

Rations of Supply Chain Management Performance and Sustainable Collaboration using Balanced Scorecard under the e-Business Context*

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Summary

It is important to control Supply Chain Management (SCM) performance and sustainable collaboration for the successful SCM under the e-business environment. This research analyzes the relationship between SCM performance and sustainable collaboration under Balanced Scorecard (BSC) framework. The research findings are: First, there was sequential relationship among learning, process, customer, and financial performances. Second, sustainable collaboration was related to financial performance while no relationship with learning, process, and customer performances has been found. Some implications of these results are discussed.

Key words:

Balanced Scorecard, e-Business, Supply Chain Management, Performance, Sustainable Collaboration, Structure Equation Model.

1. Introduction

As the business environment such as globalization and increasing competition changes, many enterprises are forced to produce many products at less cost. Many companies can achieve competitive edges through process efficiency, encompassing corporate internal and external business process efficiency [Ross, 1988]. This causes the enterprises to pay attention to the value chain management connecting subject to object of all transaction, network strategy. For example, HAITAI Confectionery & Foods Company has recorded the remarkable sales growth rate of 7.4% by using the advanced supply chain management (SCM) in operation sector. That is, quality improvement and management innovation is achieved through the supply chain innovation.

In actual, there are increasing concerns about SCM, and many enterprises are introducing it. The reason is that it provides opportunities for supply chain companies which can coexist through inter-corporate collaboration. The SCM improves business performance and enhances corporate competitiveness through the inter-corporate collaboration over the operational flows of supply chain

joining business planning, design, production, logistics and selling (National Computerization Agency, 2001). In Korea, The ministry of commerce has launched business support for collaborative system construction between large corporations and small businesses since in 2002. In reality, DIC (Doosan Infracore Companie) constructed SCM systems managing together with 36 cooperative partner companies. This activity shows that the success of SCM depends on sustainable collaboration. For the collaborative performance improvement of SCM, it is required to measure the SCM performance periodically.

The way to measure the performance of SCM is as follows: (1) using the tools developed by the enterprises, (2) using the tools developed by the external consulting company, and (3) using modified versions of performance measurement tool. The categories used for the business performance measurement are mainly classified by quantitative and qualitative measurement methods. In general, the rate of return, sales, order cycle time, and order fill rates are used as quantitative index and consumer satisfaction, collaboration relationship among supply chain companies are employed as qualitative index.

The balanced scorecard (BSC) is widely used by many global companies as a performance measurement tools. The BSC was developed by Kaplan and Norton (1992). The studies on performance measurement using the BSC are as follow: (1) performance measurement of financial institution, (2) performance measurement of e-business, (3) performance measurement of customer relationship management (CRM).

In SCM sector, Brewer, Speh (2000) also indicated performance measurement framework from learning perspective, customer perspective, process perspective and financial perspective. However, their research model was neither empirically tested, nor explained the performance difference among the industries types. Also, Suh, Kwan (2001) showed supply relationship quality framework for SCM performance measurement on the basis of the BSC developed by Brewer, Speh (2000), but didn't analyze the relationship between business performance and collaboration. For companies pursuing the SCM, the

success of it depends on whether it connects to sustainable collaboration. For instance, if firms don't achieve good performance or have little chance of it, they will not pursue the sustainable collaboration. For these reasons, the sustainable collaboration is an important variable to companies promoting the SCM and represents guidelines for measuring SCM performance. According to Ganesan (1994), business performance is closely related to long-term relationship. However, in spite of the fact that there is important relationship between business performance and sustainable collaboration, the previous researchers don't conduct a detailed analysis on SCM performance factor affecting sustainable collaboration.

Thus, the purpose of this paper is to provide corporate pursuing the SCM with guidelines of successful SCM implementation. For this research, I used Brewer, Speh's model recommending models for measuring SCM performance on the basis of the BSC developed by Kaplan, Norton (1992). I surveyed distribution and manufacturing companies, pursuing the SCM in Korea and used the structure equation model to analyze the relationship between SCM performance and sustainable collaboration. Hence, I believe that this research will provide the guidelines of continuous SCM pursuit for corporate pursuing SCM in the future.

The paper proceeds as follows. Section 2 describes research models and hypothesis. Section 3 conducts an empirical study and discusses the empirical results. The final section concludes and represents the limitation of this research.

