

Study on the Influence Factors of Supply Chain Performance of Iron and Steel Enterprises

Songfen Li

Baotou Iron and Steel Vocational Technical College, China

Abstract—In this paper, 18 items of practices and seven influence factors of supply chain management (SCM) are determined on the basis of the theoretical analysis and group focus interviews. Three dimensions of SCM practices (upstream and downstream integrating management, internal operation management and information management) and two dimensions of SCM influence factors (strategic and supportive factors) are established respectively by questionnaires and factor analyses. The path analysis approach is employed to analyze the impact of the SCM practices and influence factors on supply chain performances. The results show iron & steel enterprises' SCM practices and influence factors exert a significant impact on their supply chain performance, but some differences exist in the impacts of all dimensions of SCM practices and influence factors on the dimensions of their supply chain performance.

Keywords—iron and steel enterprise; supply chain; performance

I. INTRODUCTION

China enjoys rapid urbanization with acceleration of its industrialization process especially in equipment manufacturing. It has maintained a momentum of growth in steel production and consumption for many years. At the same time of a sharp decline of iron and steel product price, the crude fuels for iron and steel enterprises are always standing in a high price, and this becomes the instrument of very tough situations of these enterprises. In order to keep their earnings level, these enterprises must save costs of production, improve the supply chain management (SCM) level, and reduce the logistics costs in various ways.

On the basis of existing literature, this paper is intended to explore the impact of iron & steel enterprises' practices and SCM influence factors on supply chain performance, so as to seek for the pathways to improving these enterprises' supply chain performance.

II. THEORETICAL ANALYSES AND PROPOSITION OF HYPOTHESES

There are different studies on SCM operations in current literature. They are divided into four aspects based on different management objects, i.e. supply and material management, production capacity, information and technology sharing, and customer services.

A. Supply and Material Management

The efficient supplier management means advantages in high-quality products with monetary value, and long-term low costs supplied to enterprises by properly-combined suppliers[1]. Moreover, excellent suppliers can promote manufacturers to keep improving product quality and reducing costs in the product-developing stage and to get higher transport benefits[2]. After interviewing 19 purchasing supervisors, Smeltzer concluded the following trusts between manufacturers and suppliers based on their acknowledge: generalized and everlasting trusts; sharing of concept, technique and knowledge, and costs saving; open communication and listening; mutual expectation and honesty[3].

B. Production Capacity

Most of current studies on the SCM indicate that the purchasing process becomes a key link from a supportive role in the whole corporate strategy[4]. A manufacturer should give a high-quality, appropriate and timely supply to customers in consideration to their demands, and maintain a smooth operation process. For this reason, they should work out the production plan by giving full consideration to suppliers' functions in the production process.

C. Information and Technology Sharing

The more real-time information exchange and processing efficiency is the instrument of a closer relation between the upstream and downstream supply chains with constant development of information technology.

Lee et al. found cooperative partners wouldn't like to disclose sensitive cost data mutually, and they kept their information confidential. They must take into account how to share the required devices, costs and risks if they wanted to share information, and how to enhance the coordination and planning between supply chains by the information sharing[5].

John et al. held that the cooperation relation couldn't be established without a sound communication between intra-organizations and inter-organizations. So, knowledge and information were shared from the perspective of overall benefits in order to solve the trust-lacking problem[6].

Lee and Whang stressed the information sharing played an important role in supply chains. The information sharing could promote closer coordination and cooperation between cooperative partners in supply chain, to maximize their performance in the whole supply chain[7].

D. Customer Services

In the field of total quality management (TQM), customers refer to a vast group. It may be divided into external customers and internal customers, where, the latter are employees in an organization, and the former are the ones who buy goods or services from the organization. In recent years, the “customer satisfaction and service paramount” has become a common operation philosophy of global enterprises. An enterprise’s service level to customers can exert an important impact on its competitiveness.

