EMPIRICAL RESEARCH ON THE CORE FACTORS OF GREEN LOGISTICS DEVELOPMENT

Qunzhen Qu, Shanghai Maritime University
Mengxue Tang, Zhongtai Securities Company Limited
Qing Liu, Shanghai Maritime University
Wenhao Song, Shanghai Maritime University
Fangfang Zhang, Shanghai Maritime University
Wenjing Wang, Shanghai Maritime University

ABSTRACT

The green economy, as a part of China's 13th "Five-Year Plan" philosophy, represents an important breakthrough in national economic reform. The green economy depends heavily on green logistics, and studying the factors influencing green logistics development is important for national strategic planning and economic reformation. In this study, we conducted a systematic analysis of key factors influencing green logistics in terms of governmental, enterprise and environmental aspects of the logistics industry. The Decision-making and Trial Evaluation Laboratory (DEMATEL) model was used to quantitatively determine the degree of comprehensive effects among various factors. A series of key factors restricting the development of green logistics were shown with reference to a quantity relationship, which provides a scientific reference for the development of the green logistics industry and national green economy in China.

Keywords: Green Logistics, Green Economy, DEMATEL Model, Environmental Management, Sustainability.

INTRODUCTION

"Innovation," "Coordination," "Green," "Open," and "Share" represent the five development theories of China's 13th "Five-Year Plan." "Green" includes green development including the green economy, and green logistics are a basic element of the green economy. Green logistics refers to reducing the damage to environment caused by the logistics industry and maximizing resource utilization in the cycle of logistics, with the aim to move toward sustainable development. Green logistics is a component of both the environmental symbiotic economy and adaptive economic development, which have important roles in national green economy strategy.

There are various different perspectives on green logistics among domestic and international scholars. Overseas, Alan Mckinnon (Hoek, 2014) proposed to reduce logistical emissions such as freight intensity, freight mode and vehicle utilization to achieve green logistics. Paula Bajdor (Liancheng li, 2002) introduced the concept of sustainable development in green logistics and analyzed the characteristics of green logistics. Remko Ivan Hoek (Changqiong wang, 2005) conducted research on reverse logistics system construction from the green supply chain perspective and found that enterprise environment management should be built into the company development strategy. Paul Murphy and Richard Poist (Nengming wang,

2003) focused on the green logistic strategy level, highlighting the environmental effects of logistics and the importance of considering the environmental effect when making logistics decisions for an enterprise, indicating the concept of interaction between logistics and the environment. In China, Liancheng Li (Zigang yang & Qinghai guo, 2007) focused on both environmental and logistics dimensions and proposed a package solution with a company-wide green logistics management system. Changqiong Wang (Scott Keller & Katrina Savitskie, 2002) discussed the development of the green logistics industry from the government planning perspective. Yingluo Wang (Dingding xiao, 2010) examined the trend of greening of traditional logistics as the Internet developed and indicated that we could improve efficiency of logistics and complete green logistics in operation level based on internet thinking.

Most research to date has focused on green logistics and enterprise strategy level, but to our knowledge, there has been no scientific quantitative analysis of the specific factors that affect the development of green logistics. Currently, most scholars and experts take the view of government, enterprise and environment as three dimensions and the consistency of the relationship between these three aspects of green logistics influence both academic and practical fields. In this study, we combined these three aspects and applied the Decision-making and Trial Evaluation Laboratory (DEMATEL) model to produce quantitative analysis of the key factors influencing green logistics. We aimed to determine the core influencing factors by contrasting the degree of influence and the center degree and provide a scientific reference for the further development of the green logistics industry.

INDEX SYSTEM OF KEY FACTORS FOR GREEN LOGISTICS DEVELOPMENT

Because of the planning strategy and difference in green awareness between green logistics and traditional logistics, green logistics development emphasizes attention to the environment in all aspects; green logistics businesses should consider greening their logistical work and management, and government should control and supervise green logistics businesses and press for greening of currently non-green factors in the logistics cycle system (Nengming wang, 2003). In this study, we refer to both academic research and actual practice, choosing the three factors of government, enterprise and environment as the basis for the study and producing an in-depth analysis of the factors influencing green logistics development.

