Identifying Critical Success Factors of Building Green Logistics Business in China

Sung-Chi Wu, Shih-Ming Ou

***Abstract*— Since environmental pollution makes the problem of limited human living space become more severe, any logistics companies, an important source of pollution, need to deal with this issue. This paper intends to explore the critical success factors for building smart green logistics business in China. We first investigate and collect the factors impacting on the operations of smart green logistics business. In order to acquire the assessments from the experts to investigate the influence between each two factors, we invite the managers who serve in the top five logistics companies in Fujian and conduct the expected questionnaire investigation. By using Decision Making Trial and Evaluation Laboratory (DEMATEL) method, we explore the causal effect among factors. Our results show that the government investments and green power development are the two most influential factors among all.**

***Index Terms*— Green Logistics, Critical Success Factor, DEMATEL**

I. INTRODUCTION

IBM has proposed building a future-oriented concept of "smart logistics" since 2009. With this proposal, the supply chain evolves to be more advanced, interconnected and intelligent. By using sensors such as RFID tags, actuators, GPS as well as other devices, many systems with the general idea of "real-time intelligent supply chain" have been proposed. Smart logistics focus on how to build a virtual logistics with dynamic information management system.

With the tremendous grow of e-commerce, consumers' demands rise and the amount of goods increases ultimately fast resulting in a highly developed logistics business. To make the development sustainable, green logistics concept has been widely accepted worldwide. However, green technology and management still do not be adopted by most of the logistics companies in China.

This study focuses on exploring the critical success factors for developing smart green logistics business. To achieve the research objective, we first construct a hierarchy framework with many perspectives such as product, customer, operations, management and finance as well as their rules. Then Decision Making Trial and Evaluation Laboratory (DEMATEL) method is employed to find the crucial success factors. Besides the DEAMATEL approach, interpretive ranking process (IRP) modelling approach is also employed to examine the contextual relationships among CSFs about the performances measures to implement green supply chain management (GSCM) in Indian automobile industry (Sunil Luthra, Dixit Garg, and Abid Haleem, 2014). Their results show that "Competiveness" is with the most significant factor instead of the factor "Support from government" concluded in our study. Hence, the CSFs for different industries to achieve the green logistics might be diverse.

In the next part of this article, methodology that we employ in this paper will be discussed in section 2. An empirical study is addressed in section 3. Conclusions will be reached in section 4.

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II. METHODOLOGY

The DEMATEL analysis method originated from the Battelle Memorial Institute of Geneva, Switzerland, in 1971 for the implementation of the Science and Human Affairs Program. DEMATEL can be used to solve issues between technology and humans—for example, race, hunger, environmental protection, and energy issues. Its primary function was to structure complicated issues and display correlations between influential factors in a visible manner to ensure that the essence of issues could be more easily understood, thus allowing solutions to be found. Furthermore, the upcoming researchers continued to combine DEMATEL with other methods applied in the decision-making process in various research fields such as ANP (Analytic Network Process) and BPNN (Back-propagation Neural Network). Then, DEMATEL is now widely applied in marketing, strategy selection of knowledge management, investment management and market analysis of computer industry (Hsu et.al., 2007; Wu, 2008; Lee et. al., 2011; Hu et. al., 2009; Tsai, 2009; Tsai and Chou, 2009; Yang and Tzeng, 2011; Yang and Tzeng, 2011; Chang et. al., 2011; Lin et. al., 2012; Z. Juan, S. Wenbing, M. Xingmin (2015)).

The DEMATEL scheme has the following steps:

Step 1: Understand the problem and define the factors.

Step 2: Determine the degree of correlation between two factors

Designing a measuring criterion to determine the degree of inter influence between each two factors.

Step 3: Establish initial matrix

Suppose a n×n initial matrix *X*. Each value in the matrix X_{ij} (i = 1, 2, …, *n* ; *j* = 1, 2, …, *n*), expresses the direct degree influence between factor *i* and factor *j*.

$$X=\begin{bmatrix} 0 & x_{12} & \cdots & x_{1n} \\ x_{21} & 0 & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & 0 \end{bmatrix}. \qquad (1)$$

Step 4: Calculate normalized direct influence matrix

$X^k=[X^k_{ij}]$ $(1\le K\le H)$ is the matrix which indicates the assessments acquired from H experts opinions.

$$a_{ij} = \frac{1}{H} \sum_{k=1}^{H} X_{ij}^{k} \quad (2)$$

where i = 1, 2, …, *n* ; j = 1, 2, …, *n*.

Then, the normalized direct influence matrix can be obtained by

$$S \frac{1}{\max_{1 \le i \le n} \sum_{j=1}^{n} a_{ij}} \quad (3)$$

and

$$N = A \times S. \quad (4)$$

Step 5: Find the total influence matrix

Based on the normalized direct relation matric *N*, the total matrix *T* (direct and indirect relation matrix) can be obtained by formula (5) where *I* denotes the unit matrix.

$$T = N\ (I\text{-}N)^{-1}. \quad (5)$$

Step6: Draw and analyze the causal map.

