A Strategic Formulation Model Based on Performance Measurement Scales of SCM

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Abstract: The performance measurement scales on logistics and supply chain management can be used not only for benchmarking but also for the strategic formulation. The measurement scales in different scorecards were summarized in four areas, i.e., Logistics Performance (LP), Planning/Execution Capabilities (PE), IT Methods and Implementation (IT), and Corporate Strategy and Inter-Organizational Alignment (SO). Six hypotheses on the relationships among these four areas were proposed. A survey with 177 samples was conducted in Chinese manufacturing and logistics industries to test the hypotheses. A proposed framework suggests that planning/execution capabilities in the strategic formulation should be separated from logistics performance and the operations on the corporate strategy and inter-organization alignment on supply chain should move earlier than the IT methods and implementation.

Key Words: Supply Chain, Strategy Formulation, Performance Measurement, Empirical Study

1. Introduction

In supply chain management (SCM), the performance measurement can help managers make the right decisions at the right times (Lee, 2002, Gunasekaran et al., 2004). The measurement scales on supply chain performance can be used by different partners in supply chain. For example, with the wide application of ODM (Original Design Manufacturer), the brand-owners need key performance index (KPI) to communicate with ODM and monitor the whole supply chain. In the Japanese “keiretsu” supply chain, the makers can remain lean and flexible while enjoying a level of control over supply chain with KPI (Schonberger, 2007), i.e. the relationship between Toyota and Denso (Yin et al., 2011). In addition, the KPI is also used by the distributors, i.e. Wal-Mart, Ikea, to assess their suppliers (Majumder and Srinivasan, 2006).

Throughout the 1980s and early 1990s, various performance measurement frameworks had been put forward, i.e., the Performance Measurement Matrix, the Performance Pyramid, the Results-determinants Framework, the Balanced Scorecard, etc (Shaw and Grant John Mangan, 2010). Various scorecards on logistics and supply chain have been proposed and widely applied, i.e., the global and local ECR scorecard (ECCC, 1998; LSDC, 1999), the QR score card (SMRJ, 2001), the millennium readiness profile (KSA, 1999), the SCOR Matrix (SCCJ, 2000), the Quick Scan (QuickScan Website). The performance measurement scales used in these scorecards can be categorized into four areas, i.e., Logistics Performance (LP), Corporate Strategy and Inter-organizational Alignment (Strategy/Organization: SO), Planning/Execution Capabilities (PE), and IT Methods and Implementation (IT) (Arashida et al., 2004). These categories have been completely or partly supported by several empirical studies in different countries, i.e., Japan, China, Thailand, and Finland (Suzuki et al., 2005; Yaibunath et al., 2007; Kauremaa and Suzuki, 2007). Furthermore, the performance measurement scales are necessary for the strategic implementation, organizational learning, decision making process (Micheli et al., 2011; Kaplan and Norton, 2008). However, the relationships among these measurement scales have been seldom examined. The purpose of this study is to examine the relationships among these measurement scales based on a wide survey, so as to give out suggestions on the strategic formulation of SCM.

The remainder of this paper is organized as follows. In the second section, the literatures of the four areas are reviewed. In the third section, the relationships among the four areas are analysed and six hypotheses are proposed. The fourth section describes the research methodology and data analysis. The fifth section discusses the analysis results. The conclusions are reported in the last section.

2. Literature Review

Performance measurement can help implement strategy, promote organizational learning, align behaviors, support decision-making processes, and so on (Micheli et al., 2011; Kaplan and Norton, 2008). For example, the balanced scorecards can promote the strategic alignment and the
communication within organizations, such as to link the organizational goal to departmental and individual objectives, and to help managers link the operational actions to the improvement of firm value (Kaplan and Norton, 1992, 2004). The measurement scales should be consistent with the strategic management style of the organization (Dye, 2004), and can also give suggestions on the strategic formulation, such as translating the strategic plan to actions effectively (Goold et al., 1993). It is necessary for operation managers to adjust the performance measurement to support the changes in strategy (Johnston and Pontagitchat, 2008). A survey in Spanish companies shows that the firms using the Strategic Performance Measurement Systems (SPMSs) and the firms not using SPMSs can present strategic agendas with different natures, i.e., the different number and the different variety of decisions taken in each strategy (re)formulation (Gimbert et al., 2010). Especially, the strategy (re)formulation processes can play the media role between SPMS and organizational performance when environmental dynamism is low (Bisbe and Malagueno, 2012).

