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# A Study on the Factors Affecting E-logistics Systems in the Chinese Logistics Industry

Liu Yu
first author, Ph.D Student of Yeungnam University
Jung-Han Bae
corresponding author, Professor of Yeungnam University

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## Abstract

With the rapid growth of e-logistics in the global logistics industry, it is important to gain further insight into this growing segment of Chinese logistics industry. The current situation in China consists of many small and medium-sized logistics firms. Furthermore, e-logistics is still relatively undeveloped in the majority of the Chinese logistics companies and presently there are still many problems unresolved. This paper attempted to review the concepts and theoretical background of e-logistics systems from previous studies. After acknowledging the essential issues related to e-logistics systems, a research model based on the theory acceptance model was designed and tested.

The key factors to the e-logistics system (reliability, maintainability, software, facility and transportation) were validated through the modeling and testing process. Included in the modelling and testing process are other related factors of e-logistics process, logistics information system and added value as dependent variables in this model. The results of this study confirm that the e-logistics Process is affected by transportation, while maintainability and software factors influence logistics information system. reliability, maintainability, facility and transportation are significant factors associated with added value.

This research aimed to provide theoretical and practical contribution to Chinese logistics companies and to give some insights into e-logistics system as a whole. The paper also provided some useful theoretical implication and practical guidelines for the development of e-logistics system in the chinese logistics industry.

Key Words : e-logistic system, e-logistic process, logistic information system

# I. INTRODUCTION

## 1. Background and Research Objectives

The advent of the new digital economy has triggered a new type of logistics -called- e-logistics, which has become a “must have” in the global logistics industry. The speed of ordering via the Internet and other technologies exacerbates the need for an efficient and effective logistics system that can deploy appropriate levels of inventory, speed up completed orders to customers, and manage returns.[1)]

Minimizing the logistics costs in order to maintain competitiveness can be seen as an ongoing process in the 21st century. Nowadays, both global and local logistics corporations have to enhance their market competitiveness by applying efficient and effective ELS to reduce their logistics cost and improve customer services. As seen in the review of selected literature, e-logistics has become an indispensable way of doing both domestic and international trade. The successful implementation of ELS is expected to bring a number of benefits to the logistics industry. A better understanding of these benefits may help to further motivate logistics service provides to adopt ELS.

With the increase of global competition and the rapid progress of the logistics industry, Chinese logistics industry (CLI) also faces a big challenge. The development of e-logistics in the CLI is still relatively low owing to restraints resulting from different conditions. Since the logistics industry was introduced in China, the Chinese government and enterprises have been paying much more attention to it than before. Since China’s accession to the World Trade Organization(WTO) on December 11, 2001 sets the CIL has grown even faster, bringing tremendous opportunities, as well as intense competitive challenges from global players. with –the increasing intensity of competition after the WTO accession, Chinese logistics companies(CLCs) have been trying ways of creating more effective services to their customers and try to build their own ELS to allow them to survive in the global logistics market. Therefore, many issues related to ELS have emerged in CLCs.

Considering the increasing environmental complexity and competitive pressure along with increased market opportunity, research on ELS in the CLI in the international context can provide many useful insights. That is the major reason why this study focuses on the survey on the ELS adoption in the CLI. The purpose of this study thus stated as follows:

Firstly, the study states the definition and factors influencing ELS according to previous research. Secondly, the study empirically examines the major factors affecting ELS in (CLCs). Thirdly, after identifying the factors,

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1) John J. Coyle, Edward J. Bardi and C. John Langley, Jr., The Management of Business Logistics: A Supply Chain Perspective, the 7th Edition., p.1.

this study would endeavor to propose some suggestions to CLCs, which adopt ELS, to help them operate more successfully and effectively. Fourthly, this paper will attempt to suggest ways on how CLCs should adopt ELS.

### 2. Research Methodology

The research methodology employed here is based on empirical data collected through questionnaire surveys distributed to persons in charge of ELS in CLCs. This research involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence. The survey questionnaire consisted of scaled, as well as open-ended, questions on the extent to which the respondent companies had adopted the ELS in their operations, and the factors that influence ELS.

Because the exact number of logistics service providers (LSPs) in China is not known, a random sample of 1,000 LSPs involved in freight forwarding, shipping, transportation and warehousing services was drawn from the Logistics Directory in China. The completed questionnaires were to be returned within a month. Of the 1,000 questionnaires mailed, 140 were returned and used for analysis. The overall response rate was 14%, which is considered as an acceptable rate for a mail survey in China. We examined the potential non-response bias using the procedures recommended by Armstrong and Overton(1977)[2], whereby we compared the first half of the responses received (the theoretical respondents) with those of the second half (the theoretical non-respondents). We tested for the mean differences between the two groups of responses in a random selection of measurement items in the questionnaire. We found no significant differences ($p > 0.10$) in the means of the variables between the theoretical respondents and non-respondents. As such, the data collected in this study should not exhibit a non-response bias.

## Ⅱ. Literature Review

### 1. Definition of e-logistics systems

E-logistics can be defined simply as the application of Internet based technologies to traditional logistics processes. Dawe(1995) showed the logistics system is a collection of data, hardware, software, and rules that work together to support an activity.[3]

2) Armstrong, J.S., and T.S. Overton, *Estimating nonresponse bias in mail surveys,* Journal of Marketing Research 14(3), 1977, pp. 396-402.

## 2. Main components of e-logistics systems

Cheng and Yue(2006) explained details ELS. They pointed out that ELS can be described from the aspects of process, information system and value.

