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The effect of buyer-supplier performance metrics alignment on supply chain performance

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Abstract

The effect of buyer-supplier performance metrics alignment on supply chain performance

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As business performance metrics grow more and more complicated, developing a guideline to select and eliminate performance indices is now becoming an important process. Based on the belief that there is a right supply chain strategy and performance management system for a certain product, this study focuses on developing a strategy guideline by aligning strategy with environmental uncertainties and supplying partners. Adopting the framework proposed by Lee (2002), and the methodology by Szu et al. (2009), we add the supplier aspect to the model and evaluate the effectiveness of alignment in the whole supply chain level. Survey data on KPI management was collected from 134 Korean/Chinese manufacturing firms, and profile deviation approach was implemented.

Results show stronger positive effect on firm's overall performance when a supply chain achieves higher degree of alignment between both environment uncertainties and its suppliers. This emphasizes the need for cooperation and collaboration between supply chain partners, and provides empirical evidence to Lee's framework. Also, the effectiveness of current KPI PMS is confirmed.

Keywords : Performance Measurement, Alignment, Supply chain Strategy, Environmental Uncertainty

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1. Introduction

There have been numerous approaches in evaluating the performance of a supply chain throughout the history. An accurate evaluation framework is becoming more and more critical since firms nowadays compete on the efficiency of supply chains rather than competing with individual capabilities. (Calantone and Dröge, 2006) Scholars recently indicate that the emphasis on supply chain management has shifted from factory level management to enterprise level management. (A. Gunasekaran, 2001)

Clearly, performance measurement is essential given the following reasons for performance management by (Gunasekaran and Kobu, 2007).

- Identify success
- Identify if customer needs are met
- Better Understanding of the process
- Identifying bottlenecks, waste, problems and improvement opportunities
- Providing factual decisions
- Enabling progress
- Tracking progress
- Facilitating a more open and transparent communication and co-operation

Some even put performance measurement as 'vital in strategy formulation and communication and informing diagnostic control

mechanisms by measuring actual results' (Wouters, 2009).

However, precise performance measurement is a difficult task due to the mix of qualitative elements and quantitative elements. Recent performance measurement system attempts to implement these qualitative measurements within the measurement framework. Such metrics include Quality, Flexibility, Visibility, Trust, and innovativeness. (Chan, 2003)

Although there are attempts trying to identify the latent factors that affect supply chain performance, existing frameworks are still facing constant criticism. The main reasons stated by (Craig Shepherd, 2006) are,

- Lack of connection with strategy
- Focus on cost to the detriment of non-cost indicators
- Lack of a balanced approach
- Insufficient focus on customers and competitors
- Loss of supply chain context, thus encouraging sub optimization
- Lack of system thinking

But as the definition and conceptual boundaries of supply chain management grows, performance measurement faces a yet challenging issue in terms of integration and alignment. Such integration efforts take place in the four major processes of strategy integration, organizational integration, logistics integration, and information technology integration. (Sangwook Park, 2007) An integrative measurement system is a physical/technical requirement in strategy integration. This paper focuses on identifying the alignment factor in supply chain performance measurement. And by using

actual quantitative performance metrics, we could derive the actual effectiveness of current performance management efforts in supply chains. And we could also provide some empirical evidence to previous measurement and alignment frameworks.

In the following sections of this paper, we identify the concept of alignment through previous literatures. Second, we discuss the methodology of the research. And finally, the analysis and findings will be presented.

Literature Review

1.1. Performance Metrics

Previous literatures have identified many performance measurement metrics. It is now rather a problem of selection than invention. Due to the development of Business intelligence, managers are facing more and more information day after day. The number of KPI's and corporate data are being accumulated faster than ever, and failure to attend to critical signs, wasting time and resources on improving unimportant measures could lead to devastating results.

It is then important to maintain an effective performance management system. (Beamon, 1999) previously indicated the conditions for an effective performance measurement system.

- Inclusiveness (measurement of all pertinent aspects)
- Universality (allow for comparison under various operating conditions)
- Measurability (data required are measurable)
- Consistency (measures consistent with organization goals)

Although there are a number of conceptual frameworks on how to measure supply chain performance, we still lack empirical analysis and case studies on performance metrics and measurement in supply chains. (A.

Gunasekaran, 2001) In order to address various supply chain performance metrics, we take a categorical approach. Many academics tried to categorize the measures to make it easy to study the large number of existing measures.

(Neely et al., 1995) presented a category set including quality, time, flexibility, and cost. This category was also mentioned by Beamon (1999) for its usefulness in systems analysis. Another category was presented by (Stewart, 1995). Measurements are categorized by process flows such as plan, source, make/assemble, and deliver/customer. This category is also now the widely used framework in the Supply Chain Operations Reference model (SCOR) developed by the Supply Chain Council (SCC). Neely et al. (1995) also identifies a number of performance measurement frameworks. These frameworks include the balanced scorecard (Kaplan and Norton, 1992) (Brewer and Speh, 2000). The balanced scorecard approach is now widely used to measure a firm's overall performance. The measure consists of four main categories; Customer perspective, internal business perspective, innovation and learning perspective, and financial perspective. This research also uses the balanced scorecard metrics in order to measure overall firm performance.

Although there is a need for a new framework that consider factors such as measurement systems implementation (Bourne et al., 2000, Bourne et al., 2002), forces that drive change to the existing framework (Kennerley and Neely, 2002); (Waggoner et al., 1999) and dynamic factors that keeps the framework in alignment with strategy and constantly changing business circumstances (Kennerley and Neely, 2003); (Bourne et al., 2002). However,

most of the remaining performance measurement systems utilized by companies still maintains a static performance management system, and by focusing on the objective of measurement, Neely's categories still provide significant explanation in studying measures. Recent performance measurement frameworks incorporate qualitative measurements such as Visibility, Trust, Innovativeness which have significant impact on performance, but is also impossible to measure and track as a daily process.