Although the researches on the supply chain strategy have long emphasized the performance implications in the operations management literature, the strategic management field has not devoted much empirical attention to this research focus (Gonzalez-Loureiro et al., 2015; Hult et al., 2007). The actual functioning of performance measurement systems (PMS) in the organizational context needs to be further examined (Bisbe and Malagueno, 2012; Gimbert et al., 2010; Johnston and Pontagitchat, 2008). This study focuses on the measurement scales on SCM which have been categorized into four areas by Arashida et al. (2004), i.e. LP, PE, IT, and SO. Each area has been frequently studied, but the relationships among these areas and their relationships with the strategic formulation have been seldom discussed.

2.1 Logistics Performance (LP)

Logistics performance can be assessed with different competitive capabilities, i.e., quality, cost, delivery (QCD) (Shepherd and Gunter, 2006; Banomyong and Supatn, 2011). In detail, the measurement scales can include total logistics cost, inventory turnover, cash-to-cash cycle time, customer lead time, delivery quality, JIT (Just in Time) application for the elimination of idle time and setup time which is associated with the time and cost competitive capabilities (Kenneth et al., 2014), opportunity costs & supply chain inventory which is a necessary component in the inventory cost management (Sahin and Dallery, 2009). Besides of the QCD, some other capabilities have been also suggested in SCM, i.e., operational risk (Tzelzaar and Snijders, 2013), operational complexity (Perona and Miraglotta, 2004), ecology, etc. In this study, the logistics performance was defined as the external competitive performance on logistics and measured with 7 scales.

2.2 Planning/Execution Capabilities (PE)

The planning and execution capabilities focus on the internal operational processes in SCM. The operational process can often be found in the comprehensive measurement frameworks on SCM (Estampe et al., 2013; Zhang and Tan, 2012; Kim et al., 2010). In the SCOR model, the processes in supply chain include plan, source, make, deliver, return, and enable (SCOR, 2015). The plan process may be affected by the market demand uncertainty, forecast effect, imprecision of plan, etc (Hao et al., 2012). The source, make, and return processes can be understood as the execution processes. Some researchers identified four drivers for the execution of supply chain, i.e. markets trends, logistics design, information technology, and human resources (Tell, 2012). In this study, the Planning/Execution was defined as the internal capabilities of supply chain on the plan process and the execution process, and can be measured with 5 scales.

2.3 IT Methods and Implementation (IT)

The improvement based on the advanced methods, i.e., IT methods and implementation, is the key difference between logistics and physical distribution. Dehning et al. (2007) empirically found the financial benefits of information technology investments around newly adopted IT-based supply chain management (SCM) systems by 123 manufacturing firms in U.S. over the period 1994-2000. The similar survey results had been found in other countries, i.e. Swedish manufacturing firms (Olhager and Seldin, 2004). IT methods and implementation can be effective in information sharing (Byrne and Heavey, 2006), demand forecasting (Olhager and Seldin, 2004), production planning and controlling (Li et al, 2005), etc. According to a survey of CMP consulting firm and Gartner Inc., the Compound Average Growth Rate (CAGR) of the SCM software sale in China was over 17.6% , and the CAGR in Japan was estimated as 7.3% . In this study, IT methods and implementation (IT) are used as the practice of the communication and computer technologies in SCM, i.e., EDI, SCM software, DSS (decision support system), and open standards/unique identification codes, etc., and can be measured with 5 scales.