### 1) The e-logistics process (ELP)

Zhang[4](2001) described the process of e-logistics as the following:

#### (1) Request for quotes (RFQ)

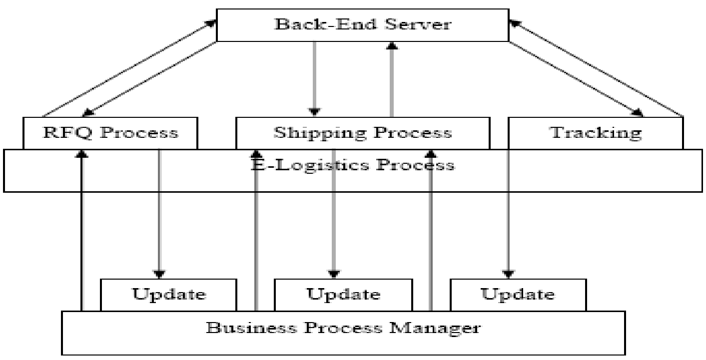
It is done by the business manager to getting the basic services such as quotes for an e-logistics process. Whenever the response is obtained, the purchase order (PO) is updated.

#### (2) Shipping

The shipping process is also invoked by the business process manager, who upon completion of the process ,updates the PO.

#### (3) Tracking

Once goods are shipped, the tracking number is given to the customer and that tracking number is mapped to the PO number in an e-commerce system. Customers can track their shipment with the help of that number.



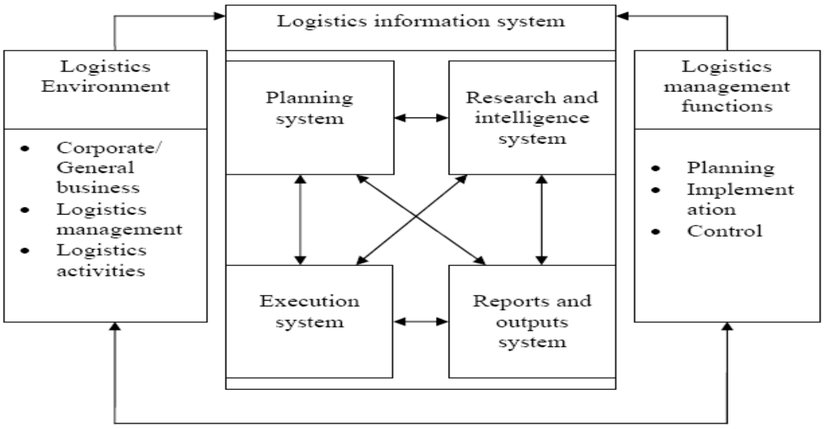

Source: Adapted from Zhang, 2001.

[Figure 1] High-level view of e-logistics processes integration framework

3) Dawe, R.L., *System put your house in order.* Transportation & Distributio, ,Oct.1995, pp. 102-106.
4) Zhang Liang-Jie, Yadav Pooja, Chang Henry, Akkiraju Rama, Chao Tian, Flaxer David, Jeng Jun-Jang, ELPIF: An E-logistics Processes Integration Framework: Based on web Services, IBM TJ. Watson Research Center, 2001.

### 2) Logistic information system (LIS)

Coyle[5](2003) proposed the model for a logistic information system. It may be defined as: an interacting structure of people, equipment, and procedures that together make relevant information available to the logistics managers for the purpose of planning, implementation, and control.




Source: Adapted from Coyle, 2003.

[Figure 2] Logistics information system

<Figure 2> highlights the relationships among the logistics information system (LIS), the elements of the logistics environments, and the logistics decision-making process. The diagram shows four principal subsystems, which are discussed below:

#### (1) Planning System

The planning system is referred to as a set of decision support technologies, that provides data and analytic models to help decision makers solve unstructured problems Such as those with many difficult-to-define variables. With the help of the planning system, managers can make better decisions and gain broader insight into issues that are strategic to the conduct of logistics and supply chain activities. (Coyle, 2003)

#### (2) Execution System

The technologies included in the LIS execution system are those that are responsible for the short-term,

5) John J. Coyle, Edward J. Bardi and C. John Langley, Jr., The Management of Business Logistics: A Supply Chain Perspective, the 7th Edition., pp. 465-473.

day-to-day functioning of the logistics system. Included are technologies that help manage activities in areas such as warehousing, transportation, international trade, and inventory. Also included is the range of capabilities needed to effectively manage the customer orders which initiate the supply chain activities.

#### (3) Research and Intelligence System

To effectively manage activities within the logistics manager's responsibilities, the logistics manager must have useful information. The LIS research and intelligence system scans the environment and makes observations and conclusions available throughout the logistics area and the whole firm.

#### (4) Report and Outputs System

The reports and outputs system is the fourth major component of the ELS. Reports may serve such purposes as planning, operations, and control.

### 3) Value

According to Zhang and Yue[6] (2006), ELS adds the following values:

time utility, revenue, operating cost, administration cost, fixed assets, customer cost saving, supplier cost saving, customer number, working capital and tax.

## 3. Factors influencing the e-logistics systems

Cheng and Yue(2006) found that most of the factors influence e-logistics in both global and local logistics corporations. However, the degree of importance of factors is different in China. The results are as follows:

- Reliability, maintainability, software and facility, transportation and handing serve as key factors for ELS
- Economic factors and supply support factors are somewhat important for ELS
- Other factors are less important for ELS

Therefore, this paper only researches on the most important factors for ELS.