In order to assess impact of specific performance measures aligned throughout the supply chain and with environmental uncertainties, we apply Neely's framework so that we can classify the measurement in functions instead of process flows. In that way, we can separately measure the performance of each individual factor that impacts the supply chain performance, such as supply/demand uncertainties and supplier-buyer relationships. In order to manage the number of measurements as low as possible, we apply Beamon's measurements with some additional measurements from other studies, to complement aspects of supply chian activities regarding trust or collaboration efforts. [

[Table 1] List of Measures

[Table 1]

[Table 1] List of Measures

Category	Measures (KPI)	QN/QL	Literature
Cost	Total cost	QN	Beamon
	Distribution cost	QN	Beamon
	Manufacturing cost	QN	Beamon
	Inventory Investment	QN	Beamon
	Inventory Obsolescence	QN	Beamon
	Work In Process Cost	QN	Beamon
	Finished goods cost	QN	Beamon
	Return on Investment	QN	Beamon
	Sales	QN	Beamon
	Profit	QN	Beamon
	Stock out Probability	QN	Beamon
	Number of backorders	QN	Beamon
	Number of stock outs	QN	Beamon
	Average Backorder level	QN	Beamon
	Shipping Errors	QN	Beamon
	Buyer-Vendor cost saving	QN	Gunasekaran
Flexibility	Volume Flexibility	QN	Beamon
	Delivery Flexibility	QN	Beamon
	Mix Flexibility	QN	Beamon
	New Product Flexibility	QN	Beamon
Quality	Target Fill Rate Achievement	QN	Beamon
	Average Item fill rate	QN	Beamon
	Customer complaints	QN	Beamon
	Level and degree of information sharing	QL	Kim
	Extent of mutual cooperation leading to improved quality	QL	Graham
	Extent of mutual assistance in problem solving efforts	QL	Maloni
	Supplier rejection rate	QN	Gunasekaran
Time	Product lateness	QN	Beamon

Average lateness of orders	QN	Beamon
Average earliness of orders	QN	Beamon
Percent on-time deliveries	QN	Beamon
Customer responses	QN	Beamon
Manufacturing lead time	QN	Beamon

1.2. Supply chain strategies

(Lee, 2002) points out the importance of choosing the right supply strategy.

- Strategy is required to match customer needs
- The degree of demand and supply uncertainty are the two major factors in deciding between supply chain strategies
- Online capabilities offer strong support functions

As (Fisher, 1997) asserted, Hau Lee also agree to the fact that level of demand uncertainty differentiate functional and innovative products. Moreover, supply uncertainty determines whether the supply conditions are stable or evolving. The combined situation of demand and supply uncertainty, we can consider four supply chain strategies (Efficient, Responsive, Risk-hedging, and Agile Supply chains). In this paper, we consider the supply and demand uncertainty of a given firm, and calculate the alignment between the proposed supply chain strategy and actual strategy. [Table 2]

[Table 2] Environmental Uncertainties and Supply chain Strategy

Environmental Uncertainty		Demand Uncertainty	
		High	Low
Supply Uncertainty	High	Agile Supply Chain	Risk-Hedging Supply Chain
	Low	Responsive Supply chain	Efficient Supply Chain

Source: Hau L. Lee (2002)

According to Hau L. Lee, each supply chain strategy could be explained by some distinctive characteristic. The Efficient Supply Chain utilizes strategies aimed at creating the highest cost efficiencies. All non-value added activities are eliminated and scale economies are pursued. Capacity utilization in production and distribution is maintained at the highest possible levels. Information linkages are established to guarantee accurate, swift communication.

Risk-Hedging supply chains utilize strategies such as pooling and sharing resources in a supply chain so that the risks in supply disruption can also be mitigated. Having multiple sources or resource alternatives also helps the supply chain to endure disruptions. Sharing inventories is a good example in this case. Inventory pooling helps managing safety stocks at lower costs.

Responsive supply chains use responsive and flexible strategies to fulfill dynamic customer needs. Firms using strategies such as build-to-order, mass customization shows a good example. Flexibility and order accuracy becomes important to these supply chains.

Agile supply chains utilize various strategies to stay responsive and be able to hedge risks at the same time. On the other hand, managing an agile

supply chain could also be costly.

As we aim in this research, in order to calculate the alignment of organization strategy with environmental uncertainties, developing an ideal supply chain strategy profile would be essential. Although Hau L. Lee proposed a conceptual framework for the four supply chain strategy, there are not much of prior studies that attempt to clarify the profile for each supply chain strategy. However previous study from (Markham T. Frohlich, 2001) proposes three types of players named as Maketeers, Caretakers, and Innovators. By studying their characteristics, we could perhaps infer profiles for the four supply chain strategies. A recent study by (Szu-Yuan Sun, 2009) made an exemplar case for the four supply chain strategies by making such an inference.

The concept of efficient supply chains are quite identical to caretakers studied in previous literature (Markham T. Frohlich, 2001); (Miller and Roth, 1994); (Wang et al., 2007). Emphasis is on performances such as cost efficiency and speed.

Responsive supply chains tend to focus on flexibility, quality, and time. Their profile matches the Marketeers from previous studies. Considering the cost, these firms are said to be capable of managing cost through manufacturing and/or logistics postponement to control inventory levels (Pagh and Cooper, 1998).

Risk hedging Supply chains have to manage multiple supply bases in order to share and pool resources. Such efforts will be costly. And given the unstable supply and predictable demand, these firms will also be handling

functional products focusing on quality. However their speed performance will not match that of the efficient supply chain.

Finally, agile supply chain will be characterized as an all rounded player. Their focus is similar to the Innovators for previous studies. By managing all aspects at high levels, we could assume that cost performance will be sacrificed.

A brief summary is displayed in [Table 3]. Each characteristic will be the guideline for deriving the alignment index later on.

