行政院國家科學委員會專題研究計畫 成果報告

店到店配送系統脆弱度與回復力分析
研究成果報告(精簡版)

計 畫 類 別 ：個別型
計 畫 編 號 ：NSC 100-2410-H-343-027-
執 行 期 間 ：100 年 08 月 01 日至 101 年 07 月 31 日
執 行 單 位 ：南華大學出版與文化事業管理研究所

計 畫 主 持 人：黃昱凱

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公 開 資 訊 ：本計畫可公開查詢

中 華 民 國 101 年 10 月 22 日

中 文 摘 要 ： 隨著電子商務技術的發展，線上購物已經越來越成熟，並由早期的企業對消費者（B2C）發展到消費者對消費者（C2C）。由於電子零售店與傳統零售店存在著交易行為與物流分開的特性，造成電子商務必須依賴強大的物流支援系統才得以順利運作其商業行為。台灣與其他國家最大不同的地方在於利用便利商店的物流系統發展出相當成熟的「線上購物、店配取貨」物流機制。近年來更結合多媒體事務機（MMK）與自身的物流機制，發展出店到店（store-to-store）寄件的服務，並迅速成為電子商務 C2C 配送服務的重要成員。供應鏈管理雖被廣泛的研究討論並且應用在實務上，隨著外在環境的不斷變化，風險管理的議題逐漸受到供應鏈研究學者的重視。本計畫藉由模糊認知圖與敏感度模式等分析技術，探討店到店寄件物流服務系統的脆弱度課題。藉由本計畫之研究調查工作，除了可建立評估研究個案之店到店寄件物流系統有關脆弱度與回復力等課題外，研究結果可進一步提供物流業者建構其供應鏈規劃模型與策略之參考。

中文關鍵詞： 脆弱度、店到店配送、模糊認知圖、多媒體事務機、敏感度模型

英 文 摘 要 ： The Internet enables many companies to use the Web to allow customers to configure specific order options tailored to the tastes and preferences of the customers. Hence, logistics management exposes the formerly latent logistics system in the economic activities and reveals the inner connections between parts of logistics activities. Store-to-store delivery service is one of the most important delivery systems in Taiwan. The authors establish an evaluation model to analyze and describe the store-to-store delivery using sensitivity model and fuzzy cognitive map. The results obtained can be used to help the manager formulate strategies and reduce risks as well.

英文關鍵詞： Vulnerability； Store-to-Store Delivery, Fuzzy Cognitive Maps, Multimedia Kiosk, Sensitivity Model

行政院國家科學委員會補助專題研究計畫 □期中進度報告 ■期末報告

店到店配送系統脆弱度與回復力分析

計畫類別：■個別型計畫　□整合型計畫
計畫編號：NSC 100-2410-H-343-027
執行期間： 2011/08/01 ~ 2012/07/31

執行機構及系所：南華大學文化創意事業管理學系

計畫主持人：黃昱凱
計畫參與人員：徐嘉陽、林維薇、陳佾筑

處理方式：除列管計畫及下列情形者外，得立即公開查詢
□涉及專利或其他智慧財產權，□一年□二年後可公開查詢

中　華　民　國　101 年　10 月 22 日

Dynamic Analysis of Store-to-Store Delivery Service through Fuzzy Cognitive Map

Abstract. The Internet enables many companies to use the Web to allow customers to configure specific order options tailored to the tastes and preferences of the customers. Hence, logistics management exposes the formerly latent logistics system in the economic activities and reveals the inner connections between parts of logistics activities. Store-to-store delivery service is one of the most important delivery systems in Taiwan. The authors establish an evaluation model to analyze and describe the store-to-store delivery using sensitivity model and fuzzy cognitive map. The results obtained can be used to help the manager formulate strategies and reduce risks as well.

Keywords: Store-to-store delivery, Multimedia Kiosk, Fuzzy cognitive map, Sensitivity model.

