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Zhang, Weiyong and Xu, Xiaobo, "Does process improvement lead to supplier performance? An empirical examination" (2016).
PACIS 2016 Proceedings. 45.

<http://aisel.aisnet.org/pacis2016/45>

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Does process improvement lead to supplier performance? An empirical examination

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Abstract

This research develops a causal-predictive model for predicting the supplier performance due to buyer-initiated supplier process improvement (SPI). SPI is one type of supply chain collaboration that focuses on process improvement. It is a common practice in supply chains that are driven by a powerful buyer firm. Drawing upon the supply chain management and process improvement literature, we relate SPI to supplier performance via a supplier's internal process improvement effort. SPI is operationalized as an index with formative indicators, which is appropriate for prediction studies. The model is then evaluated using the partial least squares structural equation modeling method, with empirical data collected from 53 supplier plants of a Fortune 500 firm. The results strongly supported the proposed causal-predictive model. Insights from this study can shed light on further theoretical development on supply chain process improvement, as well as can provide guidance for practicing managers.

Keywords: *Supply chain process improvement; supplier process improvement; survey methods; partial least squares; formative indicators*

1. INTRODUCTION

The benefits of well-known process improvement programs such as total quality management (TQM) (Kaynak, 2003; Samson and Terziovski, 1999), lean (Shah and Ward, 2003; Womack et al., 1991), and Six Sigma (Linderman et al., 2006; Linderman et al., 2003; Schroeder et al., 2008; Shafer and Moeller, 2012; Zhang et al., 2011) include fewer defects, reduced cost, improved customer service, increased sales revenue, and enhanced competitiveness (Hammer and Stanton, 1999; Silver, 2004). Many firms have extended these programs to find significant opportunities for improvement with their supply chain partners. Therefore, supply chain process improvement is an important research topic.

Buyer-initiated supplier process improvement (SPI) is a common type of supply chain process improvement. Supply chain process improvement can be initiated individually by one supply chain player or collectively by several players (e.g., an industrial association). In practice, the former is more common and usually takes the form of a focal firm extending its process improvement program to its suppliers and/or customers (e.g., Boeing's "Partnering for Success" program with its suppliers (Boeing, 2012)). According to Kopczak and Johnson (2003), supply chain improvement efforts initiated by a focal company often move faster than efforts initiated by industrial associations.

This paper focuses on the SPI effort initiated by a focal firm. The goal of this research is to operationalize SPI for a causal-predictive model that can be used to predict supplier performance. This paper is organized as follows. Section 2 reviews the relevant supply chain management and process improvement literature to define SPI as a theoretically meaningful concept and then develops a causal-predictive model linking SPI to supplier performance in the context of process improvement programs. Section 3 overviews the research design and reports on the context for the empirical research. Section 4 presents and discusses the results obtained through a partial-least squares analysis. Section 5 concludes with a discussion of the contributions of this research and future research directions.

2. THEORETICAL DEVELOPMENT

2.1 *Definition of SPI*

This research defines SPI as the effort initiated by a buyer firm to help its suppliers improve their processes and improve performance. Note that this definition is independent of any specific process improvement program (e.g., Six Sigma or lean) and independent of any specific process improvement practice (e.g., Gage R&R or supplier scorecards). Process improvement programs and practices vary widely across firms and this definition allows our research findings to be generalizable (Wacker, 2004).

SPI is also different from the concept of supplier development, which is defined as "any activity undertaken by a buying firm to improve either supplier performance, supplier capabilities, or both, and to meet the buying firm's short- and/or long-term supply needs" (Krause et al., 2000, p. 34). Supplier development activities include supplier evaluation, site visits, supplier certification, and education and training for supplier personnel (Krause and Ellram, 1997). Several studies have shown that supplier development practices lead to improved supplier performance (Krause et al., 1998; Krause et al., 2007; Modi and Mabert, 2007). SPI can be viewed as one type of supplier development activity, which focuses specifically on process improvement.