[Table 3] Supply chain Strategy Profiles

Measures	Efficient	Responsive	Risk-Hedging	Agile
Cost	High	Med	Med	Low
Flexibility	Low	High	Low	High
Quality	High	High	High	High
Time	High	High	Med	High

Source: Szu-Yuan Sun et al. (2009)

1.3. Alignment

The key to managing performance metrics is to have them well aligned with the firm or supply chain's strategy. The concept of alignment and its benefits were researched for many years. (Venkatraman, 1989) classified the concepts and methodologies of previous studies about fit and alignment into 6 groups. The groups differ in how fit is defined. Fit is defined as Moderation, Mediation, Matching, Gestalt, Profile Deviation, and Covariation. The

perspective of seeing fit as a deviation from a profile best expresses the circumstance we are trying to illustrate through this research. Previous studies from (Van de Ven and Drazin, 1984) also takes on this perspective. The degree of adherence to a specified profile has significant effect on performance. The calculation of deviation is made by measuring the Euclidean distance in an N-dimensional space MDS. This methodology is adopted when multiple variables more than two are concerned in the model.

These six groups are regrouped into three broader categories of congruence, contingency, and holistic configuration. Congruence free of specification criterion studies fit as the relationship between independent pair of variables. Contingency anchored by specific criterions shows the intervention of variables between the predictor and criterion. And fit as holistic configuration has a predefined system specification, and shows the gestalt or profile deviation characterizing holistic patterns of inter dependencies simultaneously subjected to multiple contingencies. (Umanath, 2003)

The importance of alignment has been emphasized by researchers. Successful integration and alignment in the supply chain leads to competitive prices at the required time and space. (Harland et al., 2006) Total integration of performance measurements is not an easy task. This requires a comprehensive understanding on all related variables. (Theodore P. Stank, 2001) Studies by (Stock et al., 2000) confirmed the positive impact of enterprise logistics and supply chain structure alignment on organizational performance. And the importance of alignment between strategic, operational

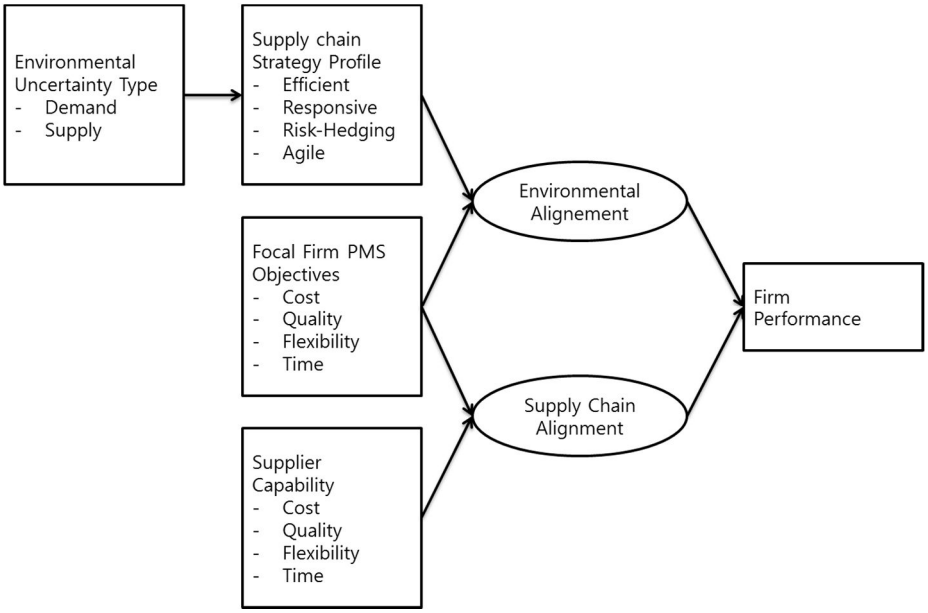
variables and environment was emphasized by (Stonebraker and Liao, 2006). Alongside with the conceptual framework by Hau Lee, (Paulraj and Chen, 2007) also pointed out that environmental uncertainty takes a crucial role in implementation of strategic supply management.

The study by Szu-Yuan sun et al.,(2009), which is also the key reference of this research followed the analytical expressions of profile deviation and treated alignment as holistic configuration type of fit in order to examine the impacts of the alignment between SC strategies and environmental uncertainties on SCM performance. However their research is only limited in calculating the distance between environmental uncertainties and SC strategies of a single focal firm. In this study, we take a step further by including the supplier of the focal firm, and calculate the alignment between the focal firm and its supplier to find out the importance of alignment within the whole supply chain.

2. Research Method

2.1. Research Model

Proposed research model is depicted in [Figure 1].



[Figure 1] Conceptual Research Model

Previous study by Szu-Yuan Sun et al., (2009) has conducted an empirical research based on the supply chain profiles. The paper's goal is to identify the impact of alignment between supply chain strategy and environmental uncertainty attributes. Items used for survey was mostly based on qualitative concepts and perceptions. In this research we tend to focus on quantitative measures that are actually used to measure business performances.

Also shown in the framework figure, this study is differentiated by another aspect named as supply chain alignment. In addition to the original environmental alignment construct, to ensure full alignment within the whole supply chain, the alignment between the buyer and supplier will be measured and its effects will be evaluated.

Once the environmental uncertainty is clarified, a single supply chain strategy will be assigned to each case following the profile discussed earlier. Each case will be evaluated be the alignment level between the environment uncertainty and the buyer firm's supply chain strategy. Next, the supplier firm's alignment will be evaluated with the given buyer firm's supply chain strategy. All evaluations will be performed at performance metrics level. Several authors have highlighted the importance of this alignment (Fisher, 1997); (Lee, 2002); (Miller, 1993); (Venkatraman and Prescott, 2006). Such research indicates that the alignment between environmental uncertainty and supply chain strategy is critical to business performance. Based on these findings we propose the following hypotheses.

H1. Supply Chain Performance will be higher when supply chain strategy of the buyer firm is well aligned with environmental uncertainty.