2.4 Corporate Strategy and Inter-organizational Alignment (SO)

The strategic importance of SCM can affect the related investment and organization changes. Alfalla-Luque et al. (2014) found that employee commitment contributes to improving supply chain integration and this integration affects supply chain performance both directly and indirectly. In addition, an efficient and effective supply chain network can improve the degree of information sharing among suppliers, reduce cost and raise customer-service levels (Chang et al., 2013). In order to improve the performance, it is necessary to take into consideration the mediating effect of customer satisfaction (Yu et al., 2013). In this study, Strategy/Organization (SO) includes the strategic positions of SCM in the corporate strategy, the communication and information sharing between suppliers and customers, customer satisfaction, and employee training and evaluation, and can be measured with 5 scales.
3. Hypotheses Development

The scorecards on SCM can be used not only for benchmarking, but also for giving suggestions on the strategic formulation. This study analyses five surveys in different counties with one scorecard as shown in the appendix, i.e., Japan, China, Thailand, and Finland. It is interesting to find that different intended factors may be identified in different surveys. Meanwhile, the relationships among the intended factors may be different. This may be not important when using the scorecard for benchmarking, but it is completely different when giving suggestions on the strategic formulation.

One difference locates in the relationships between Logistics Performance and Planning/Execution Capabilities. One survey suggests that the inventory management capabilities could be separated from the logistics performance which is called as the responsibility to market change and the customer requirement (Arashida et al., 2004). Furthermore, the capability of inventory management can improve the logistics performance in ROA (Return on Asset), ITR (Inventory Turnover Rate), etc. (Arashida et al., 2004). The survey in Thailand also suggests that the inventory management capability could be separated from the logistics performance which is named as supply chain responsiveness and flexibilities (Yaibunathet et al., 2007). However, another survey in Japan exhibits that there are three intended factors shared by the measurement scales, i.e., supply chain organization ability, supply chain performance, and IT utilization ability (Suzuki et al., 2005). This result suggests that the process capability may not be an independent factor (Suzuki et al., 2005).

When designing the scorecard, Logistics Performance focuses on the competitive priorities in delivery, cost, quality, and others which can be benchmarked from outsiders, such as by the retailers, by the infrastructure network of the industries, or by the consultant companies. Planning/Execution Capabilities concentrate on the inside process capabilities of supply chain management, such as demand forecasting, planning synchronization among PSI planning capability (Production/procurement plan, Sale plan and Inventory plan), design for logistics, inventory control, and process visibility and standardization. The inside process capability should support the performance improvement. The supporting relationships between the process management and the performance measurement have been supported by different researches. For example, the empirical study on Slovenian manufacturing companies showed that there are significant relationships between BPR and performance measurement indicators (Herzog, et al., 2009). Based on above literature review, one hypothesis can be proposed as follow.

Hypothesis 1(H1): Planning/Execution Capabilities are different from Logistics Performance and the higher Planning/Execution capabilities can improve the logistics performance.

The second difference locates in the role of IT methods and implementation. It had been identified as an intended factor in the surveys in Japan (Suzuki et al., 2005) and Thailand (Yaibunathet et al., 2007). In addition, the IT methods and implementation can improve the inventory management capability (Arashida et al., 2004). Nevertheless, the survey in Finland figured out three intended factors without IT methods and implementation, i.e., Strategy/Organization, Planning/Execution Capabilities, and Logistics Performance (Kauremaa and Suzuki, 2007). The reason was presented as "for Finnish companies the use IT is embedded in various areas of SCM, while for Japanese it is a distinct area" or "the items for LSC area of IT might not represent the use of IT for the Finnish companies in the similar way as for the Japanese companies” (Kauremaa and Suzuki, 2007). Besides of the given reasons, the high failure rate of the management information systems may also be one reason of the absence of IT methods and implementation in the applications. For example, in Korea researches, the failure rate of ERP implementation was estimated to be between 60% and 90% (Khawh and Ahn, 2010). A high failure rate of ERP implementation can also be found in the reports from Hong Kong researches (Chang, et al., 2008), and Taiwan researches (Yeh et al., 2007).

IT methods and implementation is significant for Logistics and SCM. The definition of logistics emphasizes the application of IT, and the definition of supply chain also includes the integration with IT (NRI, 2008). It can be used for inventory reduction, visibility, and integration in supply chain management (Prajogo and Olhager, 2012). Since there exist inside capabilities as well as outside performance in this study, it is possible to put forward that IT methods and implementation may be necessary for both of them. Accordingly, two hypotheses can be proposed.