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6) Cheng Wang and Yue Chen, the Utilizing e-logistics: case studies in Sweden and China(2006) http://epubl.luth.se/1653-0187/2006/10/LTU-PB-EX-0610-SE.pdf.

### 1) Reliability factors

Some view reliability as the likelihood that the product will not break. There is more to it than that: "Reliability is the probability that an item will perform its intended function for a specified interval in a stated condition."(Gerstle[7), 2004). The frequency of maintenance for a given item is highly dependent on there liability of that item. In general, as the reliability of a system increases, the frequency of maintenance will decrease, and vice versa, Unreliable systems will usually require extensive maintenance.[8)](Blanchard,1998)

### 2) Maintainability factors

Maintainability is an inherent design characteristic dealing with the ease, accuracy, safety, and economy in the performance of maintenance functions. Maintainability, in the broadest sense, can be influenced in terms of a combination of elapsed times, personnel labor-hour rates, maintenance frequencies, maintenance cost, and related logistic support factors.

### 3) Software factors

For many systems, software has become a major element of support. This is particularly true where automation, computer applications, and digital data bases are used in the accomplishment of maintenance and logistics functions. As with equipment, reliability and quality are significant considerations in software the development.

### 4) Facility factors

Facilities include the planning, acquisition and management of permanent or semi-permanent real-estate and property assets required to support the system[9)] (Galloway, 1996). These are required to support activities related to the accomplishment of active maintenance tasks, providing warehousing functions for spares and repair parts, and providing housing for related administrative functions.

### 5) Transportation, and handling factors

Transportation requirements include the movement of human and material resources between the sources of supply and the various locations where maintenance activities are accomplished. In essence, transportation plays

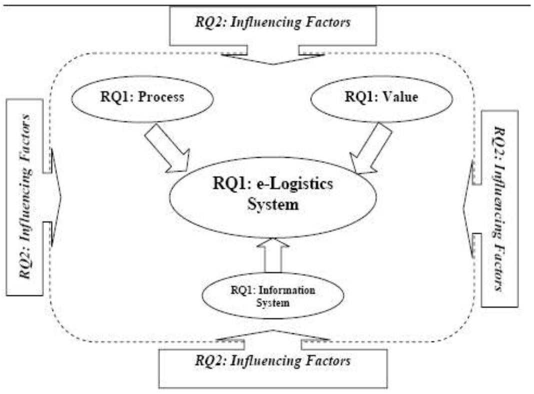
7) Gerstle D., *Selection/Development of Reliable Power Supplies,* Reliability, Maintain ability, & Support ability, April 2004, Vol. 8, No.2.

8) Blanchard, B. S., Logistics Engineering and Management, 5th Edition, Prentice Hall, 1998.

9) Galloway I. Design for support and support the design: integrated logistic support–the business case, Logistics information Management, 1996, Vol. 9 No.1.

a key role in the area of logistic support, activities and is one of the key elements of the logistic functions aimed at expanding the production system as a whole furthermore, it can be considered as a strategic activity linking all the operators along the value-chain (Calza and Passor, 1997).

The frame of reference is presented graphically as follows:




[Figure 3] Frame of reference

<Table-1> Previous research on e-logistics system

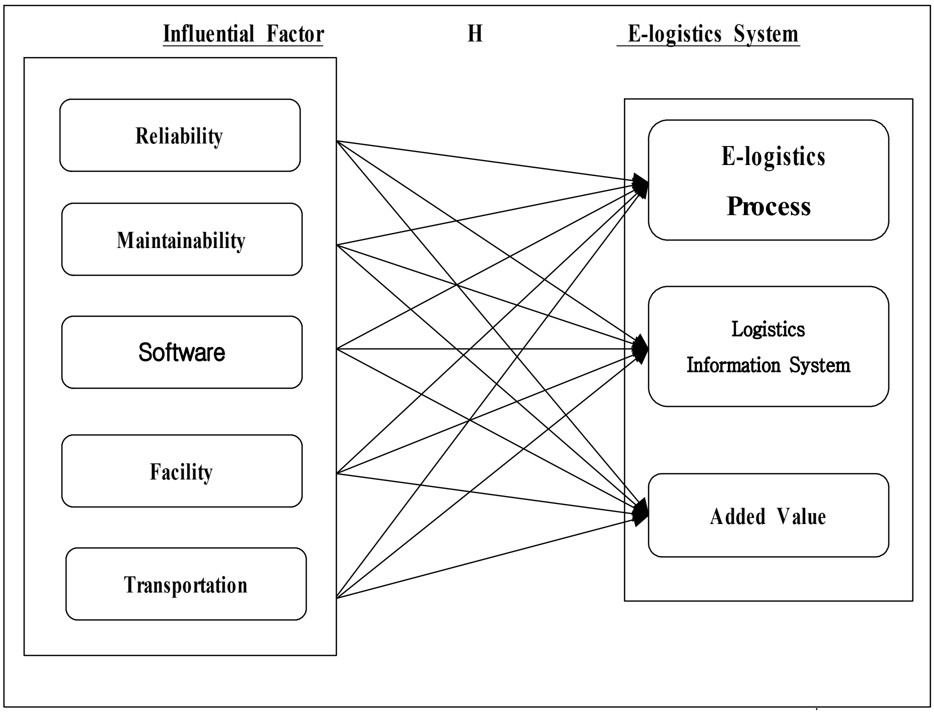
| | | |
|---|---|---|
| Daw ( 1995) | It suggested the logistics system concept. | Logistics system is a collection of data, hardware, software, and rules that work together to support an activity. |
| Zhang(2001) | It described ELP | ELP include: request for quotes (RFQ) shipping, tracking |
| Coyle(2003) | a. It proposed the ELS model<br>b. It argued that logistics can create value. | a. LIS includes: Planning system, execution system, research and intelligence system. reports and outputs system<br>b. The logistics create value in place utility and time utility |
| Cheng and Yue (2006) | It suggested ELS and the factors that influence them. | a. ELS can be described by their process, information system and value.<br>b. The degree of importance of factors is different:<br>(1) Reliability factors, maintainability factors, software factors and facility, transportation, and handing factors.<br>(2) Economic factors, and supply support factors<br>(3) Other factors |