Government Factor

As the urgency increases for industry to transform to green logistics under the current domestic logistics development situation, governments will without doubt take a leading role and become market macroeconomic regulators. Their duties will include the following:

(1) Making relevant industry laws and regulations to guide and supervise logistics. On the one hand, government could play a regulatory function to increase efficiency of green logistics companies and reduce the number of non-green traditional logistics companies. On the other hand, using economic leverage, they could guide the green logistics companies based on tax revenue and green subsidy or some other economic method.

(2) Policy could be used to support green logistics education, which could enhance the acknowledgement of the importance of green logistics and also enhance consumer support using the recognition of market choice, thus providing more support for green logistics companies. This approach could also bring up more professional talents for the green logistics revolution to ensure the talent supply–demand chain of green logistics enterprises.

(3) Improve infrastructure construction, and establish an intelligent and modern professional platform for green logistics normalization. Through the participation of government, improving the environment and social

benefits, government may ensure that China's logistics enterprises have more competitive power than the international logistics competition, and thus obtain more power for green economy realization.

Enterprises Factor

Enterprises, as the executive players in green logistics development, represent the most constrained influence factor among green logistics system construction, within the greening process of logistics work and management, with the following green logistics development segment factors:

(1) It is important for managers of the company to respond to green logistics development; senior management at companies play crucial roles in spreading green logistics awareness, to ensure that the idea penetrates into the company system.

(2) Achieving higher equipment automation and information integration is the basis of logistics work systems at the logistics technological work level. The latest technology will provide a large improvement to aspects of logistics (such as green packing, green transportation and green storage) in the green supply chain.

(3) Enterprises should pay more attention to the green marketing from the company mission perspective, in addition to improve their own green logistics operations and management system. Only when the consumer accepts the marketing of green logistics by companies, can green logistics products be sold smoothly. This would provide companies with better product benefits and service profits than traditional logistics. This would in turn can put more pressure on traditional logistics enterprises to accelerate the green logistics revolution.

(4) The reverse logistics system. The contradiction between resource and efficiency will increase because of the decline in overall stock of ecological resources. Regardless of whether the company takes the view of taking social responsibility or of self-efficiency sustainability, all modern enterprises should focus on the highly efficient reverse logistics system. Reverse logistics must be essential part in the green supply chain cycle, emphasizing resource recycling and breaking the environmental and ecological bottleneck.

Environment Factor

Progress in green logistics development progress also represents the greening progress across the logistics system industry; the companies' individual missions and social responsibility perspectives generally require companies to become resource efficient and consider ecological perspectives, not only focus on economic benefits to their business. The sustainable development strategy put forward the basic mode of modern production and consumption: clean production–green circulation–reasonable consumption (Zigang yang & Qinghai guo, 2007). Green circulation is the middle point that links the start and end of this cycle, so from this perspective it is no longer a single simple factor of green logistics, but is the framework for the whole logistics cycle. Environmental factors such as atmosphere, noise and garbage have an important influence on green logistics process reengineering; they bring human and technological challenges to greening the logistics system, and the result of these challenges will influence the energy utilization rate of enterprises (Scott Keller & Katrina Savitskie, 2002). These factors indicate that green logistics development is an essential component of social sustainable development. This leads us to understand the central notion of environmental development within whole logistics system, which is as far as possible to reduce the destruction of logistics business to the ecological environment and save ecological resources, make the ecosystem and economic system organically composite to an ecological economic system, and make the green logistics process an environmental economic process (Dingding xiao, 2010; Grant, 1996; Lee, Chen, Tsai & Wang, 2014; Guo, Zhou, Yu & Tsai, 2015; Tsai, Chien, Xue & Li, 2015).