Finally, SPI is different from supplier integration (or purchasing integration), which is an important component of supply chain integration (Narasimhan and Das, 2001). Supplier integration emphasizes forging a mutual ongoing relationship with a supplier that entails trust, commitment, long-term contract, joint problem solving, and information and benefits sharing (Narasimhan and Kim, 2002; Vickery et al., 2003). Supplier integration can also mean engaging suppliers in new product development (Koufteros et al., 2007; Petersen et al., 2005). Again, the concept of supplier integration is much broader than SPI, which focuses specifically on process improvement collaboration.

Dimensions of SPI. Having defined SPI and differentiated it with similar concepts, we next identify dimensions of SPI: supplier inclusion, active support to suppliers, and production planning integration. The first dimension of SPI is supplier inclusion. It means a buyer firm includes suppliers in its process improvement programs. This is critically important because suppliers then have the opportunity to better understand the buyer's requirements (Flynn et al., 1994). Supplier inclusion symbolizes partnership with suppliers, which also implies a high level trust to suppliers. In short, supplier inclusion lays the foundation for cross organizational collaboration. Process improvement activities across the supply chain hence can be collaborative in nature, but not an extension of command-and-control outside of the buyer firm.

The second dimension of SPI is active support. In addition to including suppliers in process improvement, a buyer firm also needs to actively help suppliers improve their processes. In a buyer-firm driving supply chain, many times suppliers are smaller in scale than the buyer firm. Process improvement requires a substantial commitment of resources, of which many suppliers may be lacking. Without active support from the buyer firm, process improvement activities can easily become an extra burden to suppliers. Active support from the buyer firm hence is critical to the success implementation of process improvement across organizational boundaries. Even for those larger suppliers, the buyer firm's active support is still highly valuable because it helps direct resources to the most needed areas, hence increasing the rate of success with process improvement. The importance of active support is well-documented in the literature. Working closely with suppliers to solve process problems is advocated by quality management leaders such as Deming (1986). Helping suppliers improve their processes also transfers valuable knowledge from the buyer to the suppliers which leads to improved long-term performance (Modi and Mabert, 2007). Sharing responsibility for process improvement also increases the suppliers' trust in the buyer and strengthens buyer-supplier relationships, both of which are positively associated with performance improvement (Cousins and Menguc, 2006).

The third dimension of SPI is the inclusion of suppliers in the buyer firm's production planning. We note that this dimension is specific to manufacturing firms. In all manufacturing firms, the production planning process is the core process that drives other processes such as procurement, production, order fulfillment, and capacity management. When the buyer includes suppliers in its production planning process, the suppliers enjoy visibility of the buyer's demand forecasts, production plans, factory schedules, and capacity plans. This, in turn, enables the suppliers to understand and prioritize the buyer's process improvement needs.

SPI and supplier performance. The discussion and comparison above lead us to postulate that a higher level of SPI will lead to better supplier performance. At the minimum level, SPI serves as a type of customer feedback that helps suppliers gain a better understanding of customer requirements. Given that meeting customer requirements is an important part of performance improvement (Griffin and Hauser, 1993), it stands to reason that SPI should improve supplier performance. SPI can also help suppliers better select and prioritize their process improvement projects. This in turn can lead to better performance improvement (Zhang et al., 2008). SPI is characterized by strong mutual trust and good communication between the buyer and its suppliers. The positive impact of mutual trust and good communication on performance improvement is supported by the supply chain management literature (e.g., Paulraj et al., 2008; Wu and Katok, 2006). This leads us to hypothesis H1.

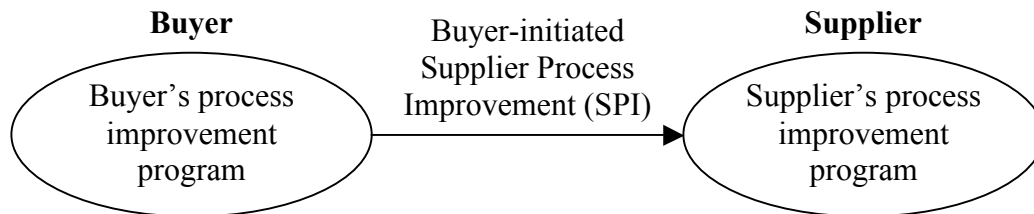
H1. SPI is positively associated with supplier performance.