# Ⅲ. Research Model and Hypotheses

## 1. Research Model

The further step of the research is to build and test the model. In order to achieve a global synchronized electronic supply chain, all of CLCs have to deploy a global strategy that enables all players to benefit from the ELS.

In the model, there are three related factors: reliability, maintainability and supportability (software, facility, transportation and handing). Based on the model, it will be tested if these factors can influence ELS as a whole, including the e-logistics process, LIS and added value. Therefore, the three aspects of ELS are the final variables. Based on the referred theories, the research model is shown in <Figure 4>:




[Figure 4] Research Model

## 2. Hypotheses

This research hypothesizes that these five factors have significant effects on e-logistics system. By providing five factors, it is more likely to enhance the degree of e-logistics process, logistics information system and added value. Based on this observation, the following three sets of hypotheses are presented.

### 1) E-logistics Process

Hypothesis 1-1: Reliability is likely to have a positive effect on the e-logistics process.
Hypothesis 1-2: Maintainability is likely to have a positive effect on the e-logistics process.
Hypothesis 1-3: Software is likely to have a positive effect on e-logistics process.
Hypothesis 1-4: Facility is likely to have a positive effect on the e-logistics process.
Hypothesis 1-5: Transportation is likely to have a positive effect on e-logistics process.

### 2) Logistics information systems

Hypothesis 2-1: Reliability is likely to have a positive effect on LIS.
Hypothesis 2-2: Maintainability is likely to have a positive effect on LIS.
Hypothesis 2-3: Software is likely to have a positive effect on LIS.
Hypothesis 2-4: Facility is likely to have a positive effect on LIS.
Hypothesis 2-5: Transportation is likely to have a positive effect on LIS.

### 3) Added value of e-logistics systems

Hypothesis 3-1: Reliability is likely to have a positive effect on the added value of ELS.
Hypothesis 3-2: Maintainability is likely to have a positive effect on the added value of ELS.
Hypothesis 3-3: Software is likely to have a positive effect on the added value of ELS.
Hypothesis 3-4: Facility is likely to have a positive effect on the added value of ELS.
Hypothesis 3-5: Transportation is likely to have a positive effect on the added value of ELS.

## 3. Definition and Measurement of Research Variables

### 1) Definition of Research Variables

The summary of the definitions of these variables is shown in <Table 2>.

〈Table-2〉 Definition of research variables

| Construct | Variables | Definition |
|---|---|---|
| Reliability | Reliability | It is the probability that an item will perform its intended function for a specified interval in a stated condition. |
| Maintainability | Maintainability | It is an inherent design characteristic dealing with the ease, accuracy, safety, and economy in the performance of maintenance functions. |
| Supportability | Software | It has become a major element of support, including automation, computer applications, and digital data. |
| | Facility | Facility includes the planning, acquisition and management of permanent or semi-permanent real-estate and property assets required to support the system. |
| | Transportation | Transportation and handling factors are significant with regard to the design of the system for transportability or mobility. It includes economic trends, inflation, cost, and so on. |
| Implementation level | ELP | The level of e-logistics process, including request for quotes, shipping, tracking. |
| | LIS | The adoption of LIS, including planning, execution, research and intelligence, reports and outputs system |
| Added value | Added value | Added benefits |

### 2) Measurement of Research Variables

Table - 3 indicates the measurements in the summarized model.

〈Table-3〉 Measurement of research variables

| Variables | Measurement | Questions |
|---|---|---|
| Reliability | 1. Trust in the implement of ELS.<br>2. Trust in the good quality system of ELS<br>3. Trust in of the validation of ELS | Q1~Q3<br>Gerstle(2004) |
| Maintainability | 1 .Ensure efficiency in maintainability of ELS<br>2. Ensure frequency in maintainability of ELS<br>3. Ensure economy in maintainability of ELS | Q4~Q7<br>LOGTECH (2002) |
| Software | 1. Increase of automations level.<br>2. Increase of computer use and procedural ability<br>2. Increase of computer facility and communication tool. | Q8~Q10<br>Galloway(1996)<br>Blanchard(1998) |
| Facility | 1. Increase of EDI and utilization of other parts.<br>2. Increase of real-estate and property assets utilization validity | Q11~Q14<br>Galloway(1996)<br>Blanchard(1998) |

| | | |
|---|---|---|
| Transportation and handing | 1. Increase of transportation capability<br>2. Decrease of transportation time.<br>3. Decrease of transportation cost | Q15~Q17<br>Blanchard(1998) |
| E-logistics process | 1. Increase of range of e-logistics process.<br>2. Increase of intensity of e-logistics process. | Q1-Q2<br>Zhang(2001) |
| Logistics information system | 1. Strength of planning management of LIS<br>2. Strength of implementation management of LIS<br>3. Strength of control management of LIS | Q3-5<br>Coyle(2003) |
| Added value | 1. Decrease in administration costs<br>2. Decrease in customer costs<br>3. Decrease in supplier costs | Q1-3<br>Lambert(2000)<br>Coyle(2003) |

# Ⅳ. Empirical Analysis

## 1. Data Collection

The survey respondents for this study were recruited from July 7th to 30th in 2008 and the participants were solicited through questionnaire distribution by email. Each questionnaire item was answered following a five-point Likert-scale~~s~~ where '1 = strongly disagree', '3 = neutral' and '5 = strongly agree' .