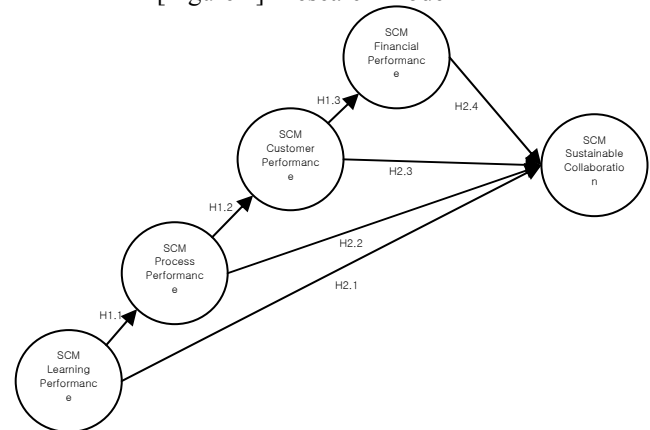
2. Research Model

2.1 Research Model and Hypothesis

There are various variables, such as organization variables, environment variables, information-system variables, and strategy variables, which affects business performance. In this study, however, I limit performance variables of corporate to variable of equilibrium performance and the independent variable is the competitive edge of corporate: sustainable collaboration. From this perspective, I analyzed the relationship between BSC and sustainable collaboration of corporate pursuing SCM. [Figure 1] presents our research model.

There are key studies for research hypothesis specification. For example, according to Ganesan (1994), management performance of corporate affects long-term relationship which means sustainable collaboration. Ganesan (1994) showed that specified analysis regarding performance factor affected sustainable collaboration of corporate is very important.

[Figure 1] Research Model



Also, Maisel (1992) analyzed business performance by using human resource factors, business process factors, customer factor, and financial factor. Their models for performance measurement are similar to BSC developed by Kaplan, Norton (1992). LP (learning performance), PP (process performance), CP (customer performance), and FP (financial performance) are related positively and sequentially each other. They asserted the fact that LP affects PP, that PP affects CP, and that CP affects FP. They suggested affecting factors such as LP \Rightarrow PP (human resource and intellectual capacity reinforce, satisfaction reinforce, vest infra investment), PP \Rightarrow CP (manufacturing technology and developing reinforce, ROA improvement), CP \Rightarrow FP (Companies growth, revenue, stability, value maximization) [lee et al, 2002]. Accordingly, I hypothesize as follows:

[Hypothesis 1] Learning performance, process performance, customer performance, and financial performance of corporate seeking SCM is related positively and sequentially to another performance.

- 1.1 SCM learning performance \rightarrow process performance
- 1.2 SCM process performance \rightarrow customer performance
- 1.3 SCM customer performance \rightarrow financial performance

As discussed above, successful SCM implementation appears to be sustainable collaboration. There are two types of sustainable collaboration. First, enterprises pursue the sustainable collaboration when they obtain more business performance (LP, PP, CP, FP) than ever before. Second, even though enterprises currently can't achieve the SCM performance, they will seek the sustainable collaboration if they have a high possibility of creating business performance. Accordingly, I hypothesize as follows:

[Hypothesis 2] Learning performance, process

performance, customer performance, and financial performance of corporate seeking SCM is related positively and sequentially to sustainable collaboration.

- 2.1 SCM learning performance → sustainable collaboration
- 2.2 SCM process performance → sustainable collaboration
- 2.3 SCM customer performance → sustainable collaboration
- 2.4 SCM financial performance → sustainable collaboration

2.2 Research Variables

In this study, to evaluate SCM performance as 16 independent variables, I used 16 SCM Balanced Scorecard (BSC) framework developed by Brewer and Shep (2000) and modified them as a 7-point Likert-type scale ranging from 1 to 7 (7 = high SCM performance, 1 = low SCM performance). Also, to measure SCM performance as 3 dependent variables, I used the modified version of Stuart, McChitcheon (2000) and measured on 7 point Likert-type scale as continuous pursuit of SCM, continuous investment to SCM, and Partnership reinforcement. The research variables are follows in <Appendix 1>.

2.3 Research Design

In this research, I conducted a survey with distributors and manufacturing companies to collected data for the study. The survey was conducted in 2003. I collected the data via paper-based survey methodology. The number of questionnaires circulated was 300 and a total 120 responses were collected. The response rate was about 40% percent. Contacting with the surveyees before the survey was distributed and placing an additional phone call to them shortly after the initial survey mailing resulted in a high response rate. Of the 120 questionnaires available, 12 questionnaires was excluded because the surveyees responded insincerely and didn't answer either one or more questions, so the final sample size was 108. All data analyses were performed using SPSS 11.0 and AMOS 4.0 statistical programs.

3. Research Result

3.1 Descriptive Information

The descriptive information of distributing and manufacturing firms is follows. Among the responding firms, 53.00% are distributing companies and 47.00% are manufacturing companies. For the position of respondents, the number of staffs, assistant managers, deputy general manager, general manager, director are 15(9%), 13(8%), 16(10%), and 44(28).

