers and pursue long-term and stable partnership. However, small and medium-sized enterprises pay more attention on short-term financial performance. Therefore, large-scale enterprises put emphasis on the similarities of cultures and values when choosing suppliers and firms prefer invest time and energy to improve partnerships with suppliers in the process of cooperation. What's more, large-scale enterprises are willing to cooperate with suppliers to solve problems instead of changing suppliers when facing challenges. Different views on performance lead that differences of the effect of informal control on collaboration between large-scale enterprises and small and medium-sized enterprises are significant. The conclusion can be reached that there is a trend of the transition from formal control to informal control gradually during the development of firms. The conclusion is consistent with certain studies (Gulati R et al., 1995; Uzzi B, 1997; Li Y et al., 2010).

For hypothesis H8g (SCC→OP), effects of collaboration on performance are significant in small and medium-sized enterprises, but large-scale enterprises are not. The conclusion is different from the result of previous study (Gao M et al., 2011), but this conclusion is regarded being more reasonable in this paper. Small and medium-sized enterprises in the upstream or downstream rely more on large-scale enterprises in China comparing with foreign firms. Firms in the downstream rely on large-scale enterprises to provide scarce goods and materials. Firms in the upstream rely on large-scale firms to provide orders. Firms have to collaborate with large-scale enterprises to gain more resources and market shares so as to improve their performance. In addition, small and medium-sized enterprises have flexible modes of operation, so firms can respond to the market fluctuations quickly. Once small and medium-sized enterprises participate in supply chain collaboration, they will put into their almost all of the products and services. Therefore, collaboration has a significant effect on their business performance.

## CONCLUSIONS

Enterprise can integrate internal and external resources effectively through collaboration to achieve the firm's strategic goals. All kinds of problems during supply chain collaboration must be solved to realize the collaboration, so the choice of control mode is particularly important during the process. Relationships among control mode, collaboration and business performance are explained in depth in this paper using questionnaire survey and structural equation model. Analysis shows that output control and informal control have positive effects on supply chain collaboration and the effect of behaviour on collaboration is insignificant. Collaboration acts as an intermediate variable in the effect of output control and informal control on business performance. During the deep analysis of moderating function of firm size, the result reveals that there is a trend of the transition from output control to output control combining with informal control. Business performance is significantly affected by collaboration in small and medium-sized enterprises because of their small scales. There is no similar conclusion in large-scale enterprises.

Although the relations among control mode, collaboration and business performance are explained further in this paper, there are still inadequacies which need the further discussion. Firstly, other intermediate invariables (such as environmental uncertainty, market competition intensity, etc.) and outcome variables (such as innovative performance, supply chain performance, etc.) can be tested, so as to explore the optimal choice of control mode in different situations. Secondly, averages of three dimensions of supply chain collaboration (information sharing, decision synchronization and incentive alignment) act as indicators of collaboration, effects of control modes on three dimensions of collaboration can be analysed independently in further study. Finally, industries are not distinguished when samples were selected, industries can be distinguished in further study so as to reach a more targeted conclusion.

## ACKNOWLEDGMENT

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## APPENDIX A

*Table1: The table of control mode, collaboration and business performance*

Variable	Code	Item	Source
<b>Output control</b>	OC1	Set the clearly defined goals (such as variety, quantity, product delivery time, etc.) for suppliers.	Jap and Ganesan (2000) , Dekker (2004) , Stouthuysen and Slabbinck et al. (2012)
	OC2	Suppliers decide how to achieve goals by themselves.	
	OC3	Check the implementation of goals setting for suppliers frequently.	
	OC4	Rewards or punish suppliers according to the realization of the goals.	
<b>Behaviour control</b>	BC1	Specific production process is put forward to suppliers	Stouthuysen and Slabbinck et al. (2012)
	BC2	Help suppliers to improve production process.	
	BC3	Assess the production process of suppliers every once in a while.	
	BC4	Give feedback to suppliers and urge them to improve production process.	
<b>Informal control</b>	IC1	The common culture and value are important standards of selecting suppliers.	

