A Study on the Key Factors of Customer Chain Effectiveness

D. Y. Sha, Kun-Chih Huang, P. K. Chen

Abstract—Facing today's highly volatile global market, the industries have well accepted the concept of supply chain management (SCM) that integrating upstream and downstream to improve the competitiveness of products. However, product innovation capability becomes critical once most of the competitors sit on equal SCM basis. The relative studies showed that traditional collaboration between manufacturer and supplier had limited help to the innovation of product and no rigid connection between the "collaboration" and "product innovation" in the industries. The disadvantage of product innovation in traditional supply chain may be explained by over-emphasis on manufacturing operation in the past. In order to solve the problem of product innovation, although both design chain and customer chain have been suggested by practitioners and scholars recently to be integrated into traditional supply chain. To our best effort, the studies and literatures are still scarce, especially for customer chain. This empirical study conducted by regression to discover thoroughly regarding key factors that may influence the effectiveness of customer chain to be integrated into traditional supply chain. The analysis results reveal that situations of data warehousing system as well as flexible service workflow are the major factors.

***Index Terms*— customer chain, data warehousing system, flexible service workflow, product innovativeness, International Manufacturing Strategy Survey**

I. Introduction

In globalization decades, how to build an absolute competitive edge in competing markets around the globe has always been an issue that constantly concerns manufacturers. In fact, customers will choose the one who can produce the highest quality product at the lowest cost. Besides, if any manufacturer can further offer the shortest delivery time and have the high-flexibility response ability, then he will be the first choice for customers. As a result, if manufacturers desire to gain a competitive edge, they should make quality, cost, delivery time, and flexibility (QCDF) their performance goals [1]-[3].

How should an organization be able to have the ability to achieve the four performance goals? According to relevant scholars and practitioners, if manufacturers can establish a supply chain management (SCM) in a global operation environment, it will enable them to achieve the ability. Introduction of a SCM can shorten lead time of manufacturing operations, effectively control product cost and quality, and enable the organization to have the high-flexibility response ability in order to respond to a highly volatile market [4]-[7]. Moreover, cases of SCMs constructed by Wal-Mart, Dell, etc. also verify a positive effect of SCM.

Nevertheless, as most of the competitors can sit on equal SCM basis in recent years, manufacturers merely having the aforementioned abilities are not adequate to be viewed as having a global competitiveness. It is suggested that manufacturers must further have a product innovation capability (PIC) in order to really secure their own global competitive edge, i.e. if customer needs can be known and physical products can be produced rapidly, then they will retain customers and maintain high competitiveness. Therefore, in addition to QCDF, how to equip an organization's internal operations with PIC has become a critical issue that concerns manufacturers commonly [8], [9].

Relevant researches that addressing SCM and product innovation issues argued that "collaboration" between manufacturers and suppliers is key to facilitating product innovation performance. For instance, Kim [10], Ulusoy [11], Nieto and Santamaria [12] et al. indicated that introducing collaborative design between manufacturer and supplier can indeed equip supply chain (SC) operation results with PIC. However, the above conclusion is questioned by the industry practitioners. This is because the traditional SCM model underlines an upgrading ability in QCDF, though weak in product innovation. Besides, in recent years in some often illustrated successful cases, no strong relevance is found between successful operation of SCM and product innovation.

In order to arm SC with a high PIC, a set of management model which can upgrade PIC is suggested to be developed from the original SC operating environment. As such, Design Chain (DC) and Customer Chain (CC) viewpoints gradually emerge. DC is a concept which has evolved from collaborative design. It emphasizes closely integration with suppliers for setting up a product design/development process [13]. A number of empirical studies [14]-[16] showed that introducing a DC management model can indeed facilitate effective execution of collaboration between manufacturer and supplier, thereby achieving PIC and avoiding negative problems derived from coordination operations.

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Nevertheless, Twigg [13] pointed out that, in addition to DC management model between manufacturer and supplier, consideration should also be given to build contact channels with customers. Chuang and O'Grady [17] further indicated that a complete DC framework should take into account building up a customer management model for effectively obtaining customer's needs. In fact, whether new products can completely pleasure customers pivots on mastering of customer's needs. As a result, as far as DC is concerned, it is important to construct contact channels with customers also. Ishii [18] proposed that, if DC can combine with CC, it will be able to effectively gather customer's needs information and benefit product development. CC is designed to closely integrate with customers through effective management model for obtaining customer's feedback. There are a couple of studies addressing how to effectively construct a CC framework, for example, the Supply Chain Council (SCC) formulated CCOR (Customer Chain Operations Reference Model) [19] and Donaldson et al. [20] proposed a Customer Value Chain Analysis model.

Though some studies have proposed CC construction models, other research such as Robert & Veryzer [21] in discussing factors that affect product development pointed out that, customers' understanding of a product was limited and that therefore they could hardly describe their needs for a new product clearly. Ishii [18] also indicated that, even if CC could form an effective tool for effectively management customers, when customers' feedback became less, it was more unfavorable for product innovation. In order to address this problem, when CC is introduced and constructed, what extraordinary work should it go through to increase customer information feedback results? Past research rarely touched on this subject.