3.2 Assessments of Validity and Reliability

In this study, I examined reliability based on Cronbach's alpha test. The most widely used internal reliability measure is Cronbach's α test. Generally, the acceptance level for coefficient alpha should be at least 0.6 [Nunnally, 1978]. I measured the reliability score using Cronbach's α test. In <Table 1>, all construct reliability scores exceed the 0.6. These values represent that all constructs show good Cronbach's α value.

<Table 1> Reliability Test

Construct Variables	Means	Items	Chrobach α
LP	4.3372	4	0.7773
PP	4.3397	4	0.7384
CP	4.2738	4	0.7885
FP	4.2811	4	0.7774
SC	5.9000	3	0.8681

<Table 2> Uni-dimensionality of Model Fit

Construct	Chi-Square	P	GFI	AGFI	RMR	RMSEA
LP	7.569	0.012	0.968	0.841	0.057	0.161
PP	1.111	0.574	0.995	0.974	0.024	0.000
CP	17.013	0.000	0.938	0.688	0.072	0.265
FP	16.951	0.000	0.938	0.688	0.068	0.264

To ensure the legitimacy of the study, I measured the validity using confirmatory factor analysis. In this study, I tested uni-dimensionality test and discriminant validity.

- (1) Learning Performance (Chi-Square = 7.569, P value = 0.012, GFI = 0.968, AGFI = 0.841, RMR = 0.057, NFI = 0.937, CFI = 0.951),
- (2) Process performance (Chi-Square =1.111, P value = 0.574, GFI = 0.995, AGFI = 0.974, RMR = 0.024, NFI = 0.988, CFI = 1.000),
- (3) Customer performance (Chi-Square = 7.013, P value = 0.000, GFI = 0.938, AGFI = 0.688, RMR = 0.072, NFI = 0.874, CFI = 0.884),
- (4) Financial performance (Chi-Square = 16.951, P value = 0.000, GFI = 0.938, AGFI = 0.688, RMR = 0.068, NFI = 0.866, CFI = 0.876). The results with the fit indices providing support for a good model fit.

First, we tested uni-dimensionality test. Model fit indices goodness of fit index (GFI), adjusted GFI (AGFI), root mean square residual (RMR), normed fit index (NFI), comparative fit index (CFI), root mean square error of approximation (RMSEA). The result is follows:

Second, we tested discriminant validity in <Table 3>. According to Anderson, Gerbing (1988), the acceptance level for coefficient alpha should be at most 0.8. The correlation matrix for the constructs shows evidence of discriminant validity.

<Table 3> Discriminant Validity

Construct	LP	PP	CP
PP	.474**		
CP	.340**	.459**	
FP	.348**	.252**	.573**

* (1). N=108, (2). ** : p< .01 2-tailed test.

3.3 Hypothesis Testing and Discussion

In this study, we used structure equation model for searching relationship of SCM performance and sustainable collaboration. <Table 4> shows the results of structure equation model. The results with the fit indices providing support for a good model fit. For example the judgment is supported further by a Chi-Square value of 163.965, P (Probability level) value of 0.03, RMR value of 0.083, GFI value of 0.871 AGFI value of 0.814, NFI value of 0.843, CFI value of 0.963, and RMSEA value of 0.048.

<Table 4> Results of Hypothesis Testing

Hypothesis	B.C.	S.E.	t.	P	Result
[Hypothesis 1.1]	1.165	0.171	6.81	0.00	Accept
[Hypothesis 1.2]	0.476	0.101	4.71	0.00	Accept
[Hypothesis 1.3]	0.676	0.112	6.06	0.00	Accept
[Hypothesis 2.1]	0.004	0.112	0.04	0.97	Reject
[Hypothesis 2.2]	0.021	0.082	0.26	0.80	Reject
[Hypothesis 2.3]	-0.025	0.115	-0.2	0.83	Reject
[Hypothesis 2.4]	0.406	0.13	3.12	0.00	Accept

※ B.C. = beta coefficients, S.E. = standard estimate, t = C.R.(Critical Ratio)

In <Table 4>, we report the beta coefficient and t-value for Structure Equation Model. The significance level explains us the results of [hypotheses 1.1], [hypotheses 1.2], [hypotheses 1.3], [hypotheses 2.4] testing. These hypotheses were conformed except hypotheses [hypotheses 2.1], [hypotheses 2.2], [hypotheses 2.3]. The detail description is follows.