Hypothesis 2(H2): The wider IT Methods and Implementation can improve the Planning/Execution Capabilities.

Hypothesis 3(H3): The wider IT Methods and Implementation can lead to the better Logistics Performance.

The third difference lies in the relationships among IT methods and implementation and Strategy/Organization. A parallel relationship has been brought up in several surveys. Based on a Japanese survey, both IT methods and implementation and Organization Capabilities have the significant relationships with Planning/Execution Capabilities, and the relationships between IT methods and implementation and Organization Capabilities were proposed as the covariance relationship without the single directions (Arashida et al., 2004). The parallel relationships have been also supported by other researches. For example, the supply chain performance in agility depends on three capabilities which shows parallel relationships among them, i.e., IT integration/flexibility, management competence, and operational competence (Ngai et al., 2011).

The IT methods and implementation can be interpreted as the technological support for the supply chain improvement. On the other hand, the Strategy/Organization can be explained as the organization support for the improvement. Unlike the parallel relationships, the surveys in
other countries, such as Thailand, suppose that the organization and technical issues should be considered together (Yaibuathet et al., 2007). Even if the technology support and the organization support are both necessary, which one should move firstly? Some case studies in China suggested the IT methods and implementation should be move earlier than the organization change. One SCM director in a Chinese manufacturing firm said that “supply chain management relates to so many departments. Without the software application it would be very difficult to formalize the operations. In practice, even there are formal requirements on the operational process, many persons may ignore it.” On the other hand, several studies showed that before the large capital expenditure in IT, it is better to transform the organization and business practices, for example to apply the lean production principles (Mo, 2009). As suggested in the technology innovation in manufacturing and supply chain management, organization change should be aligned with technology innovation, and the earlier organization change may be helpful for the technology innovation investment (Brown, 2001). Some best practices in production, i.e., Lean Production, pay more attention to the applications of team work than the advanced manufacturing technology (Womack et al., 1990; Shah and Ward, 2003). Therefore, it is likely to assume that the higher score in Strategy/organization can encourage the IT methods and implementation. Accordingly, the hypothesis can be proposed as follows.

**Hypothesis 4 (H4):** The higher importance in strategy and better organization alignment on logistics can improve the IT implementation.

As the general proposes, both the technology support and the organization support could be helpful to the performance improvement which including the Planning/Execution Capability and the Logistics Performance. Accordingly, the hypotheses could be proposed as follows.

**Hypothesis 5 (H5):** The higher importance of logistics in Strategy and the better organization for logistics can improve the Logistics Performance.

**Hypothesis 6 (H6):** The higher importance of logistics in Strategy and the better organization for logistics can improve the Planning/Execution Capability.

Based on the above six hypotheses, a research framework among these four areas can be summarized and shown as the following figure.

### 4. Research Methodologies and Sample Demographics

The hypotheses were examined based on a survey with the supply chain and logistics scorecard (LSC) developed by Tokyo Institute of Technology as shown in the appendix (Arashida et al., 2004; Yaibuathet et al., 2007). Totally, there are 22 measurement scales in four areas, i.e., five scales on Logistics Performance (LP), five scales on Strategy/Organization (SO), five scales on Planning/Execution Capabilities (PE), and seven scales on IT Methods and Implementation (IT). The value and effectiveness of the scorecard have been tested to be acceptable in several surveys in different countries (Arashida et al., 2004; Yaibuathet et al., 2007). The Chinese questionnaire was translated based on the Japanese version 4.0 and English version 3.1, and checked for keeping the consistency among these three language versions. The survey was conducted in the People’s Republic of China from December 2005 to January 2006. The surveyed firms were selected through the recommendations of the local universities and represented a variety of manufacturing industries. Totally, 322 firms were invited to take part in the survey (115 samples surveyed in 2004, and 207 samples surveyed in 2006). The contents of the questionnaires used in 2004 and 2006 are the same, but the format is different. In this study, the data in 2006 was used for the data analysis, and the data in 2004 was used in the case studies. Among the 207 samples surveyed in 2006, 30 samples were not used because of the background of the responses or the absent of the answer. The questionnaires with the absent answers over 2 questions were not used. At last, 177 questionnaires were used in the data analysis.

