

An Empirical Study of Logistics Vulnerability Causes of Urban Appliance Based on SEM*

Liu Mingfei, Lei Yin, Xie Jialong

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: Liumingfei5223@163.com, 672496037@qq.com, Xiejialong1234@126.com)

Abstract In this paper, The authors put forward research assumptions from the four capacity of urban logistics infrastructure, logistics information platform, logistics systems services management and logistics early warning and emergency response with SEM. Taking Wuhan appliance logistics as a sample, The authors make empirical study with the method of combining practical investigate and network investigate. The path coefficients of the impact of the level of logistics infrastructure, the level of logistics information, logistics service management capacity, logistics early warning and emergency response capacity to urban appliance logistics vulnerability of passed significant test. The study gets the following conclusion according to the path coefficients, the variables affecting urban appliance logistics vulnerability in decreasing order are: logistics service management capacity, logistics early warning and emergency response capacity, the level of logistics information and logistics infrastructure.

Key words Vulnerability; Urban appliance logistics; SEM

1 Introduction

Logistics has great push effect in the development of appliance industry. Unexpected event such as traffic accident, causing appliances arrived not on time, there by greatly reducing the consumer satisfaction, increased urban appliance logistics vulnerability. According to the literature search, foreign research from the perspective of the vulnerability of the logistics operations is relatively small, and most are focused on the vulnerability of natural field. In the social sciences, most research are on financial vulnerability. Minsky (1986) first proposed the famous views "financial fragility hypothesis" ^[1]. Domestic research on urban logistics vulnerability, Liu Yanhua, Li Xiubin (2002) hold that the vulnerability of natural systems and human systems should include the following: first, it shows that the system inherently unstable; second, sensitive to outside disturbance and change; Third, if foreign interference and external environmental changes, the system, groups or individuals vulnerable to some degree of damage or injury, and difficult to restore^[2]. Chen Zhuo, She Lian (2007) set up the assessment system of urban logistics vulnerability, made a good deal of multi-level fuzzy of urban logistics system using MDHGF, raised early warning management system of urban logistics system ^[3]. In this paper, we study the formation mechanism of urban appliance logistic vulnerability using structural equations modeling.

2 The Content and Features of Vulnerability for Urban Appliance Logistic

Urban appliance logistics vulnerability refers to urban appliance logistics system has strong vulnerability, sensitivity and lack of rapid response and remediation capabilities in the face of interference or stress condition within and outside environmental change, leading to the change of the structure and function city of urban appliances logistics system ^[4].

Urban appliance logistics vulnerability shows the following four characteristics. First, periodic, the sales of urban appliances has obvious seasonal, especially impacted by the holiday, at the national statutory holidays, urban appliance sales usually jump. Second, hurry, despite the urban appliance sale has a certain regularity, but experience can only provide a broad time period, can not accurately predict the burst time and the number of specific appliances remedies. This sudden events are often short, and rapid, and even lead to a temporary break of appliances supply chain. Third, loss, because of urban appliance logistics has the characteristics of cycle fluctuations and short-term outbreak, which easily lead to the backlog or out of stock of appliance, loss of sales opportunity or additional costs. Therefore, once urban appliance logistics show the vulnerability, will bring huge economic loss and some lost of market share, will take recent or long-term economic impact to enterprises, and the loss irreparable. Fourth, policy-oriented, that the government as the maker and practitioner of macro logistics policy, will

* Supported by Wuhan Social Sciences Fund (09015)

result in urban appliance logistics subtle influence, produce policy-oriented role.

3 The Concept Model and Research Hypothesis of Urban Appliance Logistics Vulnerability

3.1 The concept model of Urban appliance logistics vulnerability

urban appliance logistics vulnerability mainly shown as urban appliances logistics system exist inherent instability, according to the architecture and operation of urban appliances logistics system, this inherent instability is shown in the urban appliances logistics infrastructure, urban appliances logistics information platform, urban appliances logistics service management capacity, urban appliances logistics early warning and emergency response capacity the four areas, and the relationship between the four complementary and mutually affected. The four also posed by the various elements to form a mutual connection of the network. The concept model of urban appliances logistics vulnerability shown in Figure1.

