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Improving Performance in Supplier Relationship Management with Lower-Tier Supplier Visibility and Management

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Abstract

In this study, we investigate how a company can employ lower-tier supplier visibility and management to achieve better performance for itself. After we identified important performance criteria and practices in engendering lower-tier supplier visibility and management through literature review and focus group interview, we designed a questionnaire – based on the identified criteria – to survey organizations on supplier performances with respect to the different LTSM practices they use for engendering lower-tier supplier visibility and enhancing lower-tier supplier management. Using our survey data, we are able to show that lower-tier supplier management can positively affect all SRM performance at three levels: the immediate purchasing level, the corporate level, and the inter-corporate level. Our findings provide a justification for the industry to invest their efforts in seeking and monitoring the performance of their lower-tier suppliers along some key performance dimensions. We provide direct evidence that seeking knowledge of and monitoring certain activities of lower-tier suppliers can result in better performance in SRM.

Keywords: *supplier relationships, lower-tier visibility, survey, lower-tier supplier management, supplier performance.*

1. Introduction

In today's business reality, what we now have are the continuous and rapid growths and transformations of regional/national supply networks to complex global supply systems (e.g., Lambert & Cooper, 2000; Pilbeam et al., 2012; Wilhelm et al., 2016). Companies are interconnected and interdependent on each other across regions and countries. For example, Ford Motor Company maintains over 50 plants worldwide, which annually utilize 35 billion parts to produce six million cars and trucks with up to 10 tiers of suppliers between itself and its raw materials (Simchi-Levi et al., 2015). What is happening in one company may have profound and domino impact on other companies along supply chains. In other words, supply chains, in reality, involve multiple tiers, beyond the dyadic structure in most papers (e.g., Lambert & Cooper, 2000; Pilbeam et al., 2012; Wilhelm et al., 2016).

The first-tier suppliers directly supply materials and services to the purchasing company while they also buy supplies from their own suppliers. These first-tier suppliers' suppliers are, to be specific, second-tier suppliers of the original

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purchasing company. Due to the obvious encompassing nature of supply chains, a supplier may impact others across multiple tiers (e.g., Simchi-Levi et al., 2015; Wilhelm et al., 2016). Recent incidents ranging from toys contaminated with lead paint and salmonella risk in peanut butter to sticking accelerator pedals in some cars indicate that consumers and firms are vulnerable to many quality and other risks that may occur in a global supply chain or in any of its multiple tiers (e.g., Simchi-Levi et al., 2015; Wilhelm et al., 2016).

Supplier relationship management (SRM) has received significant attention from both industry and academia (Lambert & Cooper, 2000; Humphreys et al., 2001; Day et al., 2007; Atkinson, 2009; Monczka et al., 2009; Lambert & Schwieterman, 2012). Companies can achieve various benefits from SRM including higher quality, lower costs, quicker delivery, improved forecasting, better collaboration, and win-win relationships with suppliers. Plentiful research on SRM with respect to supplier identification, supplier evaluation, supplier selection, supplier performance management, information sharing, and collaboration can be found in Avery (2007), Day et al. (2008), Atkinson (2009), Monczka et al. (2009), Olorunniwo & Li (2010), and Lambert & Schwieterman (2012). However most of them are limited to the first-tier suppliers.

Briscoe et al. (2004) indicate that quality could be improved if the purchasing companies would know about the capabilities of their lower-tier suppliers. Christopher and Lee (2004) point out that the "end-to-end" visibility is one of the key components to enhancing supply chain confidence, thus mitigating the risks. Lambert & Schwieterman (2012) also show eight macro business processes across multiple tiers. Jolayemi et al. (2013) develop a composite process for establishing and for effectively and continuously maintaining end-to-end visibility in multiple multi-tier supplier network (MMTSN) systems. They reason that end-to-end multi-tier supplier visibility has to be established and continuously maintained before supply chain integration, collaboration, and risk reduction/elimination. Carter et al. (2015) theorize that a supply chain is bounded by the visible horizon of the focal company, subject to attenuation, where distance is based on factors including physical distance, cultural distance, and closeness centrality.

A recent empirical research conducted by Olorunniwo et al. (2014) reveal six approaches to engender lower-tier supplier visibility. These are lower-tier supplier certification, dual function, strict contract with lower-tier supplier, multiple function oversight, empowerment with tightened control, and deep-down multi-tier probing and intra supplier collaboration (Olorunniwo et al., 2013). Olorunniwo et al. (2015) further investigate how lower-tier visibility impacts supplier selection with respect to four types of suppliers: strategic, custom, collaborative, and commodity.