Based on the above discussion, the objective of this empirical study is to identify the key factors that will affect the successful execution of CC. This study is based on the samples from the International Manufacturing Strategy Survey (IMSS) database, a global research network initiated by London Business School.

II. Literature and Hypothesis

An observation showed that, before introducing CC, customers' information feedback will be increased through two key operations to facilitate effective execution of CC: establishment of a data warehousing system (DWS) and establishment of a flexible service workflow (FSWf). Kärkkäinen and Elfvengren [22] argued that mastering customer's needs was crucial for elevating firm's PIC. In order to efficiently master information of customer's needs, customer's feedback is essential. Previous research believed that, through e-Commerce interactive platform, it was possible to really grasp information on customer's needs and urged customer to feedback. However, experiences of the industry practitioners showed that customers usually will not interact on an e-Commerce platform. For this reason, how to dig out information from customer's underlying behaviors had become the key to grasp customer's needs. To that end, an observation showed that construction of a DWS would be more effective for gathering information of customer's needs than e-Commerce. A DWS is similar to a multi-dimensional data cube concept. A useful data could be formed through analyzing and summarizing in different dimensions, which could exactly reflect customer's underlying needs and provide a reference for designers in product innovation. Therefore, for those successful cases, during the process of CC construction, with the rear end of each activity with customer contact, most manufacturers would design and link to their DWS operations. When customer purchases, needs repairs, customer service, etc., these data were stored and compiled through the DWS to dig out customer's underlying needs. Establishment of a DWS was able to overcome the defects of mere relying on what customer's said. Su et al. [23] and Liao et al. [24] showed that construction of a DWS will be of help effectively gathering and classifying of customer's underlying needs, which will benefit product development.

In addition, establishment of an FSWf also played a key role in facilitating customer's data feedback. A DWS can help to effectively gather information about customers' responses. But it is necessary to classify the information according to product line, avoid gathering ineffective or non-referential data. In constructing a CC framework, if the service workflow for contact with customers can change flexibly according to different order characteristics, it will be able to effectively gather information about customers' response to different products. And then, through DWS provides useful information to DC for developing a product that can more meet customers' needs. Wetzel & Klischewski [25] and Hu & Grefen[26] both indicated that a FSWf could effectively manage customers' information and positively affect the internal operations of manufacturing firms.

According to above discussion, the construct model was built as Fig. 1 and the following hypotheses were tested in this study:

H1: DWS positively affects CC effectiveness
H2: FSWf positively affects CC effectiveness
H3: CC effectiveness positively affects PIC

Fig. 1. Construct Model

III. Research Design

A. Survey database and test samples

This study is based on the database of IMSS. The IMSS is an international cooperative research network focusing on manufacturing strategy and SCM. It gathers data about practice and performance related to manufacturing strategy in a global setting, and data pertaining to practice in SCM are also collected. The survey employed questionnaire of five-point Likert scale as the means of measurement.

The survey of fifth iteration (IMSS-Ⅴ) was performed in 2009 and the data were published in 2010. It was involved by researchers worldwide including Europe (13 countries), the Americas (USA, Canada, Brazil and Mexico), and some of

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Asia countries (Taiwan, China, Japan and Korea). IMSS-V focuses upon the manufacturing firms related to fabricated metal products; machinery and equipment; office, accounting and computing machinery; electrical machinery and apparatus; radio, television and communication equipment and apparatus; medical, precision and optical instruments, watches and clocks; motor vehicles, trailers and semi-trailers ; other transport equipment. Total 725 respondents from 21 countries were recorded in the final releasing. These data were used for this study.

Firstly, the samples were classified by citing the method of Frohlich and Westbrook [27]. As a result, only 245 samples were able to fit the research purpose. And then, 16 samples were eliminated for whose responses were not complete or with missing values for variables of DWS, FSWf, CC effectiveness, and PIC. Therefore, only 229 of the 725 respondents are remained, i.e. the sample size of this study is 229.

B. Operationalization variables and independent construct measurement

In terms of research purpose, this study involved the testing of four variables: DWS, FSWf, CC effectiveness, and PIC.

Definition of DWS in this study focused on the activities of applying electronic tools to record and analyze customers' needs for improving product design and innovation. IMSS-V provided five kinds of DWS-related activities including: (1) scouting/pre-quality, (2) RFx(request for quotation, proposal, information), (3) data analysis, (4) order management and tracking, and (5) contract and document management. For these five kinds of DWS activities, this study firstly used mean value, standard deviation, and Skewness and Kurtosis to check whether the data are normally distributed. Test result indicated that data distribution has shown normally (please refer to Appendix A for details). To ensure that these test variables meet the research's requirements, then a construct validity test for DWS by factor analysis was performed. The test results indicated that the Kaiser-Meyer-Olkin (KMO) measure of performance adequacy was 0.79, Bartlett's test of sphericity was significant, Factor loading for all five items exceeded 0.62, and the results of Cronbach's α in factor exceeded 0.78.