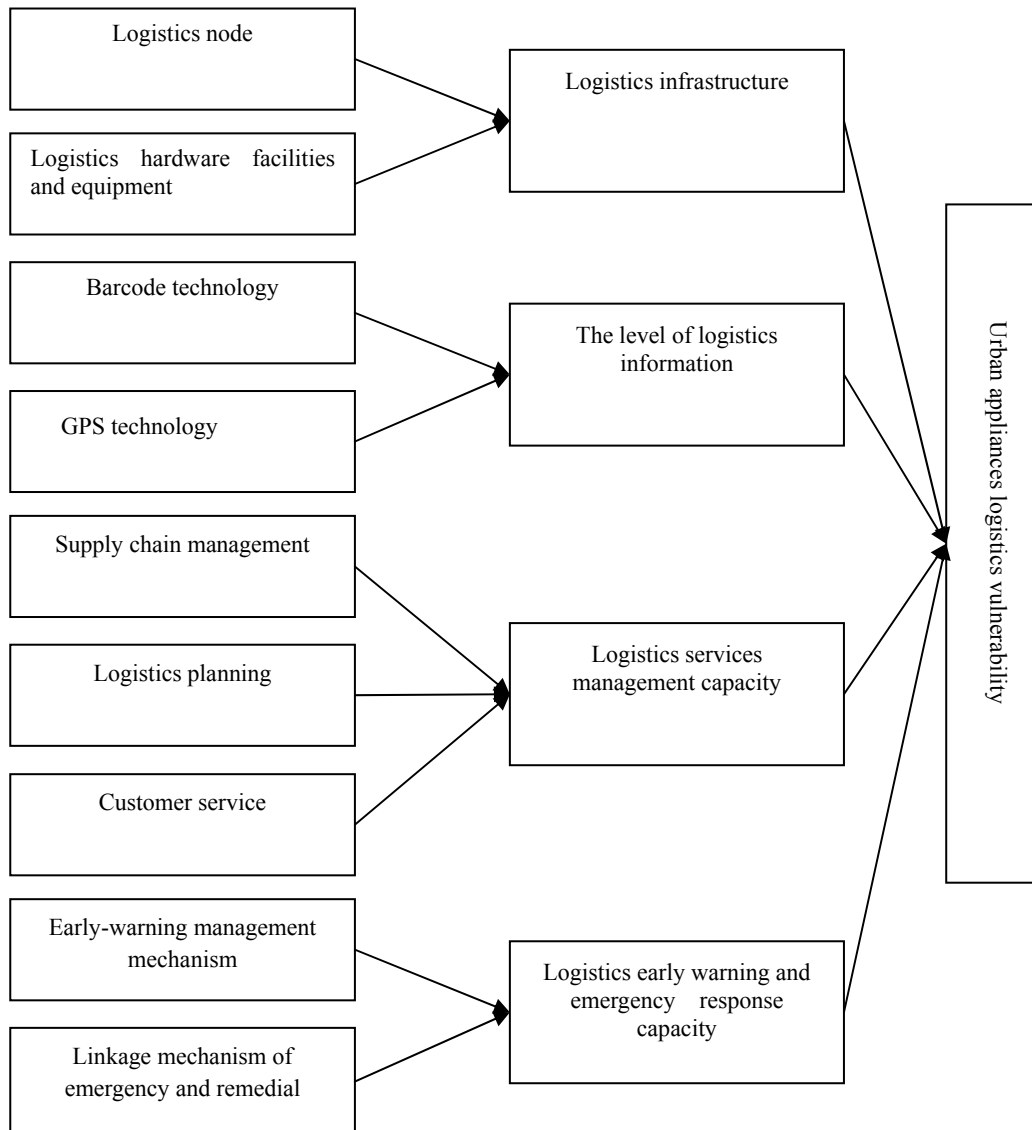


Figure 1 The Concept Model of Urban Appliances Logistics Vulnerability

3.2 Propose of hypothesis

Through the discuss of the concept model of urban appliance logistics vulnerability, we can make the following hypotheses.