2.2 Model development

A positive relationship between SPI and supplier performance, if confirmed, lays the foundation for this study. However, the question of how SPI can positively affect supplier performance has not been answered. After all, to a supplier, SPI is an external effort. The effect of an external effort has to go through the supplier's internal organizational processes. Next, we develop a model linking SPI to supplier performance through a supplier's internal process improvement effort.

Process improvement programs as the research context. We choose to develop the model in the context of process improvement programs. A process improvement program is “a systematic approach for improving organizational performance that consists of specific practices, tools, techniques, and terminology and is implemented as a set of process improvement projects” (Zhang et al., 2008, p. 40). Process improvement programs are pervasive in modern organizations. SPI is an extension of a buyer firm’s process improvement program into the supply chain, and it also serves as an input to the supplier’s process improvement program. SPI’s effect on supplier performance, if any, is channeled through the supplier’s process improvement program. Therefore, process improvement programs serve as the research context for this research (Figure 1).

Figure 1. The Research Context

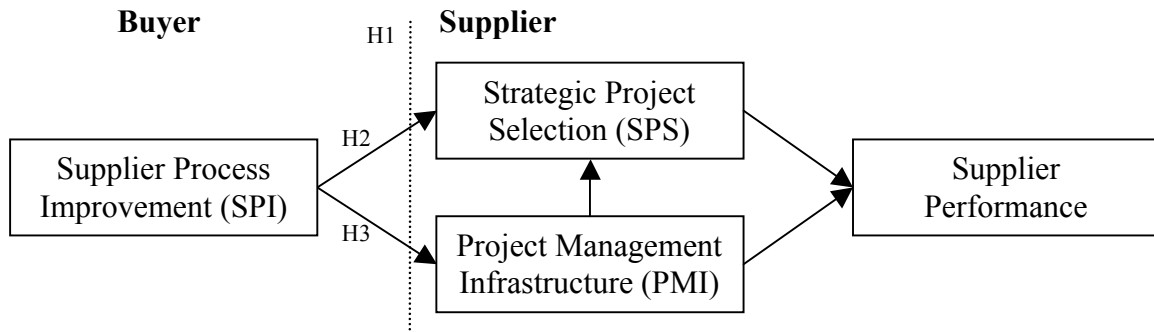


Program management research perspective. One major challenge in researching process improvement programs is their variety. As noted above, firms have adopted a number of different types of process improvement programs and have implemented them in different ways. In addition, these programs evolve and change names over time (e.g., Six Sigma versus Lean Sigma). Moreover, implementation approach can affect the effectiveness of process improvement programs (Laugen and Boer, 2007). Therefore, research on specific process improvement program practices will likely be challenged on the generalizability of the findings.

Zhang et al. (2008) identified two higher-level program management factors: strategic project selection (SPS) and project management infrastructure (PMI). SPS is an organization’s commitment to selecting process improvement projects based on the organization’s strategic objectives. PMI is an organization’s commitment to ensuring that process improvement projects follow a standard methodology and that project leaders are held accountable for results. Their study found that a strong PMI leads to a high level of SPS, and subsequently to better performance. Since PMI still has some direct effect on performance, the relationship is precisely described as SPS partially mediates the relationship between PMI and performance.

Developing a causal-predictive model. We propose a causal-predictive model that links SPI to supplier performance through the two program management factors (Figure 2). The essence of the model is that the effect of a buyer’s SPI on a supplier’s performance is mediated through the supplier’s program management activities, i.e., SPS and PMI. The model is called a causal-predictive model because of its causal nature. Yet only the model’s predictive relevance and validity is examined in the empirical study (Jöreskog and Wold, 1982). A causal-predictive study is theory-driven, consistent with the theory-driven convention of operations management research (Amundson, 1998).