But, whether and how lower-tier supplier management (LTSM) can lead to better SRM performances is still largely unclear.

For SRM performance, traditionally, companies evaluate suppliers on three major criteria: cost or price, quality, and delivery (Hirakubo & Kublin, 1998; Howard, 1998; Simpson et al., 2002; Monczka et al., 2009, p. 248). Others extend

the criteria to include continuous improvement and channel relationship (Simpson et al., 2002).

After investigating 19 categories of supplier evaluation criteria, Simpson et al. (2002) find that the most popular one is quality and process control followed by continuous improvement, facility, environment, customer relationship and communication, and delivery. Monczka et al. (2009) argue that for critical items, a purchaser needs to consider more evaluation criteria like management capability, employee capabilities, process and technological capability, total quality management, cost structure, financial stability, production scheduling and control systems, e-commerce capability, environmental regulation compliance, supplier's sourcing, and longer-term relationship potential.

More recently, supply chain management (SCM) literature started paying increasing attention to information sharing, collaboration, and integration (Humphreys et al., 2001; Olorunniwo & Li, 2010; Danese & Romano, 2011; Lambert & Schwieterman, 2012). Humphreys et al. (2001) find that the buyer-supplier relationship is moving away from adversarial, arm's-length approach towards a more collaborative one. Olorunniwo & Li (2010) show the value of information sharing and collaboration in reverse logistics. Danese & Romano (2011) investigate simultaneous implementation of customer and supplier integration. Lambert & Schwieterman (2012) identify eight macro business processes and provide a framework for implementing a cross-functional and cross firm SRM process in business-to-business relationships.

Combining these findings from the literature together, we summarize three levels of performance criteria:

i. An immediate level of the product/service, which includes mainly cost, quality, delivery, and service. These criteria assess purchasing attributes directly.
ii. An aggregate level of the corporate metrics, which covers technical capability and summative metrics, including sourcing management, employee competence, business process, financial strength, and market performance.
iii. The level pertaining to relationships that transcend or crosses the company's boundary. These include relationship with and collaboration between the purchaser and the supplier.

From our literature review outlined above it can be clearly seen that more research works need be done in the area of multi-tier SRM. Multi-tier SRM has not been well investigated or well-studied or developed.

In this research, we will examine whether and how emphasizing and enhancing LTSM can lead to a better SRM performance.

2. Development of Research Hypotheses

Work done by Jolayemi et al. (2013) and Fan et al. (2013) suggest that companies that make attempts at engendering lower-tier supplier visibility are most likely to share information (in a two-way traffic) across supplier tiers. Such companies are also likely to encourage collaborative planning, forecasting, and replenishment (CPFR) across supplier tiers. These activities seem to go beyond just 'seeing' or 'gaining visibility', in a trivial or literal interpretation of those terms. Those activities involve some planning, organizing, and monitoring. Henceforth, we refer to these activities as 'management'. Therefore, we use the term LTSM rather than lower-tier supplier visibility.

Companies that emphasize LTSM are likely more disposed to strive to maximize the relationship value, improve and ensure quality and continuity, and minimize costs and risks across a multi-tier supply chain. This disposition may translate to placing higher requirements that their suppliers do the same, resulting in differentially more rigorous requirements on the selection criteria in the traditional areas of price, quality, delivery, and service. This leads to our first hypothesis:

Hypothesis 1.
Companies that emphasize LTSM are likely to have more rigorous supplier selection process than those companies that do not value LTSM.

Companies may suffer tremendously, due to the lack of LTSM. A famous example is the Boeing 787 grounding in 2013 due to flawed battery made by lower-tier suppliers and the lack of oversight from Boeing (Gates, 2013). Other infamous examples include garment-factory buildings collapses and fires in Bangladesh, which are considered as the deadliest accidental structural failure in modern human history (e.g., Wieland & Handfield, 2013). Although these factories are just lower-tier suppliers of some leading fashion and retail companies, these brands still suffer highly damaged publicity.

So, world-class companies must strive to maximize SRM performances at all three levels: the immediate level of purchasing attributes, the whole corporate level, and the inter-corporate level. Traditionally, SRM focuses on the immediate level of purchasing attributes: first on traditional three major criteria: cost, quality, and delivery (Hirakubo & Kublin, 1998; Howard, 1998) and then extend its focus to include continuous improvement, facility, environment, customer relationship, and communication (e.g., Simpson et al., 2002). As SCM rises to a more dominant level in a company (Lambert & Cooper, 2000; Monczka et al., 2009; Pilbeam et al., 2012), more and more top executives become aware of SCM and advance SRM capability to the corporate level. Now the trend is to develop SRM further to the inter-corporate level and to multiple tiers.