Hypotheses1: Logistics infrastructure has negatively effect on urban appliance logistics vulnerability;

Hypotheses2: The level of logistics information has negatively effect on urban appliance logistics vulnerability;

Hypotheses3: Logistics services management capacity has negatively effect on urban appliance logistics vulnerability;

Hypotheses4: logistics early warning and emergency response capacity has negatively effect on urban appliance logistics vulnerability;

The four aspects of urban appliances logistics infrastructure, logistics information platform, logistics service management capacity, logistics early warning and emergency response capacity check each other and complement each other, they are the significant influencing factors of urban appliance logistics vulnerability. Therefore, the main elements within them are the key factors leading to urban appliance logistics vulnerability.

4 Empirical Analysis of the Causes of Urban Appliance Logistics Vulnerability

4.1 Design of questionnaire

Wuhan is located in the central region, hub of nine provinces and strategic location, is the distribution center of urban appliance logistics. It has strong representative, therefore we selected Wuhan as sample. The scale we used in this research is comprehensive reference to the urban appliances logistics research, we concluded the scale of the causes of urban appliance logistics vulnerability drawn from extensive literature, as is shown in table 1. Combining the characteristics of Wuhan, this scale divided the major influencing factors of urban appliance logistics vulnerability into four aspects: logistics infrastructure, the level of logistics information, logistics services management capacity, logistics early warning and emergency response capacity, and make a more fully elaborated to the influencing factors impact on the four aspects, using Likert five scale (1 representatives strongly disagree, two representatives did not agree with, 3 represents no opinion, 4 representatives agreed that, five representatives strongly agree) on the need to collect the relevant statistical data of the influential factors.

Table 1 Research Variable of the Influencing Factors of Wuhan Appliance Logistics Vulnerability

latent variable	observation variable
logistics infrastructure	Logistics node
	Logistics hardware facilities and equipment
the level of logistics information	Barcode technology
	GPS technology
logistics services management capacity	Supply chain management
	Logistics planning
	Customer service
logistics early warning and emergency response capacity	Early-warning management mechanism
	Linkage mechanism of emergency and remedial

Note: Set the latent variables and observation variables according to the survey questionnaire.

4.2 Information statistics of the sample

The survey data is collected from 200 appliance enterprises and logistics enterprises in Wuhan, surveys based on field as the main way of empirical research. The principal investigator is the business near to Luoshi Road and Wuluo Road in Wuhan, the typical surveyed enterprises are Nadu logistics, Kakichi logistics. To ensure the objectivity of the investigation results, communication were carried out with the respondents before issuing the questionnaires, and guide them in completing the questionnaires, in order to be able to more accurately understand and improve the accuracy and authenticity of the investigation. Totally 200 questionnaires were distributed, 170 copies of questionnaires returned, response rate was 85%, excluding 28 invalid questionnaires, 142 valid questionnaires, and the effective return rate was 71%.

4.3 Reliability and validity analysis of questionnaires

The reliability, the reliability index using Cronbach α coefficient and composite reliability values of CR (Composite Reliability). Generally, Cronbach α coefficient greater than 0.7, CR is greater than 0.6, then the reliability is good. This study used SPSS 11.3 to analysis and got all the Cronbach α coefficient of variables are greater than 0.7; while using Lisrel 8.0 conducted a confirmatory factor analysis to the measurement model of this study, according to the results to calculated composite reliability coefficients CR, all the composite reliability of the structure variables are greater than 0.8, indicating that the reliability of various structural variables in this study are good. The data in table 2 indicate that the reliability of variables measured in this study are good.

Table 2 Results of Reliability Analysis

Statistical variable	Cronbach α	CR
logistics infrastructure	0.786	0.856
the level of logistics information	0.819	0.912
logistics services management capacity	0.884	0.945
logistics early warning and emergency response capacity	0.858	0.923

Generally, validity assessment typically include content validity and construct validity. The observation variable we used to measure influencing factors of Wuhan appliance logistics vulnerability are all comprehensive reference to a large number of documents combined with field research and was modified, so the study had good content validity. In construct validity testing, the study still with confirmatory factor analysis to verify the construct validity of the variables. The indicators of confirmatory factor analysis were shown in Table 3, shows that all the indicators have reached an acceptable level.