The sample demographics are shown in Table 2. The size of the firms ranges from around 20 employees to over 1,000 employees. The gross sales/year in these firms varies from less than 3 million to over 1000 million U.S. dollars. The surveyed industries include Electric Machinery (For General Use, For Business Use), Fiber/Paper, Chemistry (Materials, Consumer Goods), Automobile (Automobile/Transports, Automobile/Electric Parts), Foods (Beer & Beverage, Materials & Processed Foods), physical distribution (Subsidiary, 3PL, Independent), and pharmaceutical.

### 5. Data Analysis

During data analysis, there are four steps. Firstly, the intended factors shared in the measurement scales were extracted with the Exploratory Factor Analysis (EFA), and an initial model was proposed with all possible relationships among the intended factors. Then, the dependent relationships were extracted from the initial model with Graphic Modelling (GM) (Miyakawa, 1997). In the third step, the dual directions on the dependent relationships were examined. At last, a structure model with the single directions was proposed with Structural Equation Modelling (SEM) and the hypotheses were tested based on the model. AMOS7.0 software was used for the SEM.

In the application of SEM, the models are assessed with three parameters, i.e., 1) Goodness of Fit Index (GFI) and Adjusted Goodness of Fit Index (AGFI). Values of GFI and AGFI between 0.80 and 0.89 represent a good fit and values above 0.90 represent a pretty good fit. 2) AIC: The value of AIC should be as close as possible to the value in a saturated model, and lower than it. 3) Root Mean Square Error of Approximation (RMSEA): RMSEA is a measure of the population discrepancy that is adjusted for the DF for testing the model. A value of 0.08 or less for RMSEA would indicate a reasonable error of approximation (McKone et al., 2001; Wang and Cao, 2008).
5.1 Exploratory Factor Analysis

An exploratory factor analysis was used to explore the intended factors shared by the 22 measurement scales in the scorecard. Considering the value in the Screeplot and the design of the questionnaire, four intended factors were extracted with Principle Factor Analysis. It was found seven items have loadings over 0.50 on over two intended factors. This is an important reason for other studies cannot separate the four areas targeted by the questionnaire. After discarding those items, 15 items are remained for the continuous analysis as shown in Table 3. The intended factors were extracted with Main Component Methodology, and with Kaiser Normalization Ecmatrix. The KMO and Bartlett ball test results are acceptable. These four intended factors can explain 68.0% variances. Loadings over than 0.50 are highlighted in Table 3.

Based on the contents of the intended factors, the 1st intended factor can be identified as Logistics Performance,
the 2nd intended factor can be identified as IT methods and implementation; the 3rd one can be interpreted as corporate strategy & inter-organizational alignment, which is abbreviated as Strategy/Organization; and the last one can be identified as Planning/Execution Capabilities.

5.2 Non-direction independent modeling

A structural equation model was formulated. On the normal distribution assumption, the Kurosis and Skewness indexes are calculated and the results can be accepted. The Skewness of SO2 and SO3 and the Kurosis of IT4 and IT5 have a value more than 2.0, but less than 3.2. The multivariate normal distribution test value is 5.97. Supposing that there is a covariance relationship between every two factors, a covariance model was proposed as Figure 1. Regarding the improvement on model performance, the residual error can be found between LP1 and PE1. The performance of the model shows that the initial model has a good performance. The exploratory function did not recommend deleting any connections between the intended factors.