Figure 2. The Proposed Causal-Predictive Model



We argue that a causal relationship exists between a buyer's SPI and a supplier's SPS. When a buyer initiates SPI, suppliers are engaged in joint process improvement with the buyer firm. Suppliers can gain visibility about the buyer's requirement. With a better understanding of the buyer's focus and priority, the supplier understandably can better select and prioritize its process improvement projects. This causal relationship is stated as hypothesis H2.

H2. A buyer's SPI effort will improve a supplier's strategic project selection (SPS).

We also argue that a similar causal relationship between the buyer's SPI and the supplier's PMI. When two firms work together on process improvement, they bring together different organizational cultures, terminologies, methodologies, and goals. It is difficult for process improvement effort to be effective if firms have to navigate through these differences. Conceivably, there is a strong motivation for the supplier to have not only a common language but also a common methodology in place. Meanwhile, the necessity for the supplier to have dedicated project leaders also increases. Without fully accountable personnel, it is hard to imagine a process improvement project can succeed, particularly when the project involves two organizations. In short, a buyer's SPI effort leads to a higher level of PMI in the supplier. We state this as hypothesis H3:

H3. A buyer's SPI effort will lead to a better project management infrastructure (PMI) in the supplier.

The right side of the model is constructed following Zhang et al. (2008). Both SPS and PMI are positively linked to supplier performance. Their study also found that PMI positively affects SPS. So a causal link from PMI to SPS is included in the model.

3. RESEARCH DESIGN

3.1 Empirical research setting

Partnering with a Fortune 500 high-technology electronics manufacturer firm, we carefully designed and executed a data collection plan. To protect the confidentiality of the firm, the firm's name is disguised as Hightech. Two separate surveys were conducted: (1) a Web-based supplier survey for independent variables (SPI, SPS, and PMI) and (2) a buyer survey for the dependent variable supplier performance, which is operationalized as the supplier operating performance (SOP) scale (Ahire et al., 1996). This design effectively reduces the potential for common rater bias. In order to increase methodological rigor and confidence of research findings, the supplier survey requested three respondents (a sales manager, a manufacturing manager, and a quality manager) from each plant. Finally, strong confidentiality was maintained during the survey. Only the research team has access to each individual supplier plants' responses.

All 130 direct materials supplier plants for Hightech were invited to complete the supplier survey. We used every effort to increase the response rate, including using a survey invitation from the Hightech

managers, promising to share summary results, assuring confidentiality, and following up with phone calls. For the dependent variable SOP, we administered an internal survey to the Hightech buyer group which was responsible for dealing with suppliers on a daily basis. This group had a good understanding of supplier performance. The response rate for this internal survey was 100%.

The final empirical data set was obtained by matching supplier plants from the two surveys, yielding a final data set with 104 valid individual responses from 53 plants. The majority of plants (56.6%) provided multiple responses, which were averaged to obtain a single observation. The response rate was 40.8% at the plant level and 26.7% at the individual level. Table 1 presents the characteristics of the sample. The final data set had only a few missing values, which were processed following Tsiriktsis (2005). No significant non-response bias was identified in a two-sample *t* test (responding plants versus non-responding plants) on the Number of Employees variable. The inter-rate reliability, measured by inter-class correlation, was greater than the suggested 0.6 for all constructs (Boyer and Verma, 2000).

TABLE 1. Sample Characteristics of the Research Data

Individual responses	Total individual responses	104
	Individuals from sales	37
	Individuals from manufacturing	34
	Individuals from quality	33
Plant responses	Total number of plants	53
	Number of plants with 4 responses	2
	Number of plants with 3 responses	17
	Number of plants with 2 responses	11
	Number of plants with 1 response	23
	Average number of employees	544

3.2 Partial least squares

The partial least squares (PLS) is a multivariate statistical technique that was initially invented by Wold (1981) as a regression technique for exploratory studies in the field of chemistry. Later it was developed into a model estimation technique for latent variable structural equation modeling (SEM). PLS-SEM is different than the more widely applied covariance-based SEM (CB-SEM) in that it evaluates one path at a time instead of the whole model simultaneously (Fornell and Bookstein, 1982a, b). The objective of the PLS-SEM algorithm is to maximize the variance that can be explained for endogenous variables. PLS-SEM provides R^2 value for each endogenous variable in the model, though it does not provide global model fit measures like CB-SEM does (Chin, 1995). Similar to CB-SEM, PLS-SEM provides item loadings, weights, and path coefficient estimates for model evaluation purposes (Hair et al., 2014).