The survey instrument was pre-tested with a small sample of business persons in China. The pilot study was used to pre-test potential tasks and check the experimental protocol, which included survey items and interview questions. After the pre-test, the wording of some questions were modified in order to test for non-response bias and no statistically significant differences were found for the study variables between early and late respondents. The survey was used to evaluate the model of this thesis and validate the interrelationships related ELS and the influential factors. Therefore, participants were asked to assess the degree of their experience on two sets of variables. One set consists of reliability, maintainability, facility, transportation and handing, and software as independent variables. The other ~~is~~ includes e-logistics process, LIS and added value as dependent variables.

〈Table-4〉 summary of data collection

| | |
|---|---|
| Period | July 7-30,2008 |
| Respondents | Logistics company Staff in China |
| Number of Samples | 112 |

## 2. Descriptive Analysis of Data

Of the 140 questionnaires 112 yielded usable results from the respondents. Because of unseriousness or some other reasons, 28 questionnaires were ruled out and the remaining 112 questionnaires, were used for empirical data analysis and for evaluating the variables and research model of our paper. The descriptive statistics details of the respondents' characteristics are shown in Table - 5:

〈Table-5〉 General information of survey companies

| Items | Options | Frequency | Percent (%) |
|---|---|---|---|
| Service type | Mechanical and electrical products | 17 | 15.2 |
| | Household appliances | 16 | 14.3 |
| | Automobile and accessories | 12 | 10.7 |
| | Energy products | 23 | 20.5 |
| | Construction materials | 12 | 10.7 |
| | Farm products | 9 | 8.0 |
| | Textile | 7 | 6.3 |
| | Others | 16 | 14.3 |
| Number of employees | 1-99 | 31 | 27.7 |
| | 100-999 | 52 | 46.4 |
| | 1000-1999 | 29 | 25.9 |
| | 2000-4999 | 0 | 0 |
| | 5000 and above | 0 | 0 |
| Turnover | 1-100 | 0 | 0 |
| | 100-1000 | 16 | 14.3 |
| | 1000-2000 | 30 | 26.8 |
| | 2000-5000 | 35 | 31.3 |
| | 5000 and above | 31 | 27.7 |

〈Table-6〉 General Information of E-logistics

| Items | Options | Frequency | Percent (%) |
|---|---|---|---|
| Who is the principal of the logistics business? | Director | 0 | 0 |
| | Department manager | 6 | 6.0 |
| | Vice president | 44 | 39.3 |
| | President | 62 | 55.4 |
| | No | 0 | 0 |

| | | | |
|---|---|---|---|
| What is the main conveyance pattern in the logistics business? | Telephone | 0 | 0 |
| | Fax | 0 | 0 |
| | Internet | 112 | 100.0 |
| | EDI | 0 | 0 |
| | Others | 0 | 0 |
| What is the main ELS and management and technology? | TRS | 0 | 0 |
| | GPS | 2 | 1.8 |
| | GIS | 1 | 0.9 |
| | AVLS | 0 | 0 |
| | EOS | 18 | 16.1 |
| | Service provider | 89 | 79.5 |
| | Others | 0 | 0 |
| How long has the company invested to e-logistics? | 1 year | 4 | 3.6 |
| | 1-2 years | 33 | 29.5 |
| | 2-3 years | 63 | 56.3 |
| | 3-5 years | 12 | 10.7 |
| | more than 5 years | 0 | 0 |
| What is the rate of logistics costs that cover sales figures | Under 5% | 0 | 0 |
| | 5-10% | 6 | 5.4 |
| | 11-20% | 51 | 45.5 |
| | 21-30% | 39 | 34.8 |
| | 31% and above | 16 | 14.3 |

## 3. Reliability and Validity

### 1) Reliability Test

In the next step, the reliability of the data of our research will be validated. It has been known that Cronbach's alpha is used to examine the reliability. It is a common method to test reliability. From Table - 7, the alpha value of each item shows a good reliability, and the average is 0.778, the e-logistics process even achieved 0.950. These alpha values shows that the measures have good reliability.

<Table-7> Chronbach’ s Alpha

| Variables | Number | Alpha |
|---|---|---|
| Reliability | 3 | .721 |
| Maintainability | 3 | .788 |
| Software | 3 | .741 |
| Facility | 2 | .755 |
| Transportation and handing | 3 | .811 |
| E-logistics process | 2 | .950 |
| Logistics information system | 3 | .664 |
| Added value | 3 | .799 |
| Average | | .778 |

### 2) Validity Test

Factor analysis is often used in data reduction to identify a small number of factors that explain most of the variance observed in a much larger number of manifest variables. It Is also used to evaluate underlying variables or factors that explain the pattern of correlations within a set of observed variables (Miyazaki and Fernandez, 2000)[10]. Factor analysis can also be used to generate hypotheses regarding causal mechanisms or to screen variables for subsequent analysis (Chellappa and Pavlou, 2002)[11]. In this report, the constructing validity has been assessed by identifying the concepts of ELS. In addition, factor scores the identified components were derived via the formal survey questionnaires.