In order to exclude the influence between different varieties, the partial correlations among the four intended factors were analyzed via Graphic Modeling Software, which can be used for the partial correlation analysis in the structure model (Miyakawa, 1997). The weakest partial relationship coefficient between the four intended factors is located between the Strategy/Organization and Planning/Execution Capabilities with a partial relationship coefficient equaling to 0.137 as shown in Table 4. Even cutting the relationship between Strategy/Organization and Planning/Execution Capabilities, the performance of the independent model would have no significant change \((P=0.05)\), as shown in Table 5. The second weakest relationship with the partial correlation coefficient as 0.163 is between IT Methods and Implementation and Planning/Execution Capabilities. If cutting the second weakest relationship, there is significant difference is as shown in Table 6. Therefore, in the non-direction independent model, the relationship between Strategy/Organization and Planning/Execution Capabilities is cut, and other relationships are remained.

5.3 Single Direction Model

Based on the non-direction independent structure model, the direction model could be proposed and tested. Since the relationship between Strategy/Organization and Planning/Execution Capabilities has been found as non-significant, based on the hypothesis, a single direction model can be proposed as following figure. The performance of the model suggests that this model could be accepted with the GFI, AGFI and CFI over more than 0.90 and RMSEA less than 0.05.

Based on the acceptable structure model shown in Figure 2, the path in the structure model has been checked one by one. It is found that the path coefficient between IT Practical Use and Logistics Performance is closing to zero (path coefficient=-0.02). This suggests the relationship between IT Methods and Implementation and Logistics Performance is not significant. Therefore, a revised model is proposed as Figure 3. It is found there is no significant difference between the performances of the two models. Moreover the AGFI has a better performance in the revised models.

5.4 Hypotheses Test

Based on the t test results in the modified single direction model, two of these six assumptions can be supported, while the other four hypotheses are supported. The results are shown in the following table.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Yes</td>
</tr>
<tr>
<td>H2</td>
<td>Yes</td>
</tr>
<tr>
<td>H3</td>
<td>Yes</td>
</tr>
<tr>
<td>H4</td>
<td>Yes</td>
</tr>
<tr>
<td>H5</td>
<td>Yes</td>
</tr>
<tr>
<td>H6</td>
<td>Yes</td>
</tr>
</tbody>
</table>

6. Discussion

Based on the proposed framework, some suggestions can be given out on the strategic formulation in supply chain management.

6.1 The media effect of Planning/Execution Capability

The planning/execution capability and logistics performance were identified as two intended factors shared by the measurement scales. In addition, the relationship between IT methods and implementation and logistics performance was not significant. These results suggest that the planning/execution capability has the media effect to transfer the function of IT methods and implementation to the logistics performance. This idea can also be supported in the literature which suggests the important role of the execution process between the strategy and the performance (Herzog, et al., 2009; Ward and Duary, 2000). On the other hand, the insignificant relationships between planning/execution capability and logistics performance can also support the separation between planning/execution capability and logistics performance. The proposed framework suggests that IT methods and implementation can support the improvement of planning/execution capability, but cannot improve logistics performance directly. Besides of the former explanations, some other reasons may also support the separation between planning/execution capability and logistics performance, i.e., the oligopolistic competition appearing in the retailer distribution, the fast development of the SCM software market. In many countries, in the home application electronics market, several sellers can cover a big market share. For example, in Japan, the top 28 sales in 2001 turn into only 7 sales in 2013 (JEITA, 2014); in China, 80% market share in the major cities are obtained by two sales, i.e. Guomei and Suning (Zhu and Wei, 2013). In the oligopolistic competition in the retailer distribution, the logistics performance estimation has often been used by the retailers. The motivation is that the mass retailers in the distribution can get more and more price negotiation power. With the buying power, the mass retailers can not only press profit of the makers, but also set up the requirement on the logistics performance which is forming the industrial standards level in SCM and logistics (Matsuda, 2007).
The idea on the separation between PE and LP has been considered in the design of the LSC scorecard. However, it could not be tested with the past survey data. One reason could be regarded as the different significant level in the data analysis. For example, in the Japan and Thailand surveys, the measurement on Strategy/Organization and IT Methods and Implementation could be clearly separated, but the measurement on Planning/Execution Capabilities and Logistics Performance cannot be clearly separated. Comparing with the significant difference between the Strategy/Organization and IT Methods and Implementation, the difference between the measurement scales on Planning/Execution Capabilities and Logistics Performance may not be so significant. The other reason may be the different institutional background in different countries. For example, in Japan the long term collaboration...
Table 3 Partial Correlation Coefficient in the full model