We control the effect of plant size which is a factor that must be carefully considered in any study of supply chain process improvement. Large plants tend to have more resources available for process improvement, which might positively affect the performance outcome. The effect of plant size was controlled by the Number of Employees variable (EMP), which is commonly used in this type of empirical study (Daft, 2000). A large portion of the plants in this sample were of medium to large size, with an average size of 544 employees (Table I). As expected, the distribution of EMP was highly skewed, which led us to apply a natural log transformation before using the EMP variable in the analysis (Neter et al., 1996).

The measurement instrument for the independent variables included three scales: SPI, SPS, and PMI (Table 2). SPS and PMI used scaled from Zhang et al. (2008). The development of SPI as a new scale followed the standard process given by Flynn et al. (1994). The content validity of SPI was assured since the definition of SPI was grounded in the research literature as well as distinguished from several similar concepts. Based on the definition and dimensions of SPI, possible items were generated

(Churchill, 1979; Nunnally and Bernstein, 1994) and then refined through focus group meetings with research scholars and experienced practicing managers.

The use of formative indicators for SPI is appropriate in this study. First, a valid but simpler measurement scale for SPI can help reduce measurement model complexity, so that the empirical analysis can focus on the structural relationship side. With a simpler measurement model, we have more statistical power to examine the structural paths in a model (Hair et al., 2014). In this study, the SPI index has only three formative indicators yet it captures the complete theoretical meaning of the concept. Second, when the research objective is prediction, simpler measurement scale is preferred so that they can be easily applied in practice. In other words, a simpler measurement scale can better connect research with practices. Last, but probably the most important, using formative indicators for SPI is appropriate only because we have carefully surveyed the theoretical domain of SPI, and the indicators are generated based on such a complete understanding.

The dependent variable for this study is supplier operating performance (SOP). SOP is measured by the classic five dimensions: quality, cycle time, delivery, cost, and flexibility (Benson et al., 1995). We asked the Hightech buyers to evaluate supplier performance on all five performance dimensions using the reversed Ahire et al. (1996) scale. The original scale, anchored on the worst companies in the industry, was reversed because all of Hightech's suppliers were fairly good. Table II presents the complete measurement instrument used for this study.

4. RESULTS AND DISCUSSION

We used PLS-SEM to evaluate the proposed causal-predictive model. The analysis process is a two-step procedure: first assessing the measurement model and then the structural model (Hair et al., 2014). The empirical results reported below are obtained in VisualPLS.

4.1 Measurement model assessment

We first assessed the measurement model. A PLS-SEM model is composed of both the outer model (measurement model) and inner model (structural model). The measurement model includes both reflective constructs and a formative index. They will be assessed accordingly.

Reflective constructs: SPS, PMI, and SOP. SPS, PMI, and SOP are constructs that are operationalized with reflective indicators. Internal consistency reliability of a construct is assessed by the composite reliability (CR) instead of the more conservative Cronbach's alpha (Shah and Goldstein, 2006). A scale is considered reliable if the CR value is between 0.60 and 0.70 for exploratory studies, and higher than 0.7 for confirmatory studies (Nunnally and Bernstein, 1994). The CR values for SPS, PMI, and SOP (with the cost item excluded due to a low loading) are 0.809, 0.890, and 0.729, respectively (Table 2).