Tse & Tan (2011) opine that supply chain problems are exacerbated with a low 'visibility' of hidden quality risks in a multi-tier global supply chain network.

They also add that the threat of quality risks could be from raw materials, manufacturing processes, or logistics operations in any tier of the supply network. Because all supply chain partners need to work together in harmony for the same systematic goal, LSTM should be able to positively affect all above performance criteria. With this added accuracy, we conjecture that higher LTSM are positively related to all three levels of SRM performance.

Thus, we formulate our next three hypotheses below:

Hypothesis 2.
More rigorous supplier selection requirements from LTSM positively impact immediate-level SRM performance.

Hypothesis 3.
More rigorous supplier selection requirements from LTSM positively impact corporate-level SRM performance.

Hypothesis 4.
More rigorous supplier selection requirements from LTSM positively impact inter-corporate-level SRM performance.

Our proposed research model is thus illustrated in Figure 1. Companies with more LTSM are likely to have more rigorous supplier selection, which in turn positively impact SRM performance.

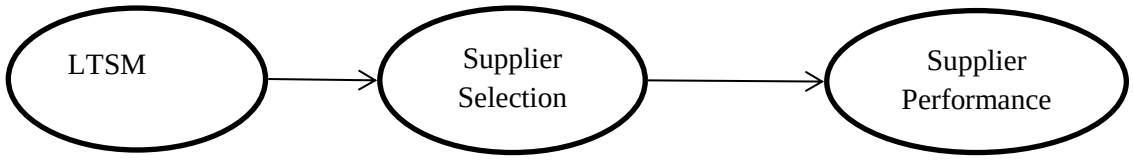

Figure 1. The research model

3. Methodology

The research presented in this paper is one portion of our broad work covering lower-tier SRM. Hence, some of the elements of the methodology presented here are similar or the same with those in Fan et al. (2013), Jolayemi et al. (2013), Olorunniwo et al (2013), Li et al. (2014), and Olorunniwo et al. (2015). Our broad work has two phases. First, we contacted and interviewed nineteen senior SRM managers or executives from fifteen companies. The nineteen executives interviewed had oversights of part or all of the supply chain function and were from fifteen fortune 100-500 companies in different industry sectors in the United States: automobile, computer, media, software, healthcare, aerospace, retail, and electronic

industries. These companies were leaders in their own industrial sectors. Many were considered world-class supply chain management companies. Therefore, our interviewed companies are exemplary firms whose practices should be benchmarked. One of the interviews was conducted face-to-face. The others were through telephone conferencing. Each interview lasted about one hour: the first half hour covers traditional SRM issues. The second part was on lower-tier supplier management. With the interviewees' permissions, the conversations were recorded on tape, and were later transcribed verbatim.

Second, our research team designed a questionnaire to survey organizations on supplier performances with respect to the different LTSM practices they use for enhancing lower-tier supplier management and engendering lower-tier supplier visibilit. Several of the purchasing executives participated in the survey pretest process. This pretest and our interviews along with our comprehensive literature review ensured the content validity of our survey instrument.

Survey data were collected through various sources and media. Respondents could answer the questionnaire through either an email attachment or an online survey. We also contacted 30 purchasing executives at various professional conferences and meetings, and received 23 responses. Additionally, we compiled our own list of 548 purchasing executives from public information available online and received 51 responses after two rounds of reminders. Overall, we collected 74 usably answered questionnaires. Our response rate is 12.8%, which is in the range of typical rates of 10-20% in surveys in recent years (e.g., Melnyk et al., 2012; Terjesen et al., 2012).

SPSS 18 and Smart PLS 3.0 (Peng & Lai, 2012; Ringle et al., 2014) were used to analyze the data and test the models. Considering our small sample size, partial least squares (PLS) has a better capability than covariance-based structural equation modeling. (We will explain later why our sample size is enough for our conceptual model in Figure 2.) Another reason is that theories in LTSM are not well-established. We used PLS to assess the measurement and structural models. The bootstrapping procedure with n = 5000 was used to examine the significance of factor loadings and path coefficients (e.g., Peng & Lai, 2012, Hair et al., 2014a, 2014 b).