H2. Supply chain Performance will be ***even higher*** *when supply chain strategies are well aligned between the buyer and supplier firm in addition to environment alignment.*

2.2. Sample and Data Collection

Online Survey Questionnaires were used to collect data. A total of 115 questions were asked to each respondent and average response time was 20 minutes. The questionnaire was distributed to manufacturing firms in Korea and China. To have the samples reflect the population, the survey was sent to all possible contacts. Contact information was extracted from commercial research firm databases and MBA students at Seoul National University. A total of 1,000 surveys were sent, and 161 samples were collected. (16.1%) Among the final samples, 27 samples were eliminated due to incomplete/inaccuracy of the information. Details of the respondent characteristics are available in [Table 4].

The survey is consisted of four main parts. The first part was to identify the environmental uncertainty of the respondent. The second part of the survey measures the strategic importance of each performance measure of the buyer firm. The third part asks the respondent of strategic importance of each performance metric when evaluating supplier performance. The final section measures the supply chain performance of the buyer firm and overall efficiency of the supply chain.

[Table 4] Respondent characteristics

	n	%
Employees		
Under 100	49	36.6
100~500	43	32.1
500~1000	10	7.5
1000~2000	9	6.7
Over 2000	23	17.2
Geographic Location		
Korea	109	81.3
China	25	18.7
Industry		
Groccery	6	4
Tobacco	1	1
Clothing	1	1
Wooden products	2	1
Chemical products	9	7
Rubber & Plastics	5	4
Metal Produce	5	4
Computer & telecom device	18	13
Electronic equipment	11	8
Motors	12	9
Furniture	3	2
Fabrics	4	3
Pulp & paper	4	3
Carbon produce	2	1
Pharmaceutical	5	4
Mineral	3	2
Metallic products	9	7
Medical & optical products	2	1
Other Equipment	18	13
Other transportation	2	1
Recycling	1	1
Other	11	8

2.3. Measurement

Scales for measurement on each survey construct were adopted from previous literatures to ensure content validity. Measurement items for supply and demand uncertainty were adopted from researches by (Premkumar et al., 2003).

And since various performance items were used to measure the performance of buyer and supplier firms, we use the balanced score card items to measure overall firm performance. Items for the supply chain balanced score card were adopted from the paper by Brewer and Speh (2000).

Each questionnaire items were measured by using a 7-point Likert scale labeled as 1=strongly disagree (not important) ~ 7=strongly agree (very important). Questionnaire was offered to the respondents in Korean and Chinese respectively. And a pretest of the questionnaire was carried out by 2 SCM experts to ensure content validity and reliability.

2.4. Reliability and Validity of Construct

A Cronbach's alpha test was performed along with confirmatory factor analysis to test the reliability and validity of measurement items and constructs. Test results and descriptive statistics are available in [Table 5].

[Table 5] Research Variables

Research Variable	Composite Reliability	# of items	Mean	Var
Environmental Uncertainty				
Overall	0.924			
Demand Uncertainty	0.917	4	3.746	2.532
Supply Uncertainty	0.908	5	3.657	2.534
Performance measurement KPI				
Overall	0.873			
Cost	0.748	5	6.118	1.092
Flexibility	0.799	4	4.892	2.552
Quality	0.862	5	5.413	2.408
Time	0.907	6	5.345	2.548
Supply Chain Performance				
Overall	0.936	5	5.241	2.110

As shown in the table, composite reliabilities of all the research variables in the study exceeded 0.700, well above the required minimum of 0.60 (Bagozzi and Yi, 1988), and also above the acceptable threshold of 0.70 (Gefen et al., 2000).

However, some items in the buyer-supplier performance measurement construct failed to pass the discriminant validity test using confirmatory factor analysis. As a result, 11 cost measurement items and 2 quality measurement items had to be dropped before further analysis. This was an anticipated result since previous performance measurement systems were heavily relying on cost and financial measures. Original proposed construct also included 16 cost items which seems unbalanced compared with the other constructs (6~7 in average). This was a predicted result, and as the remaining items are critical cost factors, the following analysis could be performed as planned. CFA results are available in [Table 6]. And as the factor analysis results shows,

discriminant validity was ensured for the remaining items. Extracting four factors yielded an eigenvalue of 1.575 which is over the suggested value of 1 by Kaiser.

[Table 6] Factor loadings for construct

Rotated Component Matrix[a]		
Variable	**Measurement Item**	**Factor Loadings**
Construct of Environmental Uncertainty		
Sup2	Supply source variation in volume	.848
Sup5	Supply source overall uncertainty	.844
Sup4	Supply source variation in delivery date	.809
Sup1	Supply source variation in price	.782
Sup3	Supply source variation in quality	.716
Dem2	Uncertainty in demand generation	.908
Dem1	Uncertainty in demand forecast	.863
Dem3	Uncertainty in demand price	.821
Dem4	Overall demand uncertainty	.784
Construct of Performance measurement KPI		
time2	Average lateness of orders	.877
time4	Percent of on-time deliveries	.851
time1	Product lateness	.828
time5	Customer response time	.733
time3	Average earliness of orders	.724
time6	Manufacturing lead time	.544
Cost8	Return on investment	.748

Cost3	Manufacturing cost	.722
Cost1	Total cost	.722
Cost2	Distribution cost	.713
Cost9	Sales	.690
qual6	Investment on mutual assistance in problem solving	.772
qual5	Investment on mutual cooperation leading to improved quality	.675
qual4	Level and degree of information sharing	.621
qual3	Customer complaints	.569
qual1	Target fill rate achievement	.542
flex1	Volume Flexibility	.852
flex3	Mix Flexibility	.758
flex2	Delivery Flexibility	.739
flex4	New product Flexibility	.624
Construct of overall firm performance		
Perf5	Customer perspective	.906
Perf1	Internal process	.871
Perf2	Innovation and Learning perspective	.865
Perf4	Financial perspective	.849
Perf3	Supply chain efficiency	.808
Extraction Method: Principal Component Analysis. **Rotation Method: Varimax with Kaiser Normalization.**		
a. Rotation converged in 8 iterations.		