Through the above analysis of government, enterprises and environment, we constructed an index system for green logistics key influence factors in Figure 1:

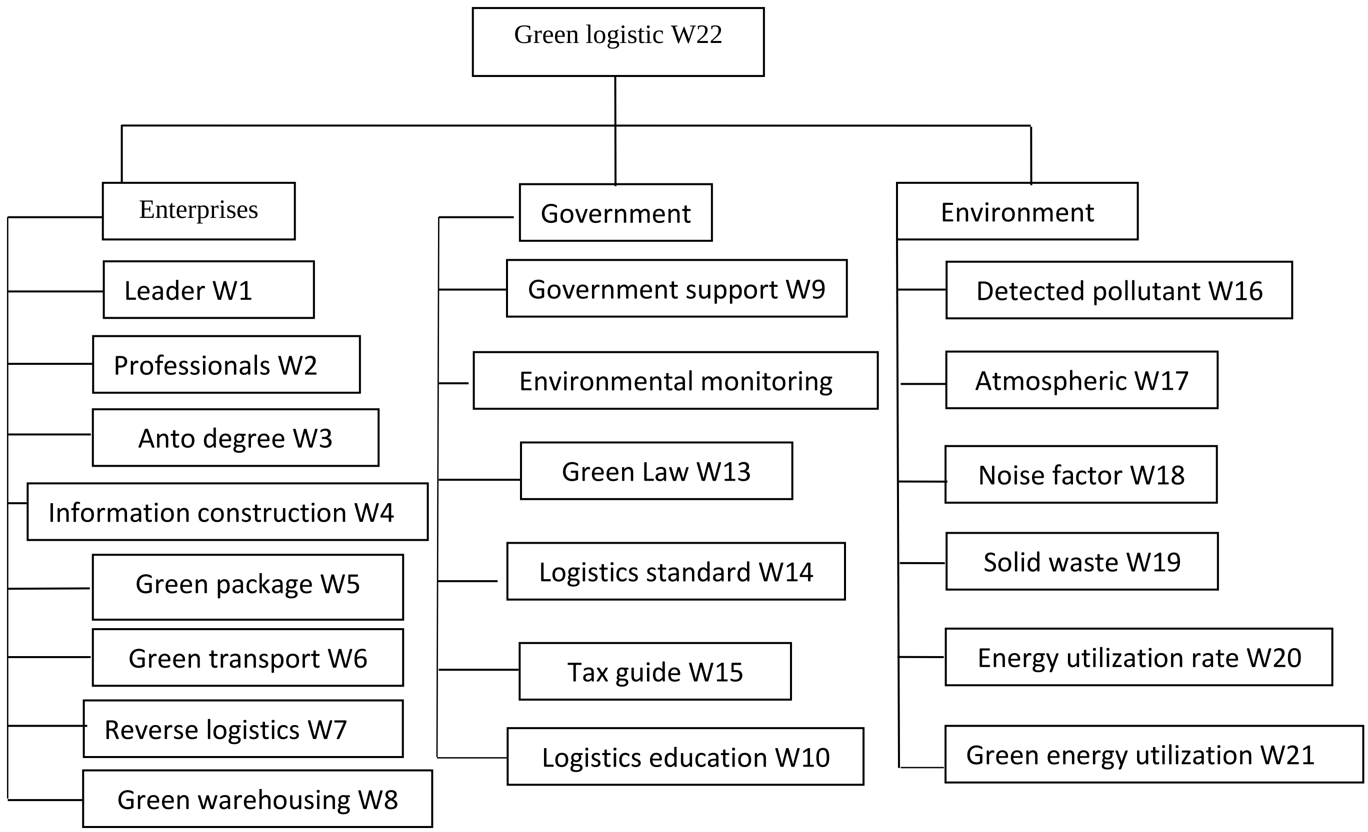

Figure 1
SCHEMATIC OF THE KEY INFLUENCE FACTORS INDEX SYSTEM FOR GREEN LOGISTICS

SEGMENT FACTOR CORRELATION ANALYSIS

To identify the core factor influencing green logistics, we first need to analyze the filtered relations between key factors. We process the relations between different influence factors by choosing an actual situation and green logistics theory as reference standards. For example, “Green logistics education” of government will influence “Technicians,” “Green marketing” and “Managers” of enterprise, and the “Atmosphere,” “Noise” and “Sustainable development” will also influence “Green logistics standards,” “Green packaging” and “Green transport. There is a complex relationship between each factor. In this study, we consider the relationships between these factors by listening to the advice of a range of experts. We define factors *i* and *j*; if *i* is affected by *j*, then their relation value is 1, otherwise it is 0, and vice versa. The relation table of factors influencing green logistics development is presented in Table 1.