We developed sound survey measurement with good validity results. Our survey content validity and the construct validity were established by grounding our measures in existing literature and our interviews with industry experts (Cronbach & Meehl, 1955; Churchill, 1979). More specifically, our findings from the focus group of executives in fifteen fortune 100-500 companies and from the pretest process confirm our literature review results. Using slightly different names on supplier performance criteria, these companies have three levels of evaluations: an immediate level of the product/service mainly including cost, quality, delivery, and service, an aggregate level of the corporate metrics, and an inter-corporate level of relationship and collaboration between the company and the supplier. This consistency indicates satisfactory content and construct validity. We also use factor loadings and

correlation matrix to test the criterion-related validity (convergent validity and discriminant validity) and use composite reliabilities for reliability.

We tested differences between early and late responses to assess nonresponse bias (Krause et al., 2000). All responses were divided into two groups: an early group of first 37 responses and a late group of the last 37 respondents. *t-tests* showed no significant differences between these two groups.

4. Data Analysis and Results

For completeness of our results, we first show the demographic information from our survey regarding company size and type of industry. In Table 1, we can find that more than 50% companies have more than 10,000 employees and about 55% are in Fortune 1 -- 500.

Table 1. Company information

Company size	Response (%)	Fortune Ranking	Responses (%)
Less than 500	28.8	1--100	31.4
500--9999	17.8	101--500	24.3
10000 and more	53.4	Over 500	44.3

Table 2 shows the details for industry distribution. About one third (33%) are in manufacturing, followed in order by professional, scientific, and technical services with 14.86%; finance and insurance with 6.76%; and health care and social assistance with 6.76%. NAICS codes are those assigned industry numbers by the North American Industry Classification System, the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.

Table 2. Industry classification

2012 NAICS Codes	Company Industry	Response (%)
11	Agriculture, Forestry, Fishing and Hunting	1.35
21	Mining, Quarrying, and Oil and Gas Extraction	1.35
22	Utilities	4.05
23	Constructions	5.41
31--33	Manufacturing	33.78
48--49	Transportation and Warehousing	2.70
51	Information	4.05
52	Finance and Insurance	6.76
53	Real Estate and Rental and Leasing	1.35
54	Professional, Scientific, and Technical Services	14.86
55	Management of Companies and Enterprises	1.35
62	Health Care and Social Assistance	6.76
71	Arts, Entertainment, and Recreation	2.70
	Other	13.51

4.1. Measurement Model

We constructed a second-order model in two stages (e.g., Wetzels et al., 2009; Hair et al., 2014a). See all items and scales in the appendix. Our conceptual framework is detailed in Figure 2, while the repeated indicator approach was used to obtain the latent variable scores.

The often-cited 10 times rule of thumb states that the minimum sample size should be 10 times the maximum number of arrowheads pointing at a latent variable anywhere in the PLS model (Barclay et al., 1995; Hair et al., 2014a). In Figure 2, the maximum number of arrowheads is 5, so the minimum sample size is 50. Our sample size 74 satisfies this rule of thumb.

Researchers frequently observe weaker outer loadings in social science studies (Hulland, 1999; Hair et al., 2014a). We dropped the weak items by following the recommendations from literature (e.g., Hair et al., 2011; Hair et al. 2014a, 2014b). We always dropped the items with outer loadings lower than 0.40 and those with outer loadings between 0.40 and 0.70 if dropping them results an increase in the composite reliability and the average variance extracted (AVE). We dropped 6 items out of 38 items.

As shown in Table 3, all factoring loadings are significant at the 0.001 level, evidenced by high *t*-values, which indicates acceptable convergent validity at the item level. All Average variances extracted (AVE) are greater than 0.5, indicating acceptable convergent validity at the construct level. All composite reliabilities are greater than 0.8, suggesting acceptable reliability (Fornell and Larcker, 1981). As shown in Table 4, the square root of AVE of the focal construct is greater than the correlation between the focal construct and other constructs, indicating acceptable discriminant validity (Fornell & Larcker, 1981; Bagozzi et al., 1991). The correlations of inter-constructs are relatively low (<0.9), indicating no undue common method bias existing in the data. Variance inflation factor (VIF) was also calculated to check the collinearity by following the procedure suggested by Hair et al. (2014a). VIFs are less than 5 (see Table 5), which demonstrates that no collinearity exists (Hair et al., 2014a). Therefore, the measurement model is acceptable and the data were then used to test the structural model as follows.