	IC2	Greatly emphasize the effort that suppliers make to realize the common goals.	
	IC3	Negotiate with suppliers timely when firm meets chances and challenges.	
	IC4	Communicate with suppliers face to face frequently.*	
	IC5	Hold seminars and trainings frequently to gain more insights into the common goals.	
	IS1	Exchange the relevant information with suppliers.	
	IS2	Exchange the core information with suppliers. *	
	IS3	Exchange information with suppliers timely.	
	IS4	Exchange information with suppliers accurately.	
	IS5	Exchange information with suppliers completely.	
	IS6	Exchange information with suppliers fully.	
	IS7	Exchange information with suppliers reliably.	
<b>Collaboration</b>	DS1	Make promotional plans together.	Simatupang and Sridharan (2005),
	DS2	Make the demand forecast together.	Wenjie Zeng and Shihua Ma (2010) ,
	DS3	Solve the unpredictable problems together.	Cao and Zhang (2011)
	DS4	Determine supply fill rate, inventory levels and optimal order quantity together.	
	DS5	Solve the exceptional cases about orders together.*	
	IA1	Share benefits brought by inventory costs declining.	
	IA2	Reach agreement on supply safeguard measures at times of peak demand.	
	IA3	Reach agreement on compensation methods when	

		products damage.	
	IA4	Reach agreement on the methods of discount when price of products falls.	
	IA5	Confirm agreement on the situation that order quantity changes	
<b>Business performance</b>	OP1	Market share.	Li and Rao et al. (2005) ,
	OP2	The growth of market share.	Chenglin Liao and Xueming Liao (2008)
	OP3	Return on investment.	, Lei Xie,
	OP4	The growth of return on investment.	Shihua Ma,
	OP5	Marginal profits of sales.	etc. (2012)

\* Represents items that have been deleted after the test with small samples.

APPENDIX B

**Table5: Confirmatory factor analysis**

Variables	Code	Standard load	T-values	CITC	$\alpha$ Coefficient	CR
<b>OC</b>	OC1	0.66	10.72	0.597	0.770	0.7702
	OC2	0.72	11.87	0.566		
	OC3	0.66	10.67	0.563		
	OC4	0.66	10.67	0.563		
<b>BC</b>	BC1	0.69	11.52	0.627	0.843	0.842
	BC2	0.82	14.66	0.718		
	BC3	0.76	13.00	0.659		
	BC4	0.75	12.89	0.709		
<b>IC</b>	IC1	0.66	10.51	0.580	0.784	0.7844
	IC2	0.72	11.82	0.648		
	IC3	0.68	11.01	0.583		
	IC5	0.70	11.28	0.549		
<b>IS</b>	IS1	0.74	12.93	0.676	0.909	0.9115

	IS3	0.73	12.77	0.687		
	IS4	0.80	14.66	0.769		
	IS5	0.89	17.30	0.841		
	IS6	0.86	16.38	0.811		
	IS7	0.74	13.02	0.702		
	DS1	0.67	11.09	0.585		
	DS2	0.71	11.94	0.646		
<b>DS</b>	DS3	0.79	13.81	0.694	0.823	0.8231
	DS4	0.76	13.00	0.667		
	IA1	0.62	9.95	0.543		
	IA2	0.68	11.20	0.587		
<b>IA</b>	IA3	0.74	12.42	0.668	0.827	0.8300
	IA4	0.76	12.94	0.691		
	IA5	0.71	11.89	0.626		
	OP1	0.74	12.92	0.710		
	OP2	0.70	11.97	0.666		
<b>OP</b>	OP3	0.85	15.82	0.789	0.892	0.8934
	OP4	0.83	15.21	0.760		
	OP5	0.83	15.27	0.759		

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