III. Empirical Study

As one of the most important China's international trade center, Fuzhou is located in Minjiang estuary. In the recent years, with the rapid growing of commodity requirements, most main logistics stationed in the Fuzhou. As a result, the city is fully invested in the construction about the intelligent and efficient logistics system.

From September to December in 2016, this study conducted expert questionnaires and received the assessments from the senior managers who work in the main logistics companies in Fuahou, China. After the re-arrangement in this article, the aspects and rules for our proposed scheme are shown in Table 1.

Table 1: Aspects and Rule

Aspect	Rule	Explanation
Product	Usage of green energy and carbon reduction method	Pursuing environmental protection and energy saving as well as carbon reduction as the main value proposition.
Consumer	Environmentalist	The customers who are willing to pay more cost for the environmental sustainability.
	Support from government	Assistance from government could improve the operations of smart green city logistics business.
	Appling information technology to logistics business	Appling information technology to logistics business to maintain more efficient customer relationships.
Operations Management	Logistics service quality	Improvement of logistics service quality.
	Infrastructure	R&D platform and facility construction.
	Laws	Legalization, standardization and institutionalization of logistics industry.
Finance	Logistics costs	Logistics cost control.
	Company investments	Expenditure on developing smart green logistics business.

By using DEMATEL to process the data, the causal-effect diagram is illustrated in Figure 1.

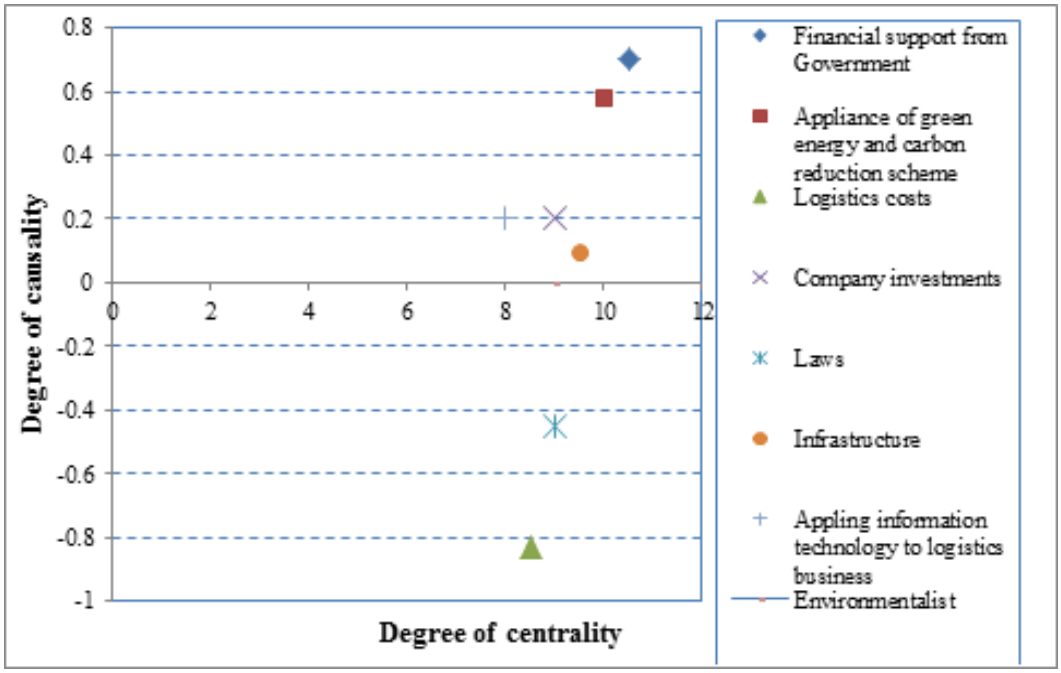

Figure 1: the causal-effect in our questionnaire survey.

Figure 1 shows that factors in the first quadrant with a high degree of centrality and causality illustrate that these are the core factors to affect other factors. These core factors include "Financial support from Government" and "Usage of green energy and carbon reduction scheme". While the factors in the fourth quadrant have high degrees of centrality and a low degree of causality, it shows the fact that these perspectives are not the core factors being most likely affected by other factors. This factor is "Logistics costs" shown in Figure 1.

IV. Conclusions

In this study, we aim at exploring the critical success factors on developing smart green logistics business. This study asked for assessments by the experts in some main logistics companies located at Fuzhou, China. Then this study employs DEMATEL method to explore and visualize the causal relationships among the factors mentioned above. Our research shows that "Financial support from government" and "Usage of green energy and carbon reduction scheme" are the two critical success factors in building green logistics business. In other words, if any government such as China can give vigorous promotion in building green logistics investments, it will facilitate the development of logistics business in a smart green city.

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