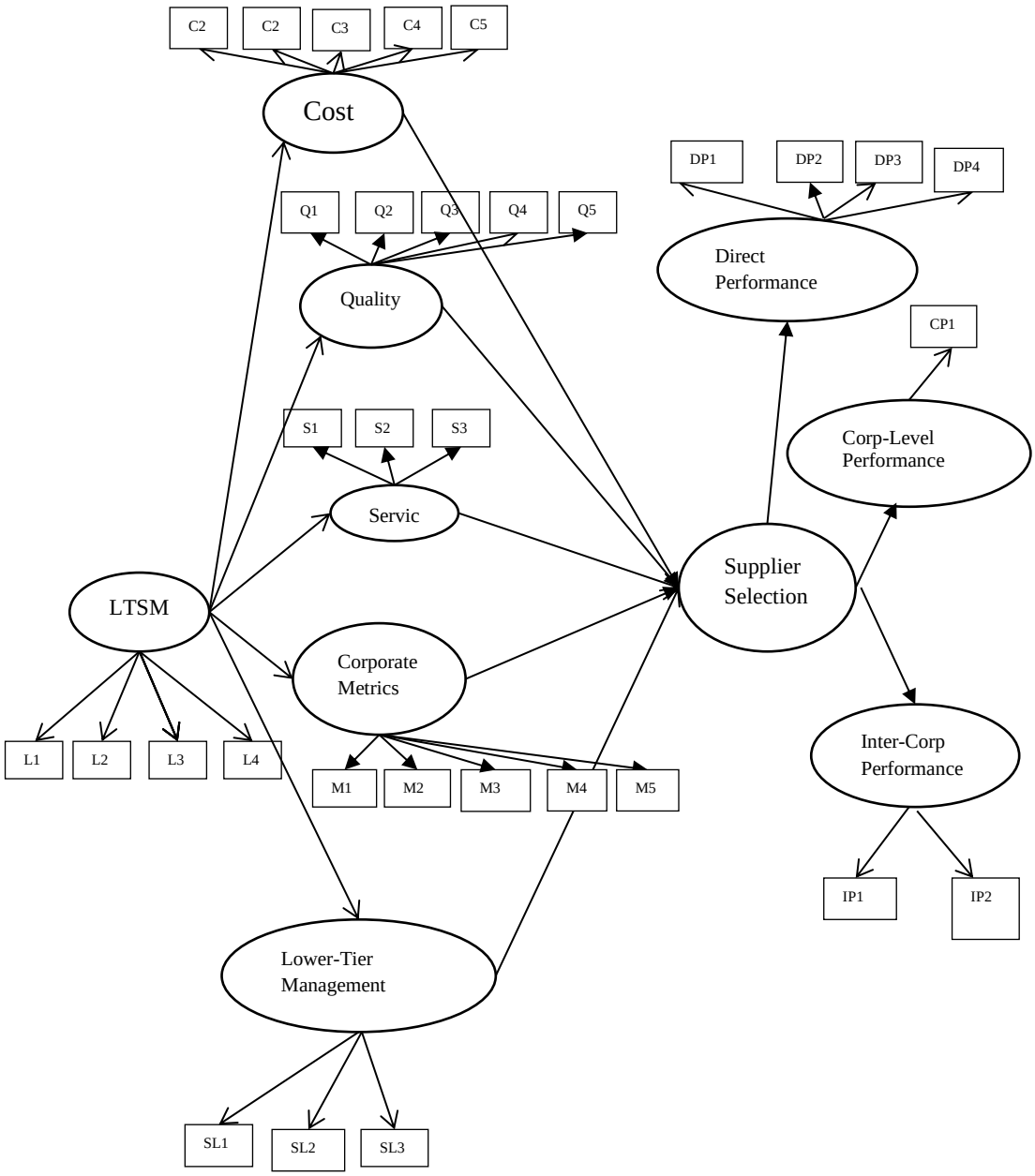

Figure 2. Conceptual framework

Table 3. The measurement model for first-order constructs

Item	Loading	*t*-value	Composite Reliability	AVE
LTSM				
Engendering lower-tier supplier visibility (L1)	0.858	21.148		
Enhancing lower-tier supplier performance (L2)	0.889	30.115	0.897	0.685
Information-sharing across supplier tiers (L3)	0.800	13.082		
Collaborative planning, forecasting, and replenishment (CPFR) across supplier tiers (L4)	0.759	10.643		
Cost				
Transportation/shipment cost (C1)	0.705	4.136		
Ordering cost (C2)	0.673	3.156	0.845	0.527
Negotiation/contracting cost (C3)	0.577	3.664		
Cost reduction plan (C4)	0.822	13.276		
Total cost of ownership (TCO) (C5)	0.821	10.476		
Quality				
Total quality management processes and practice (Q1)	0.853	25.887		
Defects/ scraps/ nonconformance (Q2)	0.836	18.071		
Six sigma quality (Q3)	0.669	5.188		
Process capability efforts (Q4)	0.900	37.131		
Product conformity (function, reliability) (Q5)	0.651	6.826	0.890	0.621
Service				
Responsiveness to complaint/change (S1)	0.721	9.046		
Provision of training (S2)	0.763	6.388		
Perceived cooperativeness (S3)	0.699	7.042	0.772	0.530
Corporate Metrics				
Management and employee competence (M1)	0.820	7.392		
Leadership/business process and practices (M2)	0.808	6.824		
Financial strength/stability (M3)	0.702	4.813		
Market performance (M4)	0.765	5.773		
Future business plans (M5)	0.739	8.094	0.878	0.590
Supplier's lower-tier management				
Supplier's relationship with its lower tiers (SL1)	0.852	21.707		
Supplier's lower-tier risks (SL2)	0.903	30.828		
Supplier's lower-tier performance (SL3)	0.796	8.614	0.887	0.725
Supplier direct performance				
Cost (DP1)	0.831	6.586		
Quality (DP2)	0.923	8.803		
Delivery (DP3)	0.953	9.127		
Service (DP4)	0.844	6.397	0.938	0.791
Supplier corporate-level performance				
Corporate metrics (CP1)	1.000		1.000	1.000
Supplier inter-corporate-level performance				
Information sharing (IP1)	0.962	16.352		