According to now available literature, current studies on the SCM influence factors focus on four aspects: supply chain coherence, information acquisition capability, regional advantage and organizational factor. The key successful SCM influence factors are discussed in the four aspects.

(1) Supply chain coherence

A close coordination is needed in the operation process of upstream and downstream enterprises in the implementation of supply chain, and the goal of upstream and downstream synchronizing operation can be reached by cooperation and information sharing in production and marketing. The benefits and competitiveness of the whole supply chain will be affected seriously if the cooperative enterprises only take into consideration their own production cost and interests in competition regardless of the purpose of the whole supply chain.

(2) Information acquisition capability

The supplier can reduce goods in stock, and improve the reliability of distributing goods to customers by using right demand information. Similarly for the downstream manufacturers, the supplier can also reduce the goods in stock with his reliability improved[8][9]. In supply chain, the real-time and efficient communication is very important among enterprises. The manufacturer can arrange the minimum safe stock and take quick action to the market changes if they gain the stock information in a real-time state.

(3) Regional advantage

The regional advantage means a shorter transport time. The physical distribution in the early time has developed into the logistics (operation) management. Super Manager Peter F. Drucker regarded logistics as a last field for the enterprises to reduce costs. The modern logistics is gradually deemed as a part of supply chain management (SCM).

(4) Organizational factor

Such individuals as manager and system designer who have power in an organization are the ones who have influences on techniques, whereas the employees without power have no influence on techniques or affected by the techniques. The managers’ intention is often an important factor influencing techniques[10]. The leaders’ attention to SCM directly affects the effect of implementation of supply chain. Many factors such as structure and power division of an organization can exert the impacts on the enterprises’ SCM.

The iron & steel enterprise’s SCM is a systematical integration of a series of activities, its main function is to

connect the main production processes inside and outside an enterprise into an integrated efficient structure. The SCM includes a sum of a series of practical activities such as management activities of all logistics as well as production operation, marketing, product design, finance and information technology. The effect of implementation of these practices has an important impact on the performance of an iron & steel enterprise’s supply chain. So, this paper puts forth Hypothesis 1:

Hypothesis 1: Iron & steel enterprise’s SCM practices can exert an impact on performance of supply chain.

The iron & steel enterprises’ SCM is a part of modern steel business management, and the SCM activities are certainly affected by such factors as business strategy and management, social environment that the enterprises face, and geographic location. These factors can exert an impact on the enterprises’ SCM performance. So, Hypothesis 2 is set forth in this study:

Hypothesis 2: The enterprises’ SCM influence factors have an impact on the SCM performance.

III. MEASUREMENT OF RESEARCH VARIABLES

A. Measurement of Variables of SCM Practices and Influence Factors

The iron & steel enterprises’ managers are direct or indirect SCM participants. They more clearly understand the enterprises’ practices and influence factors. Hence, this study determines the contents of SCM practices and the measuring items of influence factors by the way of focus group interview.

The focus group interview is also called focus interview or group indepth interview. Under the guide of the question-master, the personnel selected with the same characteristics hold a informal discussion on the topics related to work scenarios[11].

The object of this study is the managers of iron & steel enterprises. Based on research purpose and characteristics of interviewee focus group, there are four focus groups in this study, five interviewees each group for about one hour.

The four groups of focus interviews all were held at a meeting room in the interviewed enterprise. The data were collected by recording in the whole course of the activity. In order to avoid leave-out, the investigators prepared two recorders and several tapes, and these devices were tested in advance before discussion. After the interview began, the question master questioned based on the interview guides, and got to the bottom properly or other participants shared their experience. In the interview, the question master recorded the talker’s number and outlines. After the interview ended, the interview records should be sorted out word by word first, and then all sentences in the text were refined for form a title of the required contents. By this way, 18 items of SCM practices and seven SCM influence factors were established finally as shown in Table I and II.