Introduction

The internet represents a huge growing market and the development of e-commerce is an efficient business model which enables new relationship between consumers and suppliers. Nowadays, the way to trade online is not only through business to customer, but also through customer to customer. In order to send goods or products to customer quickly and safely, strong support from efficient logistics system is necessary. Supply chain integration is not new; many companies have already pursued it as a way to gain competitiveness. In the logistics system of electronic commerce, the major difference between Taiwan and other countries is the retail delivery (RD) system [1]. Today, the convenience stores have integrated the delivery service to combine their logistics system and multimedia Kiosk (MMK) to develop a new retail delivery model: store-to-store delivery, and have made remarkable success. Due to the advantages of the retailing delivery and store-to-store delivery, the delivery mechanism plays an important role in the delivery system in Taiwan. Supply chain management has been widely studied in the academic as well as practical fields. However, there are fewer studies exploring store-to-store delivery services. 7-11 is the most important convenience store in Taiwan, and they began to provide store-to-store delivery services in 2010. The service provides shippers the choice of sending their products from one convenience store and then customers pick up the purchased goods in another. The objectives of this study are to provide an understanding of the processes in store-to-store delivery system. In order to explore and overcome the vagueness of the dynamics, it may be more appropriate to apply sensitivity model (SM) and fuzzy cognitive maps (FCM) because of its fewer limitations in application, and it may help smooth the kinks for potential research obstacles.

Basic Concept of Store-to-Store Delivery Services

In Taiwan there are a lot of 7-11 convenience stores, which facilitates retail delivery service (shopping on-line and picking up orders at preferred convenience stores). Retail delivery of e-commerce in Taiwan is about ten years old, and the e-commerce RD model is mainly employed by providers. It is the first system in Taiwan comprised of information, technology systems, and convenience stores chains and provides an integrated logistics service. The development of this logistics delivery model has provided a great deal of

support to the C2C business model. Online stores can offer more delivery options for customers to choose from. Store-to-store delivery service is an advanced delivery service based on retail delivery and multimedia Kiosk. Figure 1 illustrates the store-to-store delivery service process. Firstly, sender take products to a related convenience store (7-11) and enter the receivers' information and print the barcode attached to their products through MMK. At this time, information is be uploaded to store-to-store delivery platform. Then, the goods are dealt with by the WDS corporation (Wisdom distribution service corporation), which has their own fleet and distribution center. When the goods are in the distribution center, the information is also uploaded to the store-to-store system and IT identifies the data and volume of the products. Finally, a text message and e-mail are sent to inform the receiver when they can pick up their product from the store that they selected. If they don't (or forget) go to pick up the product within a week, it will be considered returned goods. The products will be sent back to the distribution center. Because the store-to-store logistical cost of 7-11 is lower than for home delivery, and almost the same as that of delivery through the post office, more and more customers are using this system.

Figure 1: Store-to-store delivery process (7-11)

Method and Analysis Results

The fundamental ideas of SM and FCM, which make them different from other planning approaches, include system thinking, and the use of fuzzy set theory. The Sensitivity model was by no means used for the first time in logistics, and here the use of SM is to make sure if all these problems are included. Sensitivity model and fuzzy cognitive map is a semi-quantitative modeling tool based on system thinking and fuzzy logic [2]. The fundamental ideas of SM, differing from other planning approaches, include system thinking, the use of fuzzy set theory, and simulation through semi-quantitative data. Any successful medical decision support system has to take into consideration a high amount of data and information from interdisciplinary sources [3]. Fuzzy cognitive map is flexible tool that has been successfully applied in a large number of disciplines [4-7]. FCM is a modeling and simulation methodology describing on an abstract conceptual representation any system [8]. The graphical illustration of an FCM is a signed directed graph with feedback, consisting of nodes and weighted arcs. Nodes of the graph stand for the concepts that are used to describe the behavior of the system and they are connected by signed and weighted arcs representing the causal relationships that exist between the concepts. Each concept is characterized by a number A_i that represents its value and it results from the transformation of the fuzzy real value of the system's variable, for which this concepts stands, in the interval [0, 1]. A positive weight of the arcs between concept C_i and C_j indicates an excitatory relationship, while a negative weight indicates an inhibitory relationship [9]. The value A_i of C_i expresses the degree which corresponds to its physical value. At each simulation step, the value A_i of C_i is calculated by computing the influence of the interconnected concepts C_j's on the specific concept C_i following the calculation rule as Eq.