TABLE 2. The Measurement Instrument

Construct	CR	AVE	#	Item	N	Loading	Weight
Supplier Process Improvement (SPI)	---	65.8%	SPI1	Hightech has process improvement programs that include us.	47	0.811	0.442
			SPI2	Hightech helps us improve our processes.	49	0.877	0.436
			SPI3	Hightech includes us in their production planning activities.	49	0.740	0.388
Strategic Project Selection (SPS)	0.809	59.2%	SPS1	Process improvement projects are generated based on our strategy.	53	0.754	0.427
			SPS2	We prioritize new process improvement projects based on our strategy.	53	0.924	0.733
			SPS3	Process improvement project selection is driven by our customers' needs.	53	0.594	0.326
Project Management Infrastructure (PMI)	0.890	63.9%	PMI1	Our process improvement projects are led by full-time process improvement experts.	53	0.734	0.251
			PMI2	Our leadership holds process improvement project team leaders accountable for project results.	52	0.842	0.373
			PMI3	Our projects use a standard process improvement methodology and language.	53	0.890	0.308
			PMI4	Our projects have a charter that defines the metrics, goals, deliverables, scope, and timeline.	52	0.719	0.317
Supplier Operating Performance (SOP)	0.729	62.1%	SOP1	This supplier has the best internal first pass yield rate in the industry.	42	0.817	0.333
			SOP2	This supplier's throughput time is the best in the industry.	51	0.901	0.188
			SOP3	This supplier's delivery performance is the best in the industry.	53	0.723	0.478
			SOP4*	This supplier has the best unit cost in the industry.	53	---	---
			SOP5	This supplier has the best ability to quickly adjust production capacity in the industry.	52	0.693	0.392

* This item was excluded in the measurement model validation procedure.

Convergent validity is generally assessed by examining the item loadings on the construct as well as the average variance extracted (AVE). A high loading on the construct indicates good convergent validity. The suggested cut off value is that the standardized item loading should be 0.708 or higher, which indicates that the variance shared between the construct and its indicators would be at least 50% or higher. Items with loadings between 0.4 and 0.7 should be considered for elimination if this leads to an increase of the CR value to above 0.7 (Hair et al., 2014). Item loadings are presented in Table 2. All items loaded onto their respective constructs except the cost item for the SOP construct. One plausible explanation is that the cost is the price seen by Hightech buyers, and a supplier's price is affected by many competitive factors (Hendricks and Singhal, 2001a). As a result, the cost item was excluded from the SOP construct in further analysis. Table II also presents AVE for all the constructs. They all exceeded the desired 50% level.

Discriminant validity can be assessed by examining the cross loadings of the indicators. An indicator's loading on its construct should be greater than cross loadings, i.e., loadings on other constructs (Jöreskog, 1971). However, this criterion is generally considered conservative and it is recommended to use the Fornell and Larcker (1981) test instead. To pass the test, the AVE values should be greater than the squared correlation with other constructs, with the rationale being that a construct should share more variance with its indicators than with any other constructs (Hair et al., 2014). All constructs passed the Fornell and Larcker (1981) test.

Formative index: SPI. SPI is a new construct and it is operationalized as a formative index. Two approaches can be used for index validation. Since the sample size is not large in this research, we used the approach recommended by Arnett et al. (2003). Their procedure also requires a multiple indicator and multiple causes (MIMIC) model. A good measurement model needs to have a large R^2 value, loadings of the items at least greater than 0.7 (Chin, 1998), and a large Q^2 , a measure for predictive relevance (Arnett et al., 2003). Our proposed causal-predictive model is a MIMIC model and the measures exceed the threshold values. Therefore, the SPI index was considered a valid one.

4.2 Structural model assessment

Since the measurement model was judged to be adequate, we assessed the structural model. We followed the protocols to look at the path coefficients and R^2 values for all endogenous variable. They are labeled in Figure 3. As expected, all path coefficients are positive, indicating that these constructs are positively related to each other. This is in line with the research hypotheses. SPI has positive impact on SPS and PMI, and in turn positive impact on SOP. Then we examined the statistical significance of these path coefficients. Since PLS-SEM does not make data normality assumptions, traditional statistical procedures for confidence interval construction cannot be used. Instead, a bootstrapping procedure was performed to obtain the standard error of the path coefficient estimates. The bootstrapping procedure is a nonparametric resampling approach for standard error estimation. Results show that all path coefficients are significant. No path coefficient is extremely small when compared to each other, indicating that the proposed causal-predictive model does not have the issue of relevance of significant relationship (Hair et al., 2014).