Table 1
RELATION TABLE OF FACTORS INFLUENCING GREEN LOGISTICS DEVELOPMENT

NO	W1	W2	W3	W4	W5	W6	W7	W8	W9	W 10	W 11	W 12	W 13	W 14	W 15	W 16	W 17	W 18	W 19	W 20	W 21	W 22
W1	1	1	1	0	0	0	0	0	1	1	0	0	0	0	1	1	1	0	0	0	0	0
W2	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0
W3	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
W4	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
W5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
W6	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
W7	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
W8	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W9	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
W10	0	0	0	0	1	1	1	1	1	0	0	0	0	0	1	1	0	0	0	0	0	1
W11	0	1	0	1	0	0	1	0	0	1	0	1	1	1	0	1	0	0	0	0	0	1
W12	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	1	0	1	0	1	0	1
W13	0	0	0	0	1	1	1	1	0	0	0	1	0	0	1	0	0	1	1	1	1	0
W14	0	0	0	0	1	1	0	0	0	1	1	1	1	0	0	1	0	1	1	0	0	1
W15	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	1	1
W16	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
W17	0	0	0	0	1	1	1	0	1	1	0	1	0	1	0	1	0	0	0	0	1	1
W18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1
W19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
W20	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
W21	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W22	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1

The above table indicates that the complexity between different influence factors, and this complexity represents a major problem for determining the core influence factor of green logistics development because we may confuse both the degree and effect point of the influence. To be more scientific about quantifying these factors and their influences, we therefore used the DEMATEL model to conduct an analysis of green logistics key influence factors and determine the quantitative index relationship.

ANALYSIS MODEL OF KEY FACTORS INFLUENCING GREEN LOGISTICS

The DEMATEL model was proposed by the American Battelle research laboratory. The model could use the graph and matrix tool to conduct systematic quantitative research involving contrasting factors affecting logical relation matrix and direct effect matrix, calculating the degree of effect of the factors, further calculating the central factors of various factors and the contribution of the degree, so as to obtain the results of factor sorting (Tsai, Saito, Lin & Chen, 2015; Lee, Wu & Tsai, 2014; Guo & Tsai, 2015; Tsai, Xue & Huang, 2015; Tsai, Huang, Wang & Chen, 2016; Tsai, 2016).

The model of factors influencing green logistics used in this study, based on DEMATEL is conducted as described below (Tsai, Lee & Guo, 2014; Zhou, Wang & Tsai, 2016; Guo & Tsai, 2015; Tsai, Xue & Zhang, 2016):

(1) Establish the influence factors. Define "green logistics" as the overall factor, and then establish the green logistics influence factor as the second segment factor, defined as M_1, $M_2 \dots M_{23}$.

(2) Determine the relationships between factors. Based on extensive reference professional data and the advice of experts analyze the influence relation of various factors and draw the interrelationship directional graph. If the estimate factor M_j is directly affected by M_i, then just draw an arrow from M_i to M_j. There are multiple arrows to one factor at the same time if the factor is affected by many other factors.

(3) Transformation of the direct effect matrix, which means that to show the relationships for each factor by matrix, an order matrix is defined as $A = (C_{ij})_{n \times n}$ (Table 1), where C_{ij} is 1 if factor M_j is directly affected by M_i, otherwise $C_{ij} = 0$.

(4) Direct influence matrix normalization. Sum each row of matrix A as n_i, where the maximum of n_i is $n_{i(\max)}$, define X as $X/n_{i(\max)}$.

(5) Build the comprehensive influence matrix. To analyze the indirect relationship between influence factors, we need build a comprehensive influence matrix T, define $T = A + A_2 + \dots + A_n = A (I - A) - 1 = (t_{ij})_{n\times n}$ by referring to the DEMATEL formula.