Definition of FSMf in this study focused on the activities of shifting manufacturing towards services. IMSS-V included five measurement items regarding to establishment of FSWf: (1) power-by-the-hour (total responsibility for the product), (2) product upgrade (software, product modification), (3) help desk/customer support centre, (4) engaging in expanding the service offering, and (5) developing the skills to improve the service offering. Following the same processes, mean value, standard deviation, and Skewness and Kurtosis were used to verify data normality; significant results were achieved for these five items. And then, a factor analysis was done to check construct validity of FSWf. The test results showed that the Kaiser-Meyer-Olkin (KMO) measure of performance adequacy was 0.785, Bartlett's test of sphericity was significant, Factor loading for all five items exceeded 0.71, and the results of Cronbach's α in factor exceeded 0.82.

According to IMSS-V, there are three measurement items of SC operations for investigating the integration level of product development and production with customers: (1) vendor managed inventory, (2) plan, forecast, and replenish collaboratively, and (3) just-in-time replenishment. As usual, mean value, standard deviation, and Skewness and Kurtosis were firstly checked to test data normality, and the result showed that all data of three measurement items are normally distributed. And then, a factor analysis was done to check the construct validity. The test results indicated that the Kaiser-Mayer-Olkin (KMO) measures of performance adequacy were 0.704, Bartlett's test of sphericity was significant, Factor loading for all four items exceeded 0.81, and the results of Cronbach's α in factor exceeded 0.79.

Finally, according to IMSS-V, there are also three measurement items for investigating the firm's PIC: (1) product customization ability, (2) time to market, and (3) product innovativeness. The results of mean value, standard deviation, and Skewness and Kurtosis showed the data normality is significant for these three measurement items. The results of construct validity test indicated that the Kaiser-Mayer-Olkin (KMO) measures of performance adequacy were 0.701, Bartlett's test of sphericity was significant, Factor loading for all three items exceeded 0.82, And also, the test result of Cronbach's α in factor exceeded 0.77.

IV. Results and Discussion

In this section, analyses of test results for those three hypotheses of this study are presented. The regression method was employed for the analysis

The test results proved that establishment of DWS ($p < 0.05$, $F = 21.432$) and establishment of FSWf ($p < 0.05$, $F = 19.309$) both have significant positive effect on CC effectiveness. And also, CC effectiveness by DWS and FSWf it is indeed good for achieving high product innovation performance ($p < 0.05$, $F = 7.009$). All test results for those three hypotheses are summarized in Table I.

Table I: Test results

Hypotheses	Results
H1: DWS positively affects CC effectiveness	Supported F=21.432 p=.000***
H2: FSWf positively affects CC effectiveness	Supported F=19.309 p=.000***
H3: CC effectiveness positively affects PIC	Supported F=7.009 p=.009***

According to test results, it could be found that establishing of DWS and FSWf are critical successful factors for manufacturing firms to build an effective SC framework for upgrading their PIC. Meanwhile, it also could be deduced why the DWS and FSWf play important roles on CC.

V. Conclusion

The objective of this empirical study is to identify the key

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factors that will affect the successful execution of CC. The test results showed that two factors, DWS as well as FSWf, are able to significantly influence the effectiveness of CC. In addition, the test results also proved that an effective CC framework can significantly improve the PIC of manufacturing firms. In the implication, manufacturer can consider the result to construct an effective CC framework and to secure high innovative performance through successful execution of CC. On the other hands, researchers can refer to the result to explore deeply the issues of CC.

Since empirical studies with regard to CC are still rare, future research may consider exploring more thoroughly which could are factors affecting the successful introduction and execution of CC.

APPENDIX

A. Result of data normality test

	Mean	Std. Dev.	Skewness	Kurtosis
DWS				
1.scouting/pre-quality	3.0742	1.35034	-0.136	-1.098
2.RFx	3.6812	1.14273	-0.560	-0.335
3.data analysis	3.5546	1.10137	-0.537	-0.265
4.order management/tracking	3.9127	0.97839	-0.702	0.155
5.contact/document management	3.7974	1.06986	-0.747	0.129
FSWf				
1.power-by-hour	3.1179	1.36661	-0.246	-1.160
2.product upgrade	2.8690	1.38613	0.008	-1.250
3.helpdesk/customer support	3.0658	1.42355	-0.098	-1.285
4.engaging in expanding service offering	3.0611	1.31313	-0.243	-1.048
5.developing skills to improve service offering	3.2882	1.21572	-0.480	-0.659
CC Effectiveness				
1.vendor managed inventory	3.4105	1.07486	-0.578	-0.019
2.plan, forecast and replenish collaboratively	3.6157	0.94633	-0.290	-0.128
3.just-in-time replenishment	3.4061	1.08262	-0.446	-0.280
PIC				
1.product customization ability	3.5639	0.88203	0.038	-0.545
2.time to market	3.4513	0.87424	0.191	-0.640
3.product innovativeness	3.4167	0.89398	0.197	-0.517

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