The other important model evaluation measure is the R^2 values for each endogenous variable. They range from 25.1% to 40.9%. As methodologists have suggested, the level of acceptable R^2 value is research model and discipline dependent. In this research, the R^2 values are at least comparable, if not much larger than similar empirical studies in the field of operations management. Therefore, the model is judged to have moderate to strong predictive relevance and validity. Taken together, we concluded that all three research hypotheses are supported.

4.3 Discussion

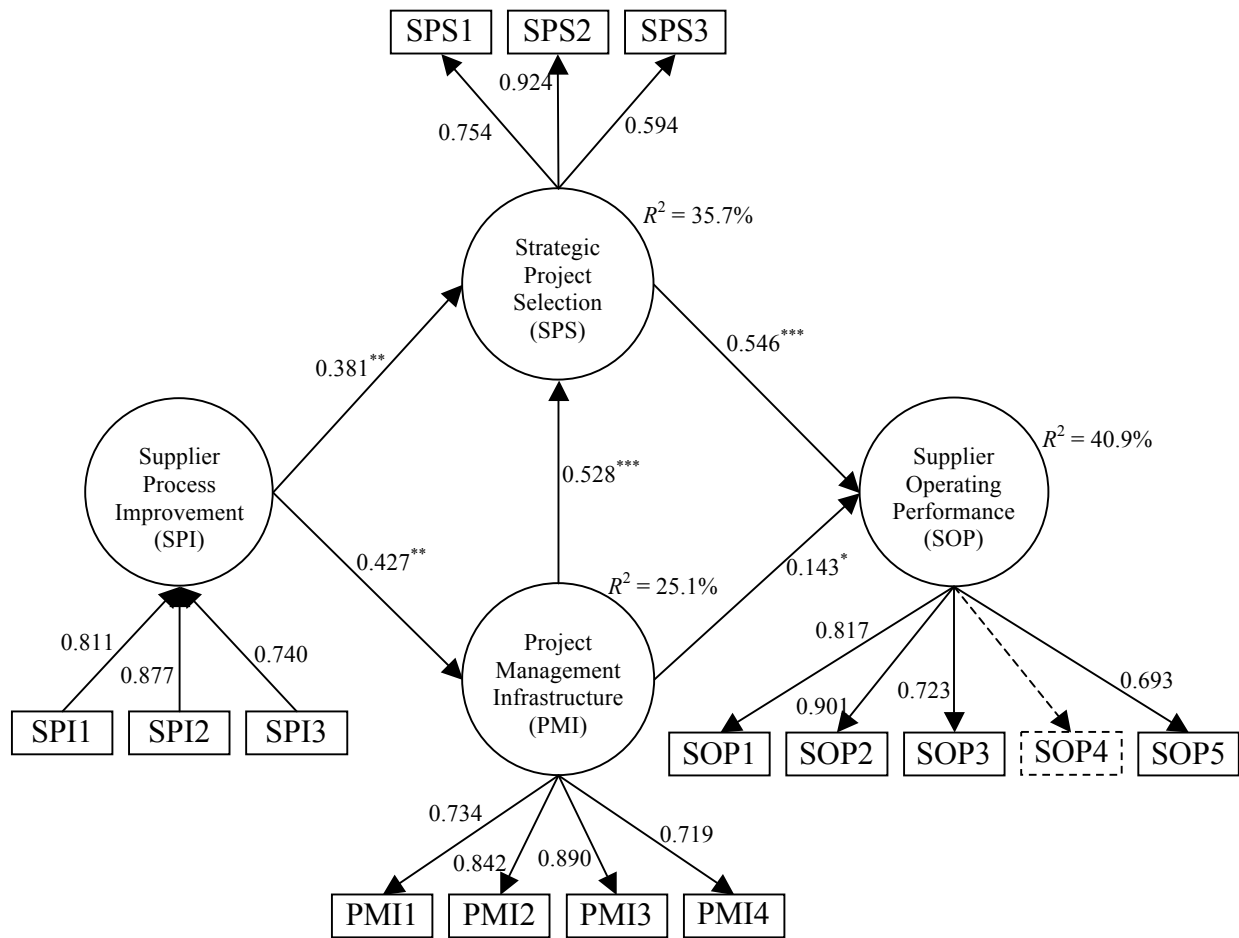
Empirical results show that the proposed causal-predictive model is a relevant and valid one. The measurement items are generated based on the literature, and they are reliable and empirically valid. All paths in the structural model are significant and the R^2 values for each endogenous construct are moderate to large. In short, a buyer firm's SPI positively affect suppliers' SPS and PMI, which in turn leads to better supplier operating performance.