(6) Key factors analysis. In the comprehensive matrix T, define t_{ij} as the value that factor j is affected by i directly or indirectly, indicating the degree of influence of factor i. Define Tr as sum of each row, $Tr = (Tr(1), Tr(2), \dots, Tr(n))T$, where Tr is influence degree for how each row of factors corresponds to other factors. Define Tc as sum of each column, $Tc = (Tc(1), Tc(2), \dots, Tc(n))T$, where Tc is influence degree for how each column of factors corresponds to other factors. Define core degree of factor Mi as $\alpha_i = Tr(i) + Tc(i)$, indicating the location and degree of contribution of factor Mi in the comprehensive influence matrix. Define reason degree (the difference between the influence and influenced degree of the system elements) of factor Mi as $\beta_i = Tr(i) - Tc(i)$; if $\beta_i > 0$, this factor has a more important influence on other factors ($Tr(i) > Tc(i)$) and may be called a "reason factor"; otherwise, if $\beta_i < 0$, other factors have bigger influence on this factor, and may be called a "result factor."

According to the correlation matrix, we can retrieve the influencing factors that need to be paid attention, and then calculate the influence and influence degree of the green logistics. Finally, the position and importance of the factors of interest are analyzed by the comparison of the degree of the center. Moreover, the degree of reason can give us a clearer understanding of the specific influence of the influencing factors and provide a reference for positive or negative strategies for specific influencing factors.

RESULTS AND DISCUSSION

We calculated the comprehensive influence matrix of the different factors influencing green logistics, by applying the DEMATEL formula based on the direct influence matrix in Table 1, and the reason or result degrees are shown in Table 2.

Table 2
ANALYSIS AND EVALUATION OF KEY FACTORS INFLUENCING GREEN LOGISTICS (×100)

NO	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
W1	0	1.85	3.01	0	12.31	6.66	7.32	2.15	4.11	1.44	0	4.21	0.90	3.98
W2	0	1.26	2.75	0	9.30	7.87	5.48	3.18	2.90	1.26	0	4.02	0.87	2.79
W3	0	0.74	1.61	0	5.44	4.60	3.20	1.86	1.69	0.73	0	2.35	0.50	1.63
W4	0	0.81	1.76	0	5.97	5.05	3.51	2.04	1.86	0.81	0	2.58	0.56	1.79
W5	0	0.96	2.09	0	7.07	5.97	4.16	2.41	2.20	0.95	0	3.05	0.66	2.12
W6	0	0.57	1.24	0	4.21	3.56	3.12	1.44	1.31	0.57	0	1.82	0.39	1.26
W7	0	0.67	1.46	0	4.94	4.18	2.91	1.69	1.54	0.67	0	2.13	0.46	1.48
W8	0	0.30	0.65	0	2.19	1.85	1.29	0.75	0.68	0.30	0	0.95	0.20	0.66
W9	0	1.35	2.94	0	9.94	8.41	5.85	3.39	3.10	1.34	0	4.30	0.92	2.98
W10	0	2.24	6.98	0	16.53	13.98	9.73	5.64	5.15	2.23	0	7.14	1.54	4.96
W11	0	4.65	10.14	0	34.32	29.02	20.20	11.71	10.69	4.64	0	14.83	3.19	10.29
W12	0	1.89	4.11	0	13.91	11.77	8.19	4.75	4.33	1.88	0	6.01	1.29	4.17
W13	0	2.94	6.41	0	21.71	18.36	12.78	7.41	6.76	2.93	0	9.38	2.02	6.51
W14	0	3.87	8.44	0	28.59	24.17	16.83	9.76	8.90	3.86	0	12.35	2.66	8.57
W15	0	2.06	4.49	0	15.22	12.87	8.96	5.19	4.74	2.05	0	6.57	1.42	4.56
W16	0	0.47	1.03	0	3.47	2.93	2.04	1.18	1.08	0.47	0	1.50	0.32	1.01
W17	0	4.15	9.05	0	30.64	25.91	18.04	10.46	9.54	4.14	0	13.24	2.85	9.19
W18	0	0.97	2.12	0	7.18	6.07	4.23	2.45	2.24	0.97	0	3.10	0.67	2.15
W19	0	0.64	1.39	0	4.72	3.99	2.78	1.61	1.47	0.64	0	2.04	0.44	1.42
W20	0	1.20	2.62	0	8.87	7.50	5.22	3.03	2.76	1.20	0	3.83	0.82	2.66
W21	0	0.23	0.50	0	1.69	1.43	0.99	0.58	0.52	0.23	0	0.73	0.16	0.51
W22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Line Total	0	26.94	77.43	0	249.44	232.79	152.66	88.11	73.43	32.92	0	111.21	25.47	76.6
W15	W16	W17	W18	W19	W20	W21	W22	Row Total	Reason degree			Core degree		
4.71	5.71	0	7.52	3.82	6.12	10.01	11.12	100	100			100		
4.07	4.66	0	7.41	3.57	6.1	8.86	8.36	92.23	58.03			126.43		
2.38	2.72	0	4.33	2.09	3.56	5.18	4.88	53.9	−20.6			128.4		
2.61	2.99	0	4.76	2.29	3.91	5.69	5.36	59.18	59.18			59.18		
3.09	3.54	0	5.63	2.71	4.63	6.73	6.35	70.03	−182.17			322.23		
2.84	2.11	0	3.36	1.62	2.76	4.01	3.79	41.75	−171.55			255.05		
2.16	2.48	0	3.94	1.9	3.24	4.71	4.44	49	−99.5			197.5		
0.96	1.1	0	1.75	0.84	1.44	2.09	1.97	21.74	−64.35			107.83		
4.34	4.98	0	7.92	3.82	6.52	9.47	8.93	98.54	20			177.08		
7.22	8.28	0	13.17	6.35	10.83	15.74	14.85	163.82	129.72			197.92		
15	17.2	0	27.35	13.18	22.5	32.69	30.84	340.2	340.2			340.2		
6.08	6.97	0	11.09	5.34	9.12	13.25	12.5	137.9	31.4			244.4		
9.49	10.88	0	17.3	8.34	14.23	20.68	19.51	215.19	191.69			238.69		