Twenty-two survey items in the questionnaires were referred to in this study. In order to determine the underlying structure, the first step was to examine the correlation matrix to determine its appropriateness for factor analysis. The KMO value of the test statistic for sphericity was based on a Chi-square transformation of the determinant of the correlation matrix (0.672) and the associated significant level was extremely low (0.000). Based on the results, all the eight factors were accepted as the interpretable ones.

<Table-8> KMO and Bartlett's test

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | .672 |
|---|---|---|
| Bartlett's Test of Sphericity | Approx. Chi-Square | 2576.295 |
| | df | 231 |
| | Sig. | .000 |

10) Miyazaki, J. and Fernandez, K., *“The antecedents and consequences of trust in online-purchase decisions”,* Journal of Interactive Marketing, 16(2), 2000, pp.47-63.

11) Chellappa, R. and Pavlou, P., *“Perceived information security, financial liability and consumer trust in electronic commerce transactions”*, Logistics Information Management, Vol.15 No.5, 2002, pp.358-368.

The second step, was to demonstrate that reliability, maintainability, facility, transportation and handing, software, ELP, LIS and added value are independent measures; SPSS 12.0 was used to perform the factors analysis. Tables 9 and 10 indicate the eight separate factors. All eight scale concerns were included in an exploratory factor analysis.

<Table-9> Rotated component matrix I

| Items | Component | | | | |
|---|---|---|---|---|---|
| | Factor1 | Factor2 | Factor3 | Factor4 | Factor5 |
| REL1 | .839 | | | | |
| REL3 | .760 | | | | |
| REL2 | .744 | | | | |
| MAI3 | | .833 | | | |
| MAI1 | | .822 | | | |
| MAI2 | | .771 | | | |
| SOF2 | | | .908 | | |
| SOF1 | | | .884 | | |
| SOF3 | | | .578 | | |
| FAC1 | | | | .873 | |
| FAC2 | | | | .862 | |
| TRA2 | | | | | .728 |
| TRA3 | | | | | .692 |
| TRA3 | | | | | .556 |

<Table-10> Rotated component matrix II

| Items | Component | | |
|---|---|---|---|
| | Factor1 | Factor2 | Factor3 |
| IMP1 | .914 | | |
| IMP2 | .901 | | |
| ADO1 | | .788 | |
| ADO3 | | .755 | |
| ADO2 | | .658 | |
| ADD1 | | | .754 |
| ADD2 | | | .744 |
| ADD3 | | | .714 |

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

## 4. Empirical Data Analysis

The effects of reliability, maintainability, software, facility, transportation and handing on the implementation of ELS were assessed by regression analysis. The results of the empirical study are listed in Tables 11, 12 and 13.

〈Table-11〉 Regression analysis for the antecedents of e-logistics process

| Dependent Variable | Independent Variable | R2 | F | Sig | Beta | t | Sig | Hypothesis |
|---|---|---|---|---|---|---|---|---|
| PROC | RELI | .327 | 10.316 | .000* | -.017 | -.216 | .830 | N.S. |
| | MAIN | | | | .061 | .765 | .446 | N.S. |
| | SOFT | | | | -.023 | -.280 | .780 | N.S. |
| | FACI | | | | -.060 | -.728 | .468 | N.S. |
| | TRAN | | | | -.578 | 7.093 | .000 | Significant |
| * p<0.05 ** p<0. 1 | | | | | | | | |

a. Dependent variable: implementation of e-logistics process

b. Independent variable: reliability, maintainability, software, facility, transportation and handing.

As can be seen from Table 11, the effect of transportation on ELP in ELS is significant (βTRAN= 0.00, p<0.05). Hence, the fifth hypothesis (H5-1) receives strong support from the study's results. In contrast, the effects of other factors are non-significant, showing that they do not act as antecedent of ELP in ELS. Hence H1-1, H2-1, H3-1, and H4-1 are not supported. The model coefficient is extremely significant (F= 10.316, p<0.05); and the data explains a substantial degree of the variation (R2=0.327).

〈Table-12〉 Regression analysis for the antecedents of logistics information system

| Dependent Variable | Independent Variable | R2 | F | Sig | Beta | t | Sig | Hypothesis |
|---|---|---|---|---|---|---|---|---|
| LOGI | RELI | .172 | 4.365 | .000* | -.053 | -.598 | .551 | N.S. |
| | MAIN | | | | .332 | 3.714 | .000 | Significant |
| | SOFT | | | | .177 | 1.929 | .056 | Significant |
| | FACI | | | | -.020 | -.217 | .829 | N.S. |
| | TRAN | | | | .114 | 1.249 | .214 | N.S. |
| * p<0.05 ** p<0. 1 | | | | | | | | |

a. Dependent variable: logistics information system

b. Independent variable: reliability, maintainability, software, facility, transportation and handing

In Table 12, the regression analysis indicates that the effect of maintainability (βMAIN= 0.00, $p<0.05$) are significantly related with LIS and software (βSOFT= 0.05, $p<0.1$) and are marginally significantly related with LIS, rendering limited support for H3-2. Thus hypotheses H2-2 and H3-2 are accepted. On the other hand, reliability, facility and transportation do not show significant relationship with LIS. Hence H1-2, H4-2, and H5-2 can not be supported. The model coefficient is significant (F= 4.365, $p<0.05$), and the data explains a substantial degree of the variation (R2=0.172).