TABLE I. 18 ITEMS OF SCM PRACTICES

No.	Item	Description
1	Information feedback mechanism	Have information feedback mechanism among product end users.
2	Understand suppliers' supply ability	Understand the material suppliers' timely supply ability.
3	Master customers' demands	Master the customers' future demands.
4	Share production and marketing information	Have the sharing platform for the whole production & marketing and supply & demand management information.
5	Tie up upstream and downstream enterprises	Establish closer strategic cooperation between the upstream and downstream enterprises.
7	Informal information channel	Get information by the informal channel.
8	Customer information sharing system	Have the information system shared with customers.
9	Strengthen commitments	Strengthen the enterprises' commitments to the delivering time to customers.
10	Have transport and distribution ability	Have enough ability to products transport and distribution.
11	Understand customer's strategy	Fully understand customers' future development strategies.
12	Enlarge upstream and downstream scope	Continuously enlarge scopes of material supplies and product sales.
13	Understand the relation of upstream and downstream supply and demand	Understand the relation of upstream and downstream supply and demand.
14	improve work flow	Constantly improve the work flow inside the enterprises.
15	Understand suppliers' strategy	Understand raw material suppliers' strategic information.
16	Master customers' marketing trend	Master the customers' marketing trend.
17	Supply in time	Timely deliver goods to the location designated by customers.
18	Give a quick response	Give a quick response to changes based on production and marketing situations.

TABLE II SEVEN SCM INFLUENCE FACTORS

No.	Item	Description
1	Lack of information system	Have no complete information system.
2	Lack of strategic partners	Have no strategic partners.
3	Lack of senior executives' support	Have no senior managers' support to SCM.
4	Lack of contingency ability	Have no enough contingency ability to production and marketing system.
5	Default of corporate culture	Have no the corporate culture applicable for SCM.
6	Overlook of threats	Overlook the competitor's threats.
7	Low level of freight management	Have a low level in freight management.

B. Measurement of Supply Chain Performance

The purpose of SCM for iron & steel enterprises is to improve product and service quality and finally strengthen the enterprise competitive competence by the management in enterprise's product processes and the cooperation of upstream and downstream enterprises. Thus, the supply chain performance is measured by these aspects in this study.

IV. DATA COLLECTION

The SCM-related Questionnaires made based on SCM practices, influence factors and the measuring items of supply chain performance were given out. The Likert 5 scale was applied, and 1--5 points were given based on admittance degrees or conformity of items in questionnaires. The interviewees were requested to score by item based on the conformity.

The SCM-related Questionnaires were given out in 10 large and medium-sized iron & steel enterprises. In order to fully reflect the practical situations, the questionnaires were provided

in the SCM-related posts in these enterprises. The objects included administrative staff in related posts. In questionnaire give-out, investigators got in a touch with the relevant enterprise first, and then under the support cooperation of the enterprise, the survey was completed by a way of the face-to-face questionnaire fill-in, the questionnaires sent by mail or e-mail. By this way, 350 questionnaires were given out totally, and 305 were taken back, with a recovery rate of 87.14%. After invalid questionnaires were deleted, 265 valid questionnaires were obtained, with an effective rate of 75.71%. This indicates the questionnaire was made in a high effective rate, and up to standard in the sample number.

The SPSS18.0 software was used for the descriptive statistics to the questionnaire results. The quantitative values of items were close to 3 or so, more living up to the normal distribution features. Skewness and peakedness of all items were figured out, where the absolute value of skewness was less than 3, and the absolute value of peakedness was less than 10. The calculating results indicate the data of questionnaires passed the normality test.

The SPSS18.0 software was used for the reliability test to the questionnaires. The calculating results show that Cronbach's α value was more than 0.8 for the whole questionnaires. The whole reliability of the questionnaires decreased after the defected items were deleted. So all defected items were reserved, and Cronbach's α value was apparently higher than 0.7; so it was up to the statistical requirement with a higher questionnaire reliability.

Investigators studied the SCM-related literature extensively in questionnaire design, and consulted experts and had interview with managers on the questionnaire contents. On this basis, the semantic description of each item was revised. So, the questionnaires in this study meet requirements in content reliability.