- In [Hypothesis 1.1], beta coefficient is 1.165, standard estimate is 0.171, C.R. (t-values) is 6.817, and P value is 0.00. In significance level 0.05 (1.96) [Hypotheses 1.1] is accepted [Joreskog and Sorbom, 1998].
- In [Hypothesis 1.2], beta coefficient is 0.476, standard estimate is 0.101, C.R. (t-values) is 4.71, and P value is 0.00. In significance level 0.05 (1.96) [Hypotheses 1.2] is accepted.
- In [Hypothesis 1.3], beta coefficients are 0.676, standard estimate is 0.112, C.R. (t-values) is 6.06, and P value is 0.00. In significance level 0.05 (1.96) [Hypotheses 1.3] is accepted.
- In [Hypothesis 2.1], beta coefficient is 0.004, standard estimate is 0.112, C.R. (t-values) is 0.04, P

value is 0.80. In significance level 0.05 (1.96) [Hypotheses 2.1] is not supported.

- In [Hypothesis 2.2], beta coefficient is 0.021, standard estimate is 0.082, C.R. (t-values) is 0.26, and P value is 0.26. In significance level 0.05 (1.96) [Hypotheses 2.2] is not supported.
- In [Hypothesis 2.3], beta coefficients is -0.025, standard estimate is 0.115, C.R. (t-values) is -0.20, P value is 0.83. In significance level 0.05 (1.96) [Hypotheses 2.3] is not supported.
- In [Hypothesis 2.4], beta coefficient is 0.406, standard estimate is 0.13, C.R. (t-values) is 3.12, and P value is 0.00. In significance level 0.05 (1.96) [Hypotheses 2.1] is supported.

As a result, we find sequentially relationships of SCM performance (LP ⇒ PP ⇒ CP ⇒ FP) and SC. Thus, the enterprise pursuing SCM focuses on improving learning performance. As a result, it increases organization capability and business performance.

4. Implication and Limitation

In this research, we analyzed relationship of SCM performance and sustainable collaboration using structure equation model. Based on data collected from 58 companies as distributors and 50 as manufacturers, the research findings were summarized as following.

The hypotheses of [hypotheses 1.1], [hypotheses 1.2], [hypotheses 1.3] and [hypotheses 2.4] didn't support and the hypotheses of [hypotheses 2.1], [hypotheses 2.2] and [hypotheses 2.3] supported.

In summary, in today's e-collaboration environment, many companies realize that successful SCM implementation is more likely to arise from better understanding of relationships of SCM performance (LP ⇒ PP ⇒ CP ⇒ FP) and sustainable collaboration. Thus, the enterprise, which is pursuing SCM, focus on improving LP. As a result, it increases organization capability.

At a managerial level, research implication is follows.

First, in implementing successful SCM, it is important to manage and control the cause and effect relationship among SCM performance index. In this research, we suggest that LP is more important to PP and CP on long term effect. Also, PP is more important to CP on long term effect. The findings of this point practice for simulating of success SCM performance management.

Second, SCM sustainable collaboration is required inter-cooperation of channel companies. If cooperation of among supply channel companies

didn't achieve their success, successful SCM implementation has a difficulty in improving SCM purpose. Therefore, successful SCM implementation operates two-way process of channel companies.

Third, SCM is dynamic and complex process. Thus, successful SCM implementation required many learning and cooperation among supply channel enterprises. Also, it required effort of AS IS process and benefit but also TO BE process and benefit. This result suggests guidelines regarding optimization of supply channel function and improvement of business performance.

In this argument, we can learn that SCM LP have the power of successful SCM implementation and sustainable collaboration. The findings might provide some useful information for another country to compare and/or forecast their level of SCM performance and SCM sustainable collaboration.

The research has some limitations.

First, the data sample size used in this research was small. Generally the analysis of structure equation model required over 150 samples sized. However, empirical result has potential risk in interpreting because of small sized and unbiased data numbers. For example, for two industrial types, 53.00% are distributing companies and 47.00% are manufacturing companies. Thus further research is necessary. Future study will be investigated in many enterprises.

Second, in this study, we used the revised SCM framework of Brewer, Shep (2000). Thus we didn't reflect various SCM performance index. Therefore, for more perspective research, future study will be examined SCM performances reflecting qualitative and quantitative perspective

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Appendix

A brief content of the questionnaire is presented. The form expressed questions of a seven point Likert type scale ranging from 1 to 7 (7 = high SCM performance, 1 = low SCM performance).

1. Product and Process innovation
2. Partnership management
3. Information flows
4. threats and substitutes
5. Waste reduction

6. Time compression
7. Flexible response
8. Unit cost reduction
9. Customer view of product and service
10. Customer view of timeliness
11. Customer view of flexibility
12. Customer view of value
13. Profit margins
14. Cash flow
15. Revenue growth
16. Return on asset
17. Continuous SCM pursuing
18. Vest investment regarding SCM
19. Partnership reinforcing

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