Collaboration (IP2)	0.924	8.496	0.942	0.890

Table 4. Correlation of constructs

Item	LTSM	Cost	Quality	Service	Corporate metrics	Lower Tier Management	Supplier selection
LTSM	0.828†						
Cost	0.459	0.726†					
Quality	0.620	0.468	0.788†				
Service	0.312	0.333	0.420	0.728†			
Corporate metrics	0.376	0.189	0.372	0.501	0.768†		
Lower Tier Management	0.577	0.159	0.530	0.449	0.548	0.851†	
Supplier selection	0.661	0.565	0.819	0.690	0.746	0.751	Formative

†Square root of the AVE on the diagonal.
Supplier selection is formative.

Table 5. Variance inflation factor (VIF)

Item	Supplier selection
Cost	1.362
Quality	1.789
Service	1.550
Corporate metrics	1.620
Lower Tier Management	1.820

4.2. Structural Model

We conducted bootstrapping to obtain *t*-values and the corresponding significance levels. The results are shown in Figure 3, including *t*-values, path coefficients, and adjusted *R*-squared values. Falk & Miller (1992) suggest a threshold of 10% for explained variance (i.e., R^2). Lower-tier suppliers should have less impact on the organization than the first-tier suppliers, thus our model demonstrates an acceptable predictability (Chin, 1998). On this basis, each individual path was examined to test our hypotheses, as follows:

Hypothesis 1.
Companies that emphasize LTSM are likely to have more rigorous supplier selection than those companies that do not value LTSM.

We assume that firms that consider LTSM more important would probably have included such activities in their SRM practice. As such, those firms are likely to place more rigorous requirements on supplier selection. All path coefficients are positive and p values are less than 0.01, indicating that higher LTSM causes higher level supplier selection. So, Hypothesis 1 is confirmed.

Hypotheses: Enhancin/emphasizing LTSM and SRM performance
One goal is to explore whether companies that consider engendering LTSM important would tend to improve their performance, in contrast to the expectations by the firms that do not value LTSM as important.