The factor analysis was done by SPSS18.0 software to verify the structure validity of questionnaires. The concrete process will be stated in the following section.

V. DETERMINATION OF VARIABLE DIMENSION

A. SCM Practice Dimension

The SPSS18.0 software was used for KMO value and Bartlett's test of sphericity to the results of the questionnaires. The KMO value was 0.726 by calculation. Meanwhile, the concomitant probability was 0.000 by Bartlett's test of sphericity. As the value was less than 5% of significance level, the 0 hypothesis for Bartlett's test of sphericity was rejected, indicating the results of the questionnaires satisfied the requirement of exploratory factor analysis.

The exploratory factor analysis was conducted by SPSS18.0 software for the data of SCM practice questionnaires. Three factors were taken by the exploratory factor analysis, and the three factors commonly explained a total variance of 76.25%. This indicates the three factors can well reflect the characteristics of SCM practices, and the total explained variance was greater than 70%, indicating the questionnaires

had a better reliability. The three factors are named as follows based on the content of items covered by each factor:

Factor 1: inclusive of eight items: understand suppliers' supply ability, master customers' demands, tie up upstream and downstream enterprises, understand customers' strategy, enlarge upstream and downstream scopes, understand upstream and downstream supply and demand relations, understand suppliers' strategy, and master customers' marketing trend. These items reflect an enterprise's management activities of strategic integration to upstream and downstream enterprises by understanding upstream and downstream demands and development strategy. So Factor 1 is named the upstream and downstream integrating management.

Factor 2: inclusive of six items: make production and marketing plan, strengthen commitments, have transport distribution ability, improve work flow, supply in time, and give a quick response. These items reflect an enterprise's activities of improving SCM ability by strengthening internal operation management ability. So Factor 2 is named the internal operation management.

Factor 3: inclusive of four items: information feedback mechanism, production and marketing information sharing, informal information channel, and customer information sharing system. These items reflect an enterprise's ability of solving the information asymmetry problem in supply chain activities by the formal and informal information management. So Factor 3 is named the information management.

B. SCM Influence Factor Dimension

The SPSS18.0 software was used for KMO value and Bartlett's test of sphericity to the results of the questionnaires. The KMO value was 0.752 by calculation. Meanwhile, the concomitant probability was 0.000 by Bartlett's test of sphericity. As the value was less than 5% of significance level, the 0 hypothesis for Bartlett's test of sphericity was rejected, indicating the results of the questionnaires satisfied the requirement of exploratory factor analysis.

The exploratory factor analysis was conducted by SPSS18.0 software for the data of SCM influence factor questionnaires. Two factors were taken by the exploratory factor analysis, and the two factors commonly explained a total variance of 74.56%. This indicates the two factors can well reflect the characteristics of SCM influence factors, and the total explained variance is greater than 70%, indicating the questionnaires have a better reliability. The two factors are named as follows based on the content of items covered by each factor:

Factor 1: inclusive of three items: lack of strategic partners, lack of contingency ability and overlook of threats. These items reflect an enterprise's factors in judgment of competitive situation, and strategic choice. So Factor 1 is named the strategic factor.

Factor 2: inclusive of four items: lack of information system, lack of senior executives' support, default of corporate culture, and low level of freight management. These items reflect an enterprise's ability of support in personnel and

culture in logistic management. So Factor 2 is named the supportive factor.

VI. HYPOTHESIS TESTING

The path analysis was conducted by LISREL8.7 program based on the data from questionnaires to verify the relation SCM practices and influence factors with supply chain performance. The results by the path analysis are shown in Figure I. The degree of fitting passed the test, indicating the model's degree of fitting is more reasonable.



*** and ** represent a significance at 1% and 5% respectively

FIGURE I. RESULTS OF PATH ANALYSIS

It is seen by the results of path analysis that three dimensions of upstream and downstream integrating management, internal operation management and information management of iron & steel enterprises' SCM practices exert an significant impact on three dimensions of supply chain performances. So Hypothesis 1 is verified.