3. Discussion

3.1. Data Analysis and results

In order to derive the alignment index, first, each response cases are classified into one of the four uncertainty profiles by calculating the total sample mean of supply and demand uncertainty. Each case is classified into their respective environment and thus, assigned to an ideal supply chain strategy.

For the next step, performance scores are transformed into standard scores in order to calculate the distance between each case and the ideal supply chain strategy.

For the third step, ideal supply chain strategies were assigned to target values for each measurement construct. As discussed earlier, each supply chain strategies were profiled in terms of the level of each performance metric in terms of High-Med-Low. The target values are assigned as 1=High, 0=Med, -1=Low. Then the Euclidian distance between the standardized scores and target values are calculated.

$$\text{Distance} = \sqrt{\sum \left\{ \left(X_j - I_j \right)^2 \right\}}$$

Where, X_j is the standardized score for jth construct, and I_j is the target value for jth construct. The distance would mean the deviation from the target profile, and small distance values would mean high alignment with environmental uncertainty and focal firm's supply chain performance

management efforts.

The supply chain alignment index is also calculated in a similar way. Instead of subtracting the Ideal value of a supply chain strategy, standardized score of buyer firm is subtracted from the standardized score of the supplier firm. Also this distance would mean the supplier's deviation from the buying firm's strategic goals, and small distance could be interpreted as higher degree of alignment between the two firms.

3.2. Results

Result from the classification is as follows. The analysis identified 48 HD/HS, 24 HD/LS, 22 LD/LS, and 40 LD/HS environmental uncertainty firms. Agile, Responsive, Efficient, Risk-hedging supply chain strategies were assigned to each segments respectively.

In order to test the hypothesis, a simple stepwise linear regression test was performed. The first regression was performed with only having buyer alignment as the predictor, and the second model included the supply chain alignment as another predictor. Regression results for the first model showed significant fit ($p<.05$). And also, the results showed significant ($p<.05$) changes in R square values (0.024->0.061) and F statistics (4.313->6.094) by adding supply chain alignment. Overall fit of the regression model also increased, thus supporting both hypotheses. Results of the regression analysis are provided in [Table].

[Table 7] Regression Results

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.178[a]	.032	.024	.98777266	.032	4.313	1	132	.040	
2	.273[b]	.075	.061	.96924875	.043	6.094	1	131	.015	1.938

a. Predictors: (Constant), buyerdistance2

b. Predictors: (Constant), buyerdistance2, Inter distance

c. Dependent Variable: REGR factor score 1 for analysis 1

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.208	1	4.208	4.313	.040[b]
	Residual	128.792	132	.976		
	Total	133.000	133			
2	Regression	9.933	2	4.966	5.287	.006[c]
	Residual	123.067	131	.939		
	Total	133.000	133			

a. Dependent Variable: REGR factor score 1 for analysis 1

b. Predictors: (Constant), buyerdistance2

c. Predictors: (Constant), buyerdistance2, Inter distance

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
(Constant)	-.270	.155		-1.736	.085	-.577	.038					
buyerdistance2	-.168	.081	-.178	-2.077	.040	-.327	-.008	-.178	-.178	-.178	1.000	1.000
(Constant)	-.221	.154		-1.434	.154	-.525	.084					
buyerdistance2	-.285	.092	-.302	-3.083	.002	-.467	-.102	-.178	-.260	-.259	.737	1.357
Inter distance	-.198	.080	-.242	-2.469	.015	-.356	-.039	-.087	-.211	-.207	.737	1.357

a. Dependent Variable: REGR factor score 1 for analysis 1

Correlations

		REGR factor score 1 for analysis 1	buyerdistance2	Inter distance
Pearson Correlation	REGR factor score 1 for analysis 1	1.000	-.178	-.087
	buyerdistance2	-.178	1.000	-.513
	Inter distance	-.087	-.513	1.000
Sig. (1-tailed)	REGR factor score 1 for analysis 1	.	.020	.159
	buyerdistance2	.020	.	.000
	Inter distance	.159	.000	.
N	REGR factor score 1 for analysis 1	134	134	134
	buyerdistance2	134	134	134
	Inter distance	134	134	134

4. Conclusion

4.1. Implications

This study contributes to research for the following reasons. First, this study provides further empirical evidence for environmental uncertainty and supply chain strategy alignment. Hau Lee's framework is supported by the findings in this study. Second, the findings in this paper agrees and supports the profiling of the four supply chain strategies proposed by Szu-Yuan Sun et al. (2009). However instead of just following the framework, we identified important aspects of supply chain strategy alignment. It is the fact that supply chain alignment should be incorporated though out the entire supply chain instead of just a single entity. Third, by using actual quantitative measures, we could evaluate the effectiveness of current measures applied by companies. Fourth, compared with the SCOR framework which only compares the supply chain strategy with supply chain performance, we can conclude that there can be a preferable supply chain strategy given the uncertain environment. And that the importance of buyer-supplier alignment and cooperation is never emphasized too much.

For practitioners, this research provides guidelines on evaluating their own business and set a corresponding supply chain strategy. Identifying the core performance attributes would enable a more goal driven and effective supply chain management. Simple imitations of competitors would not seem

as attractive as before. And the importance of supplier cooperation and collaboration is elevated.

4.2. Research Limitations

The research results showed several limitations as well. First of all, since the survey was taken only by the buyer firm, performance evaluation of suppliers has a possibility to be biased. And although the construct was considering actual quantitative measures, acquiring real performance data is highly difficult.

Second, ideal values for the target supply chain strategy requires further research since the current method cannot fully reflect the weights between measurement constructs. The SCOR model uses market research data and calculates the industry average for top performing firms. Other studies use various methods such as AHP, Fuzzy models in order to derive priorities between performance measures. There is still no consensus regarding this issue and comparing the outcomes of each method would be a promising field of future research.