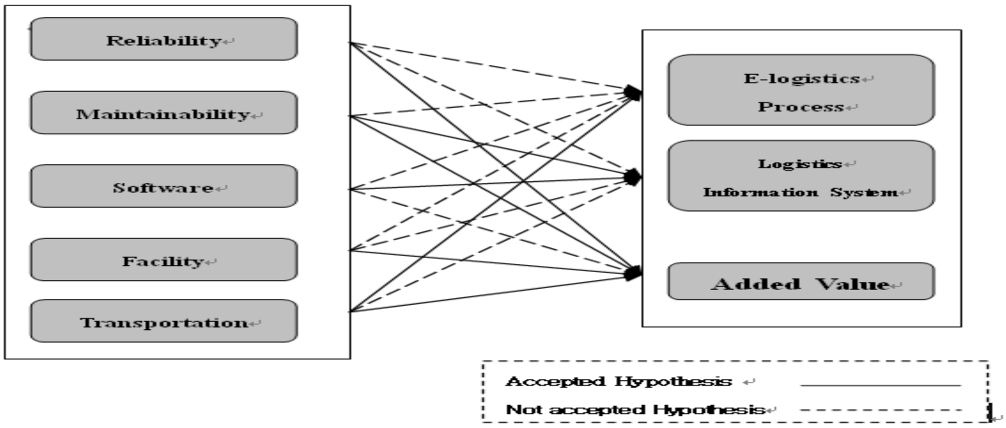
〈Table-13〉 Regression analysis for the antecedents of added value

| Dependent Variable | Independent Variable | R2 | F | Sig | Beta | t | Sig | Hypothesis |
|---|---|---|---|---|---|---|---|---|
| ADDE | RELI | .397 | 13.984 | .000* | .286 | 3.714 | .000 | Significant |
| | MAIN | | | | .200 | 2.637 | .010 | Significant |
| | SOFT | | | | .120 | 1.542 | .126 | N.S. |
| | FACI | | | | .173 | 2.227 | .028. | Significant |
| | TRAN | | | | .382 | 4.959 | .000 | Significant |
| * p<0.05 ** p<0. 1 | | | | | | | | |

a. Dependent variable: added value
b. Independent variable: reliability, maintainability, software, facility, transportation and handing

As can be seen from Table 13, the regression analysis indicates that the effect of reliability (βRELI= 0.00, $p<0.05$), maintainability (β= 0.01, $p<0.05$), facility (βFACI= 0.02, $p<0.05$) and transportation (βTRAN= 0.00, $p<0.05$) are significantly related with added value of ELS. Thus hypotheses H1-3, H2-3, H4-3 and H5-3 are accepted. On the other hand, software does not show significant relationship with the added value of ELS.

Hence H3-3 can not be supported. The model coefficient is significant (F= 13.984, $p<0.05$ and the data explains a substantial degree of the variation (R2=0.397).




[Figure 5] Empirical analysis result of research model

This section presents the statistical results of the measurement-validation and hypothesis testing. As shown in Figure 5, significant results have been found to support the study hypotheses. It's clear that transportation affects ELP. It's also evident that maintainability and software are significant factors influencing the level of LIS. Additionally, it was found that the added value of ELS is influenced by reliability, maintainability, facility and transportation.

This study finds no evidence of statistically significant relationship between these factors (reliability, maintainability, software, facility) and ELP, thus the hypotheses are not certified. The same situation also appears for reliability, facility, transportation factors and the LIS; software factor and added value.

# V. Conclusions and Implications

## 1. Conclusion

ELS have been examined by a large number of scholars. However, most of these studies focused on the issues related to ELS as a whole and its internal characteristics. This research explores the internal components of ELS and their exogenous influence factors and tests their relationship to each other in CLCs.

Based on the findings of data analysis, transportation factor is found to have a positive relationship with the e-logistics process and added value in CLCs. One of the key challenges for the Chinese logistics industry is the situation of the country's transport infrastructure. Consistent with the literature (Tseng, Yue & Michael, 2005)[12], this paper argues that without well developed transportation, logistics cannot bring its advantages into full play. Besides, good transport system in logistics activities can provide better logistics efficiency, reduce operations cost, and promote service quality. However, outside of the main economic centers in China, the logistics sector tends to be of low quality, highly inefficient and with little technological competence. Logistics companies in the region often complain of insufficient integration of transport networks, warehousing and distribution facilities. Thus, LSPs recognize that transportation factors have played an important role in the improvement of e-logistics. The investigation results of this paper also indicates this point.

This investigation also found that reliability factor contributes only to the added value. Present findings support that improving the cost–effectiveness approach based reliability is a powerful variable. Seemingly, CLC would find reliability advantage to be a prerequisite to competitive cost which in turn contributes to reliability growth.

The study revealed that maintainability contributes to LIS and added value in CLCs. Logically, LSPs that continue to strive for maintaining ease, accuracy, safety, and economy in the performance of maintenance functions through R&D, would be in a better position to achieve their strategic goals of gaining access to new technology, shortening its lead time, creating improved customer value and enhancing customer satisfaction.

Moreover, this study found that software contributes only to LIS in CLCs. Software has become a major element of support in China. This is particularly true where automation, computer application, digital databases are used in the accomplishment of supportability and maintainability of LIS.( E.g. Enterprise Resource Planning (ERP), Customer Relationship Management (CRM) and other advanced software which have been applied on LIS.) Thus, the survey results show that software factors have a positive support function for the LIS in the CLI.

The study found that facility has a significant effect on value growth performance in CLCs. According to the related research (Cheng and Yue, 2006), when evaluating the effectiveness of facility, such factors must deal with : Item process time or turnaround time, facility utilization, energy utilization in the performance of maintenance, and total facility cost for system operation and support.