12.49	14.32	0	22.78	10.98	18.74	27.23	25.69	283.35	207.75	358.95
6.65	7.62	0	12.12	5.84	9.98	14.49	13.67	150.8	40.6	261
2.52	1.74	0	2.76	1.33	2.27	3.31	3.12	34.36	−92.04	160.76
13.39	15.35	0	24.41	11.77	20.09	29.18	27.53	303.71	303.71	303.71
3.14	3.6	0	5.72	2.76	4.71	6.84	6.45	71.18	−129.82	272.18
2.06	2.36	0	3.76	1.81	3.09	4.49	4.24	46.77	−50.09	143.63
3.87	4.44	0	7.06	3.41	5.81	8.44	7.97	87.88	−77.42	253.18
0.73	0.84	0	1.34	0.65	1.11	1.61	1.51	16.73	−223.47	256.93
2.70	3.13	0	4.98	2.4	4.1	5.95	5.61	59.5	−167.1	286.1
0	0	0	0	0	0	0	0	0	−201.5	207.9
112.19	121.44	0	203.75	99.97	172.11	241.01	212.18	-	-	-

Based on the calculated results from Table 2, we generated a reason degree and the core degree effect graph (Figure 2) for all the factors using SPSS19.0 (IBM, New York, US). The distribution of two degrees is chaotic, sometimes concentrated and sometimes scattered, indicating that there is no clear rule to follow.