Third, there remains some obscurity in current profiling of the four supply chain strategies using KPIs. Supply uncertainty is not yielding much distinguishable characteristics at this point. This makes grey areas in the profiling when it comes to set ideal performance targets for agile, responsive strategies. Re-categorizing current performance measures, or defining new performance attributes could perhaps shed some light on this issue.

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Appendix

공급사슬망에서 공급자-구매자 성과측정 지표의 연계 효과에 관한 연구 설문지

안 내 문

안녕하십니까?

설문에 응해주신 귀하께 진심으로 감사드립니다. 본 설문조사는 서울대학교 경영대학원 생산관리 연구실에서 작성되었으며, 귀사는 본 설문조사를 위해 국내 기업 중에서 본 연구를 위해 몇 가지 기준에 의해 특별히 엄선되었음을 알려드립니다. 업무에 여러모로 바쁘시겠지만, 우리나라의 경영학 발전에 도움을 주신다는 마음으로 설문에 응해 주신다면 대단히 감사하겠습니다.

조사목적

본 설문지는 공급사와 구매사의 핵심 제품의 수요/공급 불확실성 특성을 반영한 공급사슬 성과측정 지표의 연계를 통해 이루어지는 전략, 조직, 물류, 정보기술 통합이 공급사슬 성과에 미치는 영향을 분석하기 위해 작성되었습니다. 본 연구는 기업의 공급사슬 경쟁력을 진단하고 기업간 역량을 비교하기 위한 자료로 활용할 수 있는 공급사슬의 통합도 지표를 산출하는데 그 목적이 있습니다.

조사내용

본 설문에는 정답이 정해져 있는 것이 아니며, 각 질문에 대해 주어진 안내를 주의 깊게 읽으신 후 평소 사내에서 하시는 그대로 응답해주시면 연구에 큰 도움이 될 것입니다. 본 설문조사는 총 112 개의 단순 체크 문항으로 구성되어 있으며 완료 예상시간은 15~20 분입니다. 모든 문항은 7 점 척도로 구성되어 있으며 귀사 핵심제품의 시장 특성, 핵심 성과 지표에 대한 귀사의 인식, 공급망 통합을 위한 귀사의 노력에 대한 질문, 지표간 상대적 중요성 평가 파트로 구성되어있습니다.

비밀유지 서약

귀하께서 응답하신 내용은 순수한 연구목적으로만 사용되며 이 외의 다른 어떠한 용도로도 절대 사용되지 않는다는 것을 약속 드립니다. 또한 응답자는 모두 익명으로 처리되며 어떠한 경우에도 비밀이 철저히 보장될 것임을 약속드립니다.

연구에 대한 문의사항

혹시 본 조사와 관련하여 의문점이 있으시면 아래의 연락처로 언제든지 문의해주시면 답해 드리도록 하겠습니다. 협조해 주신 점 다시 한번 감사 드립니다.

귀사의 무궁한 발전을 기원합니다.

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질문그룹 1: 기업 정보

1. 본 설문조사는 제조기업의 자재 구매/조달 담당 실무자를 대상으로 진행됩니다. 귀사가 제조업체가 아니거나, 자재 구매/조달 담당 실무자가 아닌 경우 아래의 "아니오"를 체크하시고 설문조사를 종료하여주시기 바랍니다. 위의 설문조사에 관한 안내를 모두 읽고, 이해하였으며, 본 설문조사에 참여하겠습니다.

○예 (1) ○아니오 (2)

2. 귀사의 법정 유형에 해당하는 곳에 표시해주시기 바랍니다.

○대기업 (1)

○중기업 (2)

○소기업 (3)

○해당 없음 (4)

3. 귀사의 명칭을 적어주시기 바랍니다.

4. 귀사의 설립 연도를 적어주시기 바랍니다.

5. 귀사의 현재 종업원 수는 총 몇명입니까?

6. 귀사의 작년도 총 매출액을 적어주시기 바랍니다.

7. 귀사의 주 업종은 무엇입니까? 아래의 목록에서 선택하여 동그라미에 체크해 주시기 바랍니다.

○식료품 제조업(음료와 담배제조업 제외) (1) ○담배 제조업 (2) ○의복, 의복 악세사리 및 모피제품 제조업 (3) ○목재 및 나무제품 제조업(가구 제외) (4) ○인쇄 및 기록매체 복제업 (5) ○화학물질 및 화학제품 제조업(의약품 제외) (6) ○고무제품 및 플라스틱제품 제조업 (7) ○1 차 금속 제조업 (8) ○전자부품,컴퓨터,영상,음향/통신 장비 제조업 (9) ○전기장비 제조업 (10) ○자동차 및 트레일러 제조업 (11) ○가구 제조업 (12) ○음료 제조업 (13)	○섬유제품 제조업(의복 제외) (14) ○가죽, 가방 및 신발 제조업 (15) ○펄프, 종이 및 종이제품 제조업 (16) ○코크스, 연탄 및 석유 정제품 제조업 (17) ○의료용 물질 및 의약품 제조업 (18) ○비금속 광물제품 제조업 (19) ○금속가공제품 제조업(기계 및 가구 제외) (20) ○의료, 정밀, 광학기기 및 시계 제조업 (21) ○기타 기계 및 장비 제조업 (22) ○기타 운송장비 제조업 (23) ○폐기물 수집운반, 처리 및 원료재생업 (24) ○해당 없음(직접 기입) (25)

8. 위에 해당사항이 없는 경우, 귀사의 주 업종을 직접 기입하여 주시기 바랍니다.

질문그룹 2: 핵심 제품의 수요 불확실성 정도

9. 다음은 귀사 핵심 제품의 수요 불확실성 정도를 파악하기 위한 질문입니다. 아래 불확실성 요소를 보시고 해당하는 정도에 동그라미 표시를 해주시기 바랍니다.