Table 3 Analysis Results of Confirmatory Factor

Fit Index	χ^2 / df	NFI	IFI	CFI	RMSEA
logistics infrastructure	2.087	0.942	0.955	0.912	0.038
the level of logistics information	2.257	0.911	0.944	0.906	0.040
logistics services management capacity	2.961	0.898	0.903	0.919	0.047
logistics early warning and emergency response capacity	2.548	0.931	0.936	0.878	0.041

4.4 Hypothesis testing based on structural equation model

First, made fitting analysis to the research model and empirical data use AMOS 7.0, the fit statistics of initial model and the modified model were shown in Table 4.

Table 4 Goodness of Fit Statistics of Initial Model and the Modified Model

Target volume	χ^2 / df	NFI	IFI	CFI	RMSEA
Prior to the amendment	2.122	0.615	0.765	0.713	0.042
Revised	2.353	0.701	0.798	0.756	0.039

Comprehensive comparison the goodness of fit statistics of initial model and modified model, the fit index of amendments to the former are improved. Table 3-4, the chi-square freedom χ^2 / df should in general be less than 5, standard fit indices NFI, value-fit index IFI and comparative fit index CFI values closer to 1 as possible, the root mean square RMSEA of approximation error less than 0.05 was a very good fit [5]. Therefore, we can see from Table 5, the modified model than the initial model can better reflect the relationship between variables.

According to structural equation modeling analysis, we can get the related information of the four hypotheses, as is shown in Table 5.

Table 5 Path Coefficients and Test Results of Theoretical Model

Hypothesis	Direction of influence	Path coefficient	t (C.R)	Test results
H1		0.205*	3.409	Endorsement
H2		0.256*	2.623	Endorsement
H3		0.388*	3.586	Endorsement
H4		0.324*	3.018	Endorsement

Note: * significance level less than 0.05

In structural equation modeling techniques, the standard that path coefficient is significantly different from zero is critical ratio (Critical ratio, referred to as CR or value t), when the absolute value $t \geq 2$, the path coefficients can be identified as a significant levels under 0.05 significant difference with zero. combined with logistics capabilities and commodity circulation pattern, we Conducted a questionnaire survey and analysis the data, results shown in Table 5, we can see that path coefficient of the effect of logistics infrastructure, the level of logistics information, logistics services management capacity, logistics early warning and emergency response capacity to urban appliance logistics vulnerability all pass through the test of significance. Path coefficient shows that the influencing to urban appliance logistics vulnerability, the influence of four factors in decreasing order: logistics services management capacity, logistics early warning and emergency response capacity, the level of logistics information, logistics infrastructure.

5 Conclusion

Through the confirmatory factor analysis on issues related to the questionnaire data, we can find many appliances logistics vulnerabilities. First, the logistics infrastructure as the least influencing factor to the appliance logistics vulnerability, that the vulnerability mainly reflected in urban appliances logistics network node is not tight enough, some appliances logistics hardware old and so on. Second, the level of appliance logistics information has larger influence compare to infrastructure, which become a major bottleneck constrained the development of appliances logistics industry in Wuhan, which includes transport technology, storage technology, handling technology, packaging sorting technology, management technology, evaluation technology and so on, and the using of bar code technology and GPS technology are still has a wide gap compared to the leading region and abroad. Third, the appliance logistics service management is that government or enterprise made the scientific development plan of logistics in the long-term development from the consumer point of view, and build a stable supply chain. Fourth, early warning and emergency response of urban appliance logistics vulnerability as the main influencing factors of vulnerability, its scientific and practical of early warning mechanism, and high efficiency of emergency response capabilities have decided the level of urban appliance logistics vulnerability.