(1)[10]. Where $A_i^{(k+1)}$ is the value of concept C_i at simulation step $k+1$, A_i^k is the value of concept of at simulation step k, w_{ji} is the weight of the interconnection from concept C_j to concept C_i and f is the sigmoid threshold function: $f=1/(1+e^{-\lambda x})$. In this study, the value $\lambda=5$ has been used.

$$A_i^{(k+1)} = f(A_i^k + \sum_{j\neq 1, j=1}^{N} A_i^k \cdot w_{ji}) \quad (1)$$

The subjects were asked to fill out a questionnaire eliciting information concerning the concepts' relationship for store-to-store delivery. There are ten survey findings to be collected. This research focuses the concept of "delivery on time" of store-to-store delivery service. In order to analyze what kind of concept will affect the "delivery on time", we developed five concept of store-to-store delivery as Tab. 1 shown. Table 1 also offers a criteria matrix of FCM and SM of store-to-store delivery service. The values in the last two columns and rows of the impact matrix (Tab. 1) provide us with needed information to identify the role for each variable in the system. When sum up the numbers of one row to the right, we get the active sum (AS) of the corresponding variable. It represents how strongly any concept affects on the other concepts of the system. We also add the numbers in a column and get the passive sum (PS) of a variable, showing the extent to which the concept is affected by other concepts.

Tab. 1 The input matrix of FCM and SM

Concept of criteria and matrix value		Criteria matrix of FCM						Impact matrix of SM						AS	P
		C_1	C_2	C_3	C_4	C_5	C_6	C_1	C_2	C_3	C_4	C_5	C_6		
X_1: Frequency of communication and coordination	C_1	0.00	-0.65	-0.50	0.60	0.70	0.30	0	3	2	3	3	1	12	13 2
X_2: Delivery service failure	C_2	0.65	0.00	0.00	0.00	0.00	-0.60	3	0	0	0	0	3	6	48
X_3: Store clerk failure	C_3	0.60	0.60	0.00	-0.10	0.00	-0.70	3	3	0	1	0	3	10	40
X_4: Stability of Logistics Information System	C_4	-0.25	-0.20	-0.10	0.00	0.35	0.45	1	1	1	0	2	2	7	35
X_5: Stability of Multimedia Kiosk	C_5	-0.02	-0.10	-0.07	0.33	0.00	0.25	1	1	1	1	0	1	5	25
X_6: Delivery on time	C_6	-0.70	0.00	0.00	0.00	0.00	0.00	3	0	0	0	0	0	3	30
	PS							11	8	4	5	5	10		
	Q							1.09	0.75	2.50	1.40	1.00	0.30		

There are two other indices that are useful in describing the role of a concept in a system, i.e. P and Q. P, AS and PS represents the concept plays a primary role. Q, the quotient of AS over PS, is for describing the distinct role of a concept. According to the above rules, all the concepts of the system are plotted in Fig. 2 We can see that "frequency of communication and coordination (*C1*)", and "store clerk failure (*C3*)" are the critical concepts in store-to-store delivery system, which means these concepts are the major driving force behind system development. In order to deal with the problem of dependence and feedback among concepts, we first depict the FCM as shown in Fig.3 to illustrate the situation from the relationship of store-to-store delivery, and the weights between concepts are shown as Tab.1, the criteria matrix of FCM is six by