	그렇지 않다		중립		매우		그렇다
수요량에 있어 자사의 수요 예측은 부정확한 편이다 (1)	1	2	3	4	5	6	7
수요 발생 시기에 있어 자사의 수요 예측은 부정확한 편이다 (2)	1	2	3	4	5	6	7
수요 가격 형성에 있어 자사의 수요 예측은 부정확한 편이다 (3)	1	2	3	4	5	6	7
결론적으로, 자사의 핵심 제품은 수요 불확실성은 높은 편이다 (4)	1	2	3	4	5	6	7

10. 다음은 귀사 핵심 제품의 공급 불확실성 정도를 파악하기 위한 질문입니다. 아래 불확실성 요소를 보시고 해당하는 정도에 동그라미 표시를 해주시기 바랍니다.

	그렇지 않다		중립		매우		그렇다
자사의 공급원은 공급가격 변동이 큰 편이다 (1)	1	2	3	4	5	6	7
자사의 공급원은 공급량 변동이 큰 편이다 (2)	1	2	3	4	5	6	7
자사의 공급원은 공급 품질 변동이 큰 편이다 (3)	1	2	3	4	5	6	7
자사의 공급원은 운송일 변동이 큰 편이다 (4)	1	2	3	4	5	6	7
결론적으로, 자사의 핵심 제품은 공급 불확실성이 큰 편이다 (5)	1	2	3	4	5	6	7

질문그룹 3 : 핵심 성과 지표(KPI)

다음은 다른 기업 혹은 기존의 학계 사례 연구에서 사용한 핵심 성과 지표(KPI) 들입니다. 각 지표를 보시고 귀사에서 생각하는 중요도에 동그라미 표시를 해주시기 바랍니다.

	중요하지 않다		중립				중요하다
비용							
Total cost (총 비용) (1)	1	2	3	4	5	6	7
Distribution cost (유통 비용) (2)	1	2	3	4	5	6	7
Manufacturing cost (제조 비용) (3)	1	2	3	4	5	6	7
Inventory Investment (재고 투자 비용) (4)	1	2	3	4	5	6	7
Inventory Obsolescence (재고 폐기 비용) (5)	1	2	3	4	5	6	7
Work In Process cost (재공품재고 유지비용) (6)	1	2	3	4	5	6	7
Finished goods cost (완제품 재고유지 비용) (7)	1	2	3	4	5	6	7
Return on Investment (총자산대비 순이익) (8)	1	2	3	4	5	6	7
Sales (매출) (9)	1	2	3	4	5	6	7
Profit (이익) (10)	1	2	3	4	5	6	7
Stockout Probability (품절 확률) (11)	1	2	3	4	5	6	7
Number of backorders (품절로 인한 주문 미충족 수량) (12)	1	2	3	4	5	6	7

Number of stockouts (품절 횟수) (13)	1	2	3	4	5	6	7
Average Backorder level (평균 제품별 주문 미충족 수량) (14)	1	2	3	4	5	6	7
Shipping errors (선적 오류 횟수) (15)	1	2	3	4	5	6	7
Buyer-Vendor cost saving initiatives (구매자-공급자 공동 비용 절감노력) (16)	1	2	3	4	5	6	7
	중요하지 않다		중립			중요하다	
유연성							
Volume flexibility (제조 수량 유연성) (17)	1	2	3	4	5	6	7
Delivery flexibility (운송 계획 유연성) (18)	1	2	3	4	5	6	7
Mix flexibility (제조 제품 종류 유연성) (19)	1	2	3	4	5	6	7
New Product flexibility (신제품 개발/출시 속도) (20)	1	2	3	4	5	6	7
품질							
Target fill rate Achievement (목표 주문충족율 달성도) (21)	1	2	3	4	5	6	7
Average item fill rate (평균 제품별 주문 충족율) (22)	1	2	3	4	5	6	7
Customer complaints (고객 불만 접수 건수) (23)	1	2	3	4	5	6	7
Level and degree of information sharing (정보 공유 수준) (24)	1	2	3	4	5	6	7
Extent of mutual cooperation leading to improved quality(품질 향상을	1	2	3	4	5	6	7

위한 공동 협업) (25)							
Extent of mutual assistance in problem solving efforts(문제 해결을 위한 공동 지원 노력) (26)	1	2	3	4	5	6	7
Supplier rejection rate (공급자 납품 거부율) (27)	1	2	3	4	5	6	7
시간							
Product lateness (제품 지연 납품) (28)	1	2	3	4	5	6	7
Average lateness of orders (평균 주문별 지연 납품) (29)	1	2	3	4	5	6	7
Average earliness of orders (평균 주문별 조기 납품) (30)	1	2	3	4	5	6	7
Percent on-time deliveries (정시 납품 비율) (31)	1	2	3	4	5	6	7
Customer response time (고객 주문 충족 시간) (32)	1	2	3	4	5	6	7
Manufacturing lead time (제품 제조 시간) (33)	1	2	3	4	5	6	7

질문그룹 4 : 핵심 원자재 공급자를 선정하는데 있어 각 지표가 고려되는 정도

다음의 성과지표들을 보시고, 핵심 원자재 공급자를 선정하는데 있어 각 지표가 고려되는 정도에 동그라미로 표시하여 주시기 바랍니다.