References

- [1] Shi Yujie. Theoretical Review of Financial Fragility[J]. Shandong textile economy, 2006, (1):66-67 (In Chinese)
- [2] Liu Yanhua, Li Xiubin. Fragile Ecological Environment and Sustainable Development[M]. Beijing: Commercial Press, 2001 (In Chinese)
- [3] Chen Chuo. safety Research on Urban Logistics System Based on Vulnerability Analysis[D]. Wuhan: Wuhan University of Technology, 2007 (In Chinese)
- [4] Liu Mingfei, Zhao Jingjing. Correlation Analysis of Customer Resource Management Capacity and Enterprise Vulnerability[J]. Technology of Huazhong Agricultural University, 2010,(1):94-98 (In Chinese)
- [5] Hou Jietai, Wen Zhonglin, Cheng Zhijuan. Structural Equation Model and Its Application[M]. Beijing: Education and Science, 2004:28-50 (In Chinese)

Research on the Reliability of the Collection System of Heavy Haul Railway Based on the Dynamic Fault Tree

Ye Junqing, Zhen Zhiya, Yu Mingmin

School of Transportation Engineering, Centre South University, Changsha, P.R. China, 410075

(E-mail: yjq29@mail.csu.edu.cn, zychen@xidian.edu.cn, 310107125@qq.com)

Abstract Reliability theory is applied to the reliability study of the collection System. Systematic analysis method, DFT and professional knowledge of railway transportation and mining engineering are used to do integrate analysis and system research about the characteristics, main research contents and methods of reliability of the system. Based on these methods, combined with example in the transportation work in Daqin line, final analysis result comes out, which provided reference for correlated problem.

Key words Heavy haul railway; Collection system; Reliability; Dynamic fault tree

1 Introduction

China's heavy haul railway has made great contribution on alleviating the tension situation of China's railway transportation capacity and promoting the national economic. The collection system of heavy haul railway is the origin of supply chain. Its security and reliability is not only the assurance of high efficiency and quantity of coal mining, but also influences organization of train flow and line smoothie. However, the study on the reliability of the Heavy-load Railway Cargo system is relatively inadequate. So finding out effective methods for collection system study is significant.

As one of the basic methods, Fault Tree analysis was initiated by Dr. H. A. Waston from the Bell Lab of the United States while he was studying the automatic control system's reliability of the Telephone dial-up machine. After researchers' 40 years arduous work, it has been the indispensable method to study the system reliability in the field of nuclear^[1], mining metallurgy^[2], transportation^[3] and computer software^[4] etc...

This thesis will firstly analyze the specificity of the Heavy Haul Rail collection system. Dynamic fault tree model would be used in the reliability analysis. A new model for the reliability analysis of the system would be proposed and used to obtain the results of the reliability analysis.

2 Heavy Haul Rail Collection Systems

The Heavy Haul Rail collection system setting in the structure of heavy transport systems may be expressed as Figure 1

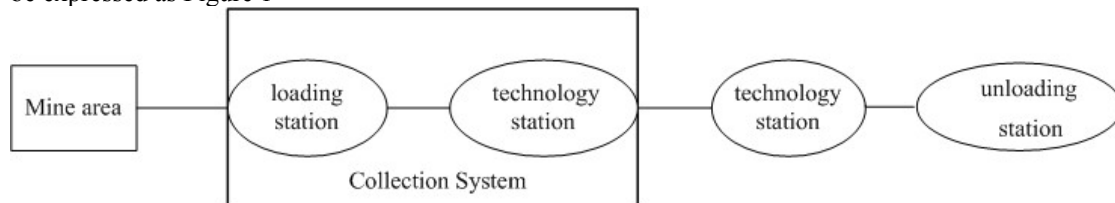


Figure 1 Relationship Diagram of Collection System and System of Heavy Haul Railway

Generally progresses are as follows: sending empty container by heavy haul train from the station of departure to loading station, loading through the loop or series loading line, returning to the departure technology station for the technical inspection of the train and the inspection operations of the locomotive, composing those trains from loading station that can not composed as an entire loading train as a heavy haul train. Finishing all these progresses, heavy haul train would depart from the technical station to the unloading station

2 Dynamic Fault Tree Reliability Analyses

2.1 Applicability of the reliability appraisal method

Reliability block diagram method, truth table method, Bayesian method, the minimum cut-set method, fault tree analysis, etc, are general methods for system reliability analysis. Although the traditional fault tree analysis method can not indicate the dynamic process of some system, and there