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Logistics Performance</th>
<th>IT</th>
<th>Strategy /Organization</th>
<th>Planning/Execution Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logistics Performance</td>
<td>-1 0.336</td>
<td>0.292</td>
<td>0.22</td>
<td>0.163</td>
</tr>
<tr>
<td>IT</td>
<td>0.336</td>
<td>-1</td>
<td>0.28</td>
<td>0.137</td>
</tr>
<tr>
<td>Strategy/Organization</td>
<td>0.292</td>
<td>0.28</td>
<td>-1</td>
<td>0.137</td>
</tr>
<tr>
<td>Planning/Execution Capabilities</td>
<td>0.22</td>
<td>0.163</td>
<td>0.137</td>
<td>-1</td>
</tr>
</tbody>
</table>

Note: Sample partial correlation coefficient determinant as 0.356

Table 4 Partial Correlation Coefficient in the model without links between SO and PE
Population Partial Correlation Coefficient Estimation

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Logistics Performance</th>
<th>IT</th>
<th>Strategy /Organization</th>
<th>Planning/Execution Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logistics Performance</td>
<td>***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IT</td>
<td>0.313</td>
<td>***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategy/Organization</td>
<td>0.322</td>
<td>0.303</td>
<td>***</td>
<td>0.098</td>
</tr>
<tr>
<td>Planning/Execution Capabilities</td>
<td>0.259</td>
<td>0.202</td>
<td>0</td>
<td>***</td>
</tr>
</tbody>
</table>

Note 1: Left lower triangular matrix shows the estimation of partial correlation coefficient; Right up triangular matrix shows the difference in the correlation coefficient.
Note 2: n=177, degree of deviation=3.344(df=1), p=0.0675
Note 3: GFI=0.991, AGFI= 0.907, NFI= 0.982, SRMR= 0.031

Table 5 Partial Correlation Coefficient in the model without links between IT and PE

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Logistics Performance</th>
<th>IT</th>
<th>Strategy /Organization</th>
<th>Planning/Execution Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logistics Performance</td>
<td>***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IT</td>
<td>0.363</td>
<td>***</td>
<td></td>
<td>0.16</td>
</tr>
<tr>
<td>Strategy/Organization</td>
<td>0.312</td>
<td>0.31</td>
<td>***</td>
<td>0.149</td>
</tr>
<tr>
<td>Planning/Execution Capabilities</td>
<td>0.348</td>
<td>0</td>
<td>0.001</td>
<td>***</td>
</tr>
</tbody>
</table>

Note 1: Left lower triangular matrix shows the estimation of partial correlation coefficient; Right up triangular matrix shows the difference in the correlation coefficient.
Note 2: n= 177, degree of deviation=11.477(df=2), p=0.0032 degree of deviation=8.133(df=1), p=0.0043
Note 3: GFI= 0.970 AGFI= 0.848 NFI= 0.937 SRMR= 0.069

Table 6 The tested results on the hypotheses.

<table>
<thead>
<tr>
<th>No.</th>
<th>Hypotheses description</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>The Planning/Execution Capabilities and the Logistics Performance can be significant separated. The improved Planning/Execution Capabilities can lead to a better Logistics Performance.</td>
<td>Significant</td>
</tr>
<tr>
<td>H2</td>
<td>The wider IT methods and implementation can improve the Planning/Execution Capabilities.</td>
<td>Significant</td>
</tr>
<tr>
<td>H3</td>
<td>The wider IT methods and implementation can lead to a better Logistics Performance.</td>
<td>Not Significant</td>
</tr>
<tr>
<td>H4</td>
<td>The higher importance of logistics in Strategy and the better organization for logistics can lead to a wider IT methods and implementation.</td>
<td>Significant</td>
</tr>
<tr>
<td>H5</td>
<td>The higher importance of logistics in Strategy and a better organization for logistics can lead to a better Logistics Performance.</td>
<td>Significant</td>
</tr>
<tr>
<td>H6</td>
<td>The higher importance of logistics in Strategy and a better organization for logistics can improve the Planning/Execution Capability.</td>
<td>Not Significant</td>
</tr>
</tbody>
</table>

among SCM has been paid higher attention before the IT practical use than the attention in Finland and Thailand (Yaibuathet et al., 2007; Kauremaa and Suzuki, 2007).