	중요하지 않다		중립				중요하다
비용							
Total cost (총 비용) (1)	1	2	3	4	5	6	7
Distribution cost (유통 비용) (2)	1	2	3	4	5	6	7
Manufacturing cost (제조 비용) (3)	1	2	3	4	5	6	7
Inventory Investment (재고 투자 비용) (4)	1	2	3	4	5	6	7
Inventory Obsolescence (재고 폐기 비용) (5)	1	2	3	4	5	6	7
Work In Process cost (재공품재고 유지비용) (6)	1	2	3	4	5	6	7
Finished goods cost (완제품 재고유지 비용) (7)	1	2	3	4	5	6	7
Return on Investment (총자산대비 순이익) (8)	1	2	3	4	5	6	7
Sales (매출) (9)	1	2	3	4	5	6	7
Profit (이익) (10)	1	2	3	4	5	6	7
Stockout Probability (품절 확률) (11)	1	2	3	4	5	6	7
Number of backorders (품절로 인한 주문 미충족 수량) (12)	1	2	3	4	5	6	7

Number of stockouts (품절 횟수) (13)	1	2	3	4	5	6	7
Average Backorder level (평균 제품별 주문 미충족 수량) (14)	1	2	3	4	5	6	7
Shipping errors (선적 오류 횟수) (15)	1	2	3	4	5	6	7
Buyer-Vendor cost saving initiatives (구매자-공급자 공동 비용 절감노력) (16)	1	2	3	4	5	6	7
	중요하지 않다		중립		중요하다		
유연성							
Volume flexibility (제조 수량 유연성) (17)	1	2	3	4	5	6	7
Delivery flexibility (운송 계획 유연성) (18)	1	2	3	4	5	6	7
Mix flexibility (제조 제품 종류 유연성) (19)	1	2	3	4	5	6	7
New Product flexibility (신제품 개발/출시 속도) (20)	1	2	3	4	5	6	7
품질							
Target fill rate Achievement (목표 주문충족율 달성도) (21)	1	2	3	4	5	6	7
Average item fill rate (평균 제품별 주문 충족율) (22)	1	2	3	4	5	6	7
Customer complaints (고객 불만 접수 건수) (23)	1	2	3	4	5	6	7
Level and degree of information sharing (정보 공유 수준) (24)	1	2	3	4	5	6	7
Extent of mutual cooperation leading to improved quality(품질 향상을	1	2	3	4	5	6	7

위한 공동 협업) (25)							
Extent of mutual assistance in problem solving efforts(문제 해결을 위한 공동 지원 노력) (26)	1	2	3	4	5	6	7
Supplier rejection rate (공급자 납품 거부율) (27)	1	2	3	4	5	6	7
시간							
Product lateness (제품 지연 납품) (28)	1	2	3	4	5	6	7
Average lateness of orders (평균 주문별 지연 납품) (29)	1	2	3	4	5	6	7
Average earliness of orders (평균 주문별 조기 납품) (30)	1	2	3	4	5	6	7
Percent on-time deliveries (정시 납품 비율) (31)	1	2	3	4	5	6	7
Customer response time (고객 주문 충족 시간) (32)	1	2	3	4	5	6	7
Manufacturing lead time (제품 제조 시간) (33)	1	2	3	4	5	6	7

질문그룹 5 : 주요 경쟁사 대비 자사의 공급사슬 성과

19. 다음에 각 성과지표들을 보시고, 각 지표에 대해 주요 경쟁사 대비 자사의 공급사슬 성과가 얼마나 경쟁력을 가지고 있는지를 동그라미로 표시해주시기 바랍니다.

	그렇지 않다		중립		매우 그렇다		
자사의 공급사슬은 경쟁사 대비 고객 성과가 높은 편이다 (1)	1	2	3	4	5	6	7
자사의 공급사슬은 경쟁사대비 내부 프로세스가 효율적인 편이다 (2)	1	2	3	4	5	6	7
자사의 공급사슬은 경쟁사 대비 혁신 추진력과 변화 관리 역량이 높은 편이다 (3)	1	2	3	4	5	6	7
자사의 공급사슬은 경쟁사 대비 재무적 성과가 높은 편이다 (4)	1	2	3	4	5	6	7
전반적으로 자사의 공급사슬은 효율성이 높은 편이다 (5)	1	2	3	4	5	6	7

질문그룹 6 : 인적 사항

20 귀하의 성별을 표시하여주시기 바랍니다.

○남 (1)

○여 (2)

21 귀하의 나이를 기입하여 주시기 바랍니다.

22 장시간 설문에 응해 주셔서 대단히 감사합니다. 연구결과가 나오는대로 요약본을 송부해 드리겠습니다. 하단에 응답자의 업무용(사내)이메일 주소를 기입해주시기 바랍니다.

E-mail:

초 록

구매자-생산자 성과 측정 지표 연계와 공급사슬 성과와의 상관관계에 관한 연구

정 문 원

생산관리 전공
서울대학교 경영대학원

첨단 기술 발전에 힘입어 경영 지원 시스템의 성과측정 역량이 비약적으로 향상되고 있다. 이에 따라 성과측정지표의 선정 및 제거를 위한 기준마련이 보다 중요해지고 있다. 이 연구는 제품의 특성에 따라 적합한 공급사슬 전략이 존재한다는 가정하에 환경 불확실성 및 공급자들과 공급사슬 전략을 연계하는 기준을 마련하는데 초점을 두고 있다. 환경 불확실성에 따른 공급사슬 전략을 제시한 Lee(2002)의 프레임웍과 Szu et al.(2009)의 방법론을 토대로 공급자와의 연계를 새롭게 추가하여 공급사슬 전체에서의 연계를 측정하고자 하였다. 한국/중국의 제조기업 134 업체의 성과측정지표 관리에 대한 설문조사 자료를 바탕으로 연계도 측정이 이루어졌다.

결과로, 환경 불확실성에 따른 효과적인 공급사슬 전략의 연계에 더해 공급자와의 연계 정도가 높을수록 기업의 전체적인 성과가 향상됨을 확인하였다. 이는 공급자와의 협업 및 상생의 중요성에 무게를 더해줄 뿐만 아니라, Lee의 프레임웍에 실증적 근거를 마련해주며, 현재 기업들이 활용하고 있는 KPI 성과관리 시스템의 효과성 또한 입증시켜주었다고 할 수 있다.

주요어 : 성과관리, 연계, 통합, 공급사슬 전략, 환경 불확실성
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