Two dimensions of the strategic and supportive factors of iron & steel enterprises' SCM influence factors have a significant impact on three dimensions of supply chain performances. So Hypothesis 2 is verified.

VII. RESULT ANALYSIS

It is found by the coefficient results of path analysis that differences exist in the impact of all dimensions of SCM practices and influence factors on the dimensions of supply chain performances:

(1) The upstream and downstream integrating management has a bigger impact on the competitive ability, indicating iron & steel enterprises can gain higher production efficiency to promote their competitive ability in the whole industry by strengthening the integration of supply chain for their integrated upstream and downstream enterprises.

(2) The internal operation management has a bigger impact on the product quality. The iron & steel enterprises' optimization of the whole iron & steel product manufacturing process directly affects their product quality.

(3) The information management has a bigger impact on the competitive ability. Iron & steel enterprises can more timely master the information on upstream and downstream information and make a quick response by information management, so as to gain stronger competitive ability within the industry.

(4) The strategic factor has a bigger impact on the competitive ability. Iron & steel enterprises can make judgment on their status in supply chain, and their strategies by this can exert a direct impact on their competitive ability.

(5) The supportive factor has a bigger impact on the service quality, indicating iron & steel enterprises' internal management, especially organizational management and corporate construction, are important guarantees for improving customer satisfaction.

VIII. CONCLUSIONS

On the basis of the literature analysis on SCM practices, SCM influence factors and supply chain performance, three dimensions of iron & steel enterprises' SCM practices and two dimensions of their SCM influence factors are determined by focus group interview, questionnaires, factor analysis and path analysis; the analysis is done on the impact of SCM practices and influence factors on the supply chain performances.

The analysis results show that iron & steel enterprises' SCM practices and influence factors both have a significant impact on their supply chain performances; differences exist in impacts of all dimensions of SCM practices and influence factors on the dimensions of supply chain performances.

REFERENCES

- [1] M. Christopher. Logistics: The Strategic Issues, UK, London: Chapman and Hall[M].1992.
- [2] Waller, D. L. Operations Management: a Supply Chain Approach. London: International Thomson Business Press, 1999.
- [3] Larry R. Smeltzer. The Meaning and Origin of Trust in Buyer-Supplier Relationships[J]. Journal of Supply Chain Management,1997,33(4):40-48.
- [4] Reck, R. F., Landeros, R., and Lyth, D. M.. Integrated SupplyManagement: the Basis for Professional Development. International Journal of Purchasing and Materials Management[J].1992, 28(3), 12-18.
- [5] Lee, H.L. and Billington, C. Managing Supply Chain Inventory: Pitfallsand Opportunities. Sloan Management Review[J]. 1992,9(1):65-73.
- [6] John, T. Mentzer, William, Dewitt, James, S. Keebler, Soonhong, Min, Nancy,W. Nix, Carlo, D. Smith and Zach, G. Zacharia. Defining Supply Chain.Management. Journal of Business Logistics[J]. 2001,22(2), 1-25.
- [7] Lee, L. H. and S. Whang. Information Sharing in a Supply Chain. International Journal of Manufacturing Technology and Management[J]. 2000,1(1):79-93.
- [8] Bourland, E. K., G. S. Powell, et al., 1996, Exploiting Timely Demand Information to Reduce Inventories. European Journal of Operational Research[J].1996(92): 239-253.
- [9] Ellram, L. M. Supply chain Management: The Industrial Organization Perspective.International Journal of Physical Distribution and Logistics Management[J].1991,21(1):13-22.
- [10] Perrolle, J. A.Intellectual Assembly Lines: The Rationalization of Managerial, Professional and Technical Work. Computer and social sciences[J].1996(2):111-121.

- [11] Beck, L. C., Trombetta, W. L., & Share, S Using focus group sessions before decisions are made[J]. North Carolina Medical Journal, 1986, 47(2): 73-74.