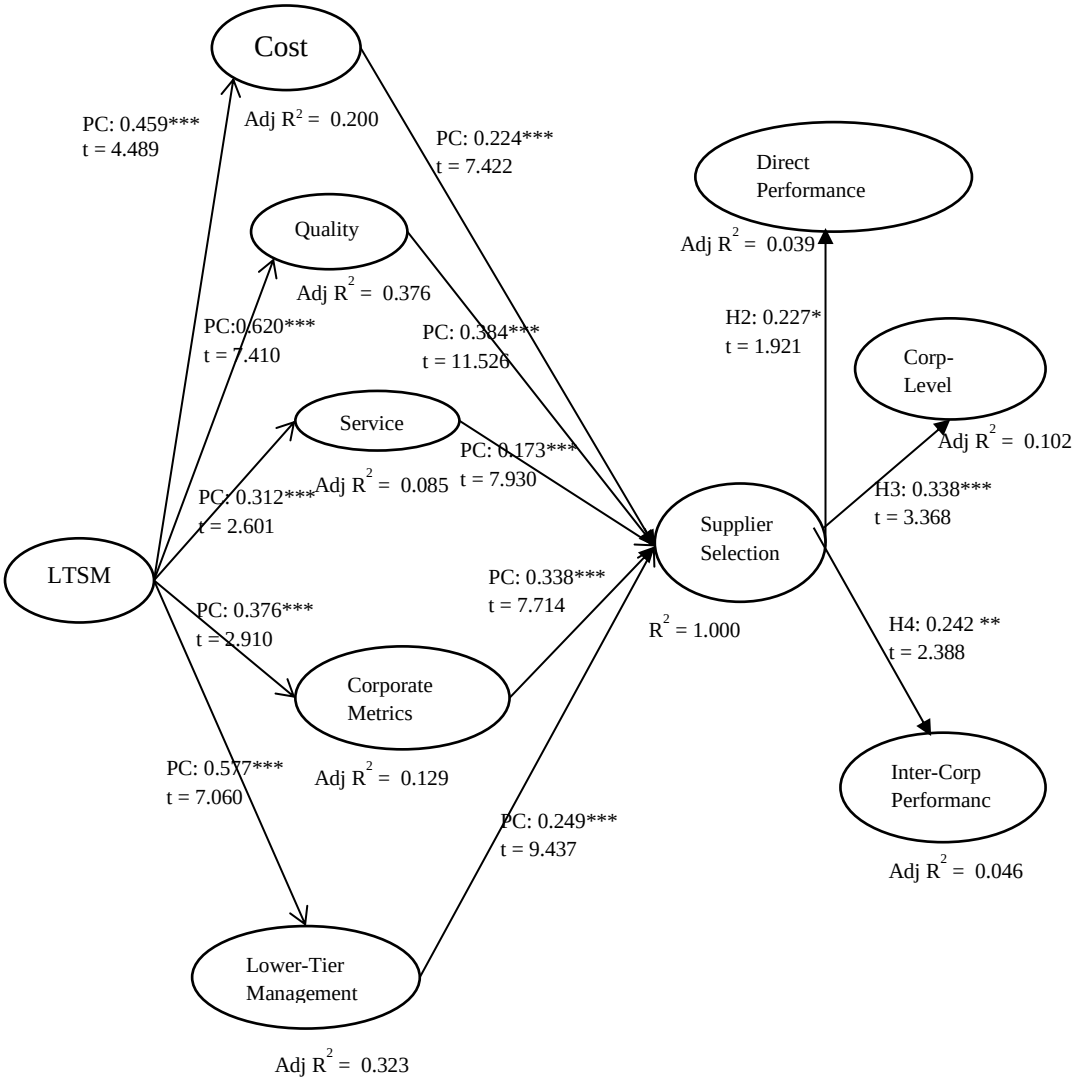

Figure 3. The structural model

*p < 0.001; **p < 0.05; *p < 0.10; ns: not significant at 0.10 level; PC = Path Coefficient*

Hypothesis 2.
More rigorous supplier selection requirements from LTSM positively impact immediate-level SRM performance.

The path coefficient is 0.227 and p-value is 0.055. The immediate-level SRM performance is positively impacted by LTSM, but only significant at 0.10 level.

Hypothesis 3.
More rigorous supplier selection requirements from LTSM positively impacts corporate-level SRM performance.

The path coefficient is 0.338 and p-value is 0.001, indicating that LTSM mostly affects corporate level performance.

Hypothesis 4.
More rigorous supplier selection requirements from LTSM positively impact inter-corporate-level SRM performance.

The path coefficient is 0.242 and p-value is 0.017. The inter-corporate-level SRM performance is positively impacted by LTSM, and significant at 0.05 level.

5. Conclusion and Discussion

The paper studies how LTSM impacts SRM performance. In summary, among three levels of supplier performance, LTSM has the most impact on corporate level SRM performance. This is likely driven by the management at the corporate level by corporate metrics, sourcing management, and technical/production capability. This finding reaffirms our intuitive comprehension of LTSM. In other words, LTSM relies heavily on corporate metrics such as management capability, employee capabilities, process and technological capability, total quality management, financial stability, production scheduling and control systems, e-commerce capability, minority supplier development, and supplier sourcing. LTSM will not happen if a company only cares about direct purchasing. Luckily, more and more top management teams are moving away from treating purchasing as a clerical function to unveil substantial strategic value from procurement and SRM (e.g., Humphreys et al., 2001; Lambert & Schwieterman, 2012). So LTSM has a special role in improving SRM performances.