Although the path from PMI to SOP is significant ($p < 0.10$), we note that the path coefficient is comparably smaller than others, and the level of significance is higher than others too. A prior study showed that SPS partially mediates the relationship between PMI and SOP (Zhang et al., 2008). What we can conclude from this result is that the effect from PMI to SOP is weak. One possible explanation to this result is that, when SPI is taken into the picture, SPS may have a stronger mediating effect, to the extent that there is not much direct effect from PMI to SOP. This may be both an interesting theoretical and empirical issue worth more exploration in future studies.

Another open question is whether the SOP indicators should be treated as formative instead of reflective. The traditional approach is to treat the indicators as reflective. However, it is a valid argument that these indicators are actually formative in nature. They are distinct dimensions of supplier operating performance. And a high level of performance in one dimension is not necessarily correlated with other dimensions. For example, a supplier may have good quality but cycle time could be long. Following this line of reasoning, the latent variable SOP should be an aggregation of five distinct dimensions (assuming that the five dimensions form the whole domain), but not a common factor among the five dimensions. In addition, issues such as an unloading cost item may vanish when SOP is a formative index. We suspect

that treating SOP as a formative index may lead to better model predictive power. Of course, all these must be based on a thorough understanding of the SOP measurement model. This is something future empirical research can look into.

Figure 3. Model Assessment Results



Dashed arrow: excluded measurement item.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5. CONCLUSIONS

The development of SPI as a new concept is therefore supported and contributes to the supply chain process improvement literature. Further, this study shows that a buyer's SPI effort can help its suppliers better manage their process improvement programs, leading to project management and project selection excellence. Eventually, better supplier performance is ensued. While this result should not be interpreted as a positive theory testing, it clearly shows that the proposed model is theoretically sound. This study furthers theory development by "pre-testing" a theoretical model on an important research subject.

This study also provides useful guidance for practicing managers. For buyer firm managers, this research shows that SPI is an important and effective way to improve supplier performance. Buyer firm managers can use SPI to predict the performance of their suppliers. The SPI index is simple and easy to use, which is an advantage to practicing managers. For supplier plant managers, this research shows that they can leverage SPI as an important resource for performance improvement. SPI may serve as a change

agent for suppliers (Hartley and Choi, 1996), so it makes sense for suppliers to actively approach the buyer to become involved in the buyer's process improvement activities.

Since empirical data for this research was collected from supplier plants for one common buyer firm, the findings may not be generalizable beyond the types of suppliers in the sample. A careful examination of the plants in the sample, however, revealed that a power asymmetry between Hightech and its suppliers should not be a serious concern. Another potential concern is related to the sample size. The sample size for this study ($N = 53$ plants) was large enough to find very interesting and statistically significant relationships, but a larger sample size would provide for more statistical power and also enable the use of covariance-based structural equation modeling (CB-SEM) for theoretical model testing.

This research can be extended in several directions. A large sample CB-SEM examination of the same or adapted model will likely confirm the model, hence making a significant contribution to the literature. The model may incorporate several possible adaptations. For example, an adapted model may include the often-touted synergistic effect, i.e., the notion of better return for supply chain players when they collaborate with each other. It is also a plausible idea to look beyond manufacturing settings, for example, to examine the relationship in a service supply chain setting.

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