Logically, logistics companies would also find facility advantage to be a prerequisite to competitive cost which in turn contributes to facility effectiveness.

Therefore, consistent with the current situation in the CLI, the investigation results perfectly reflect the main problems of the most logistic enterprises in China and also provide valuable insights into the current status of ELS in the CLI.

## 2. Implications

One of the contributions of the study is the development of an extensive set of interrelationships in each

12) Yung-yu TSENG, Wen Long YUE and Michael A. P. TAYLOR, THE ROLE OF TRANSPORTATION IN LOGISTICS CHAIN, Proceedings of the Eastern Asia Society for Transportation Studies, Vol. 5, 2005, pp. 1657-1672.

component of ELS and exogenous influence factors. The paper also provides some helpful suggestions for the development of ELS in CLC.

### 1) Reliability

For most enterprises, understanding of “e-logistics” is still superficial and limited to the integration of transportation and storage. They only believe that E-logistics can create added value and most of companies still doubt that reliability can develop and improve ELP and LIS and do not recognize the direct relationship between them. Currently, CLCs are still thinking in a “traditional” way at a primary stage. They only recognize ELP competition by taking advantage of transportation effectiveness positions and of the reliability factor, which contributes to only one component of superior ELS performance.

Therefore, not only CLC but also the entire society should improve their appreciation of e-logistics. E-commerce is a revolution in the business field, and e-logistics is a revolution in the logistics field. The functions of e-logistics include the design, execution and management of the logistics demands of a customer’s supply chain. Its key feature uses information and professional logistics knowledge to “provide quality services with minimum cost." CLCs should first change their traditional way of thinking and learn to have an in-depth understanding of logistics. They should then upgrade development of the status of ELS development to that of a competitive strategy. Finally, the social development of ELS should be included in the agenda.

### 2) Maintainability and Software

Internet-based LIS should be adopted as the new-style of general logistics management information system. Two objectives should be realized in the LIS design process. First, the previous logistics business should effectively control the flow of logistics, improve the efficiency of ELP and reduce logistics costs. Secondly, it should adopt a customer-centric service focus to attracting more customers.

Therefore, effective LIS should be designed via strengthening maintainability managements and upgrading software technology. Thus the development of LIS is linked to two critical conditions: advanced management and software technology. At the present stage, CLCs should enhance the personnel training. As we know, lack of e-logistics experts is one of the serious problems in China. E-logistics personnel are composed of high-level talents. On the one hand, logistics companies might consider hiring e-logistics personnel; on the other hand, they could send people with potential to learn abroad.

Most CLCs have weak competitive capability and inadequate financing ability to acquire advanced software technology;. They cannot invest additional funds to purchase the the advanced software technology. Therefore, the survey results show software factor does not have a positive effect on added value in CLC. Thus the Chinese government should provide some preferential treatments and policies to Chinese the CIL for the development of LIS.

In this case, logistic companies could learn from the experience of e-logistics management in developed countries and eliminate funding problems with the support of government to facilitate or speed up the pace of development of LIS.[13] Meanwhile, CLCs take advantage of LIS to accelerate ELP development to drive the whole e-logistics industry to move forward.

### 3) Transportation and Facility

Together therefore, the Chinese government and enterprises should establish ELS, that is they should cooperate and invest together to build the whole ELS. The government needs to invest adequate funds on the highway, railways, aviation, and information network and then form community-wide coverage of transportation and information network in order to ensure that traffic and the information flow smoothly . Meanwhile, logistics enterprises should invest on modern logistics technology and facilities to improve ELP and customer services. In addition, in order to attract~~ing~~ more manufacturing companies and Internet businesses, logistics companies should improve business competitiveness and profitability and promote the development of e-commerce to accelerate the development of the e-logistics industry.

To sum up, logistics companies should recognize that ELS is the outcome of the process of managing for logistics companies as a whole. In as much as the model used in this study coupled with the findings suggested that the competitive advantage of ELS are linked to critical resources and capabilities, logistics managers who decide on buildig up competitive advantages should give attention to how they can re-engineer their support resources and improve their logistics management skills for ELS development. The development of logistics management skills is a key issue that logistics companies should pay more attention to. Improvements related to inventory tracking, container scheduling, transportation cost, and data sharing with suppliers, are required to allow logistics firms in China to achievement higher ELS competitiveness . The sustenance of adequate logistic support resources is an other key issue to logistics firms in China. Making supportability resources available for logistics market development, meeting competitive prices, advance facilities and technology from suppliers, and offering competitive credit terms to customers depends on the improvements of infrastructure facilities and cost advantages / disadvantages. In other words, logistics firms need to coordinate supply chain activities and leverage the function of learning to build up the logistics supportability resources for customer satisfaction and market success.

13) http://www.clb.org.cn/qywl/121686303329501_2.html

## 4. Limitations and Further Research

There are a number of limitations in this research. First, although the research demonstrates significant findings, it does not cover all factors related to ELS. Additional research needs to extend the study to other factors and business contexts to reinforce our confidence in the generalization of the findings of this study. Second, the sample used in this paper for empirical analysis is based on Chinese circumstances. The study provides an insight into ELS for logistic companies which stays in the same level of development. Hence, for the next phase of ~~our~~ research, it will be interesting to investigate logistic companies in different countries. ELS is widely popular topic in Korea. Therefore, it is meaningful to develop a comparative analysis on both Korean and Chinese logistics industries. This would provide significant value for both countries. Thus, although the study provides theoretical and practical insight into ELS in CLCs, future research is needed to extend the proposed model to reinforce our confidence in the findings of this study.

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