6.2 The media effect of IT methods and implementation

The results show that IT methods and implementation cannot improve the logistics performance directly, but can improve the planning/execution capabilities. In addition, the relationship between planning/execution capability and strategy/organization is also not significant. These results suggest that IT methods and implementation have the media effect between planning/execution capability and strategy/organization. Besides, without the IT methods and implementation, the investment on the strategy/organization cannot improve the planning/execution capabilities. The media effect of IT methods and implementation may be explained by the turbulent environment. The environment is full of the huge quantity orders and material information with the very high updating frequency. This difficulty makes it impossible to be dealt by hand. These difficulties require the supply chain to respond to short-term changes in demand or supply quickly and handle external disruption smoothly (Lee, 2004). For example, the planning synchronization among partners in supply chain has become the operational basis in SCM. It requires not only the ERP in the local operations in each partners, but also the SCM software and EDI data transmission between the partners.

The researches on the relationships among these areas
can give suggestions on making good use of IT methods in SCM. In the definitions on physics distribution and the definitions on logistics management or supply chain management, one important difference is that the later two definitions emphasize the application of IT methods (NRI, 2008). The supply chain software has a big market which is increasing very quickly. According to the survey by Technavio, the CAGR (Compound Average Growth Rate) of the global SCM software market is regarded as 10.73% during 2013-2018 (Technavio, 2014). However, how to make good use of IT is a major challenge in SCM. For example, ERP has been regarded as the most imperative information technology in modern organizations (Park and Kusiak, 2005), and has been integrated with additional modules, such as Supply Chain Management (SCM), Supplier Relationship Management (SRM) and Customer Relationship Management (CRM) systems (Moller, 2005). In Korean researches, the failure rate of ERP implementation was estimated to be between 60% and 90% (Kwahk and Ahn, 2010). A high failure rate of ERP implementation can also be found in the reports from Hong Kong researches (Chang et al., 2008), Taiwan researches (Yeh et al., 2007), China mainland (Zhu and Ma, 1999).

6.3 The original motivation of strategic importance and organizational changes

The results suggest that the strategic importance and the organization change should move earlier than the IT methods and implementation in supply chain management. In details, the strategic importance on logistics and supply chain, the contract terms and degree of information sharing with suppliers and customers, the measurement and improvement of customer satisfaction and the employee training and evaluation are the necessary conditions for the supply chain management. Though IT methods and implementation is important in supply chain management, the strategic importance and organizational changes should be more valued.

7. Conclusion and Future Research

The measurement scales on supply chain and logistics management scorecards are summarized in four areas, i.e., Logistical Performance, Strategy/Organization, Planning/Execution Capabilities, and IT Practical Use. The relationships among these four areas are examined based on a survey in China. The significant relationships have been found between Logistical Performance and Planning/Execution Capabilities, between Planning/Execution Capabilities and Strategy/Organization, between Planning/Execution Capabilities and IT Practical Use, and between Strategy/Organization and IT Practical Use. A structural equation model on the relationships are proposed for the strategic formation on supply chain management. The model suggest that the planning/execution capability improvement can play the media role between IT methods and implementation and logistics performance improvement; IT methods and implementation can play the media role between planning/execution capability and strategy/organization; the strategy/organization operations should be move earlier
than the IT methods and implementation in supply chain management.

This study builds one framework for the strategic formulation in supply chain management. The planning/execution capability examined in this model focuses on understanding of market trends & accuracy of demand forecasting, and the accuracy and adaptability of SCM planning. The other execution capability including the control and tracking of inventory, the process standardization and visibility, the logistics system optimizing with design for logistics have not been included. For the other execution capabilities, the validity of the framework need to be further examined in the future work.

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