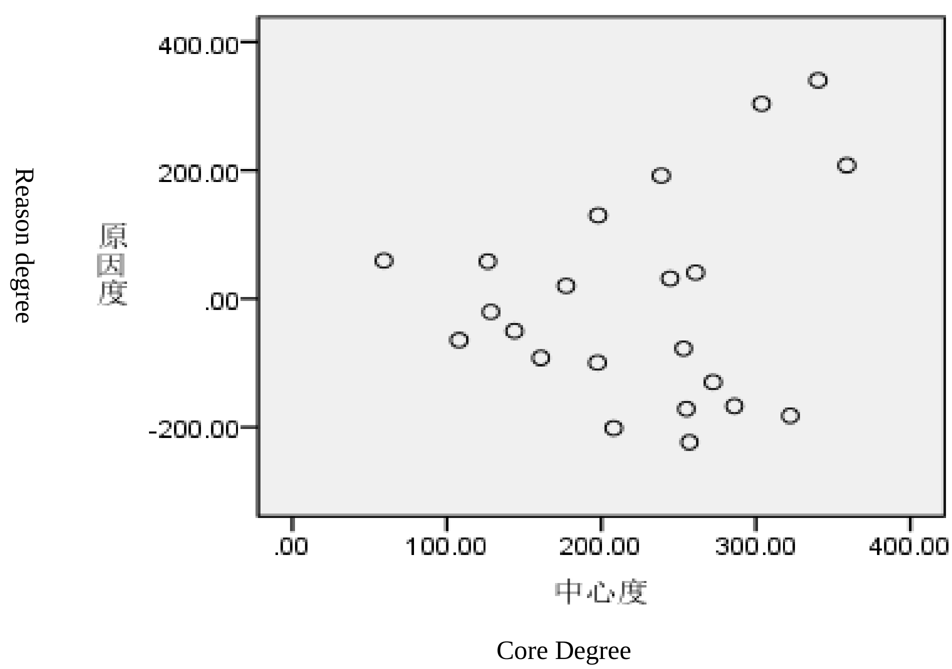

Figure 2
REASON DEGREE AND CORE DEGREE EFFECT GRAPH

Key Factors Filter

Sorting factors by contribution value, observing the reason and core degree of index, allowed us to then determine the core contribution factors as follows:

(1) We first filtered the reason degree, divided the influence factors into two categories based on whether the value is positive or negative. For reason factors, we ranked the factors based on their reason degree (>0): “Government support,” “Sustainable development,” “Green laws and regulations,” “Environmental monitoring system,” “Green logistics education,” “Managers,” “Informatization,” etc. For result factors, we ranked the factors

according to the absolute value of the reason degree as follows: “Energy utilization rate,” “Green packing,” “Green transport,” “Green energy utilization rate,” etc.

The reason factors are positive dynamic factors, the factors earlier in the order may be understood as those with a positive effect on green logistics and those that we should enhance and improve in strategy. The result factors will be more easily affected by other factors, and thus we can control and manage these factors to produce an effect on the result factor, so the performance of the result factor will be improved. Taking energy utilization rate as an example, it is certainly affected by “Informatization,” “Green transport” and “Technicians,” and thus the enterprise energy utilization rate can be improved by taking positive actions on these three factors.

(2) We filtered for the core degree and ranked the factors by value: “Green laws and regulations,” “Government support,” “Green packing,” “Sustainable development,” “Green energy utilization rate,” “Green logistics standard,” etc. This indicates that green laws and regulations and government support were in the central location by a larger amount, suggesting that they possess a greater driving force and balance effect on other factors. Therefore, these factors will have a greater influence on green logistics development.

Analysis at Government, Enterprise and Environment Levels

We next explain the contribution role of factors from government, enterprise and environment levels to show their influence degree, reason and core degree as shown in Table 3.

Table 3
GOVERNMENT, ENTERPRISE AND ENVIRONMENT INFLUENCE DEGREE, REASON DEGREE AND CORE DEGREE AND INDICATED LEVEL.

Metric	Influence Degree	Reason Degree	Core Degree
Government	120.97	600.74	1504.67
Level	1	1	2
Enterprise	38.09	1387.63	−289.97
Level	3	3	−2
Environment	57.23	1623.88	−601.31
Level	2	1	−1

Table 3 indicates that regardless of whether a factor is identified as an influence degree, reason degree or core degree, government is the main factor influencing green logistics development. Only the government value for the core degree is positive, indicating that it has a positive power on the development of green logistics, and the reason degree for enterprise is between government and environment, suggesting that the role of enterprise is changing from passive to active. As for the influence and core degree, the value of government is greater than the sum of the other two levels, suggesting that government is of key importance to the green supply chain cycle.

CONCLUSION

At the current important stage of the national economic revolution in China, sustainable development is the essential breakthrough point for the national green economy and ecological economy, and the green logistics is the major node that links modern production and consumer model. In this study, we quantitatively analyzed the influence relationships between government, enterprise, environment and green logistics using the DEMATEL model. By comparing each factor, we found that “Green laws and regulations,” “Government support” and “Green packing” are the core factors influencing green logistics, and the government has an important role in these factors; the development of green logistics is not entirely the responsibility of enterprises. The conclusions of this paper provide a reference for decision making in green logistics development.

By pushing the development of green logistics, China's green economy will develop dynamically and provide future ecological, economic and social benefits.

REFERENCES

Hoek, R. (2014). From reversed logistics to green supply chains. *Supply Chain Management, 4*(3), 129-135.