Performance impact of LTSM at the inter-corporate level for information sharing and collaboration is also positive. This finding matches the rationale that LTSM is the basis for any information sharing and collaboration with lower-tier suppliers. It also calls for more information sharing and collaboration with lower-tier suppliers to unveil more strategic value and to achieve more win-win solutions, as it is already happening in industry with first-tier suppliers (e.g., Humphreys et al., 2001; Lambert & Schwieterman, 2012).

LTSM is least linked to the direct purchasing attributes. LTSM by definition is beyond the direct purchasing attributes, so it is not surprising that LTSM is least linked to direct purchasing attributes among three levels. Nonetheless, LTSM still positively and significantly impacts the immediate-level SRM performance at 0.10 level. Overall, LTSM brings positive benefits to all three levels.

Due to the big investment required for the enhancement and increment of emphases on LTSM, companies may be reluctant to embark on such activities. Our

research provides a good for enhancing and emphasizing LTSM because it can lead to better SRM performances at all levels. In fact, our research calls for LTSM, more information sharing, and more collaboration with lower-tier suppliers to unveil more strategic value and to achieve more win-win solutions, as happening already in industry with first-tier suppliers. The developing effective models or processes for doing or achieving these are excellent topic for future research.

The major limitation of this study is the limited sample size: only 74 respondents. In other words, our data show a snapshot of 74 respondents that are widely distributed among a large number of industries. On the positive side, this makes the finding more generic and widely applicable. On the other hand, it weakens the findings due to the small sample size and a very limited representation of each industry. The reason for the small sample size is largely due to its goal to cover non-traditional areas of SRM: lower-tier supplier visibility and management. Also, we do not have data to compare LTSM with higher-tier supplier management, which remains an interesting future research topic.

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Appendix

Items and Scales (1 = least important; 5 = most important)

I. LTSM

1. How important is each of the following LTSM activities in your company?
   Engendering lower-tier supplier visibility (L1)
   Enhancing lower-tier supplier performance (L2)
   Information-sharing across supplier tiers (L3)
   Collaborative planning, forecasting, and replenishment (CPFR) across supplier tiers (L4)

II. Supplier selection

1. COST: What degree of importance do you attach to the following cost elements in selecting your suppliers?
   Transportation/shipment cost (C1)
   Ordering cost (C2)
   Negotiation/contracting cost (C3)
   Cost reduction plan (C4)
   Total cost of ownership (TCO) (C5)

2. **QUALITY**: How important is it that your suppliers have the following quality assurance processes?
   Total quality management processes and practice (Q1)
   Defects/ scraps/ nonconformance (Q2)
   Six sigma quality (Q3)
   Process capability efforts (Q4)
   Product conformity (function, reliability) (Q5)

3. DELIVERY: Regarding supplier selection, how important are the following elements?
   Lead time (Dropped)
   Arrival early/tardy (Dropped)
   Quantity correctness/shipment quotation errors (Dropped)
   Flexibility (Dropped)

4. SERVICE: Of what degree of importance are the following service elements in your supplier selection?
   Responsiveness to inquiry (Dropped)
   Responsiveness to complaint/change (S1)
   Management of warranty, maintenance and repair (Dropped)
   Provision of training (S2)
   Perceived cooperativeness (S3)

5. CORPORATE METRICS: In selecting your suppliers, how important is it that a supplier has some strength as measured by the following corporate metrics/dimensions?

Management and employee competence (M1)
Leadership/business process and practices (M2)
Financial strength/stability (M3)
Market performance (M4)
Future business plans (M5)

6. **SUPPLIER'S LOWER-TIER MONITORING**: How important is each of the following in selecting your suppliers?
Supplier's relationship with its lower tiers (SL1)
Supplier's lower-tier risks (SL2)
Supplier's lower-tier performance (SL3)

III. Performance

1. Your SRM has experienced improvement or deterioration on each of the following suppliers' performance? (1 = Significant deterioration; 5 = Significant improvement)
    1.1. Direct Performance
    Cost (DP1)
    Quality (DP2)
    Delivery (DP3)
    Service (DP4)
    1.2. Corporate-Level Performance
    Corporate metrics (CP1)
    1.3. Inter-Corporate-Level Performance
    Information sharing (IP1)
    Collaboration (IP2)