Liancheng li. (2002). Green logistic: Modern enterprise inevitable choice of sustainable development. *Business & Trade Economy, 11*(5), 32-35.

Changqiong wang. (2005). The logistics industry sustainable development evaluation index system. *Economic Management*, (1), 38-40.

Nengming wang. (2003). Green supply chain management. *Beijing: Tsinghua university press*, 15-16.

Zigang yang & Qinghai guo. (2007). Development status and trend of international logistics in globalization background. *China Trade Economy, 21*(11), 17-20.

Scott Keller, B. & Katrina Savitskie. (2002). A Summary and Analysis of Multi-item Scales Used in Logistics Research. *Journal of Business Logistics*, 101-113.

Dingding xiao. (2010). Research on the factors of green logistics from the DEMATEL view. *Industry Project*, (13), 52-57.

Grant, R.M. (1996).Toward A Knowledge-based Theory of the Firm. *Strategic Management Journal*, (17),109-122.

Lee, Y.C., Chen, C.Y., Tsai, S.B. & Wang, C.T. (2014). Discussing green environmental performance and competitive strategies. *Pensee*, *76*(7), 190-198.

Guo, W.F., Zhou, J., Yu, C.L. & Tsai, S.B. (2015). Evaluating the green corporate social responsibility of manufacturing corporations from a green industry law perspective. *International Journal of Production Research, 53*(2), 665-674.

Tsai, S.B., Chien M.F., Xue Y. & Li L. (2015). Using the Fuzzy DEMATEL to determine Environmental Performance: A Case of Printed Circuit Board Industry in Taiwan. *10*(6)

Tsai, S.B., Saito, R., Lin, Y.C. & Chen, Q. (2015). Discussing measurement criteria and competitive strategies of green suppliers from a Green law Perspective: Proceedings of the Institution of Mechanical Engineers. Proceedings of the Institution of Mechanical Engineers. *Journal of Engineering Manufacture, 229*(1), 135-145.

Lee, Y.C., Wu, C.H. & Tsai, S.B. (2014). Grey System Theory and Fuzzy Time Series Forecasting for the Growth of Green Electronic Materials. *International Journal of Production Research, 299*(8), 1395-1406.

Guo, J.J. & Tsai, S.B. (2015). Discussing and evaluating green supply chain suppliers: A case study of the printed circuit board industry in China. *South African Journal of Industrial Engineering, 26(*2), 56-67.

Tsai, S.B., Xue, Y., Huang, P.Y. (2015). Establishing a criteria system for green production. Proceedings of the Institution of Mechanical Engineers. *Journal of Engineering Manufacture*, *229*(8), 1395-1406.

Tsai, S.B., Huang, C.Y., Wang, C.K. & Chen, Q. (2016). Using a Mixed Model to Evaluate Job Satisfaction in High-Tech Industries. *11*(5).

Tsai, S.B. (2016). Using Grey Models for Forecasting China's Growth Trends in Renewable Energy Consumption. *Clean Technologies and Environmental Policy*, *18*, 563-571.

Tsai, S.B., Lee, Y.C. & Guo, J.J. (2014). Using Modified Grey Forecasting Models to Forecast the Growth Trends of Green Materials: Proceedings of the Institution of Mechanical Engineers. *Journal of Engineering Manufacture, 228*(6), 931-940.

Zhou, J. Wang, Q. & Tsai, S.B. (2016). How to Evaluate the Job Satisfaction of Development Personnel. *IEEE Transactions on Systems Man Cybernetics-Systems*.

Guo, J.J. & Tsai, S.B. (2015). Discussing and evaluating green supply chain suppliers: A case study of the printed circuit board industry in China. *South African Journal of Industrial Engineering, 26*(2), 56-67.

Tsai, S.B., Xue, Y. & Zhang, J. (2016). Models for Forecasting Growth Trends in Renewable Energy. *Renewable & Sustainable Energy Reviews.*

Lee, Y.C., Chu, W.H. & Chen, Q. (2016). Integrating DEMATEL Model and Failure Mode and Effects Analysis to Determine the Priority in Solving Production Problems. *Advances in Mechanical Engineering*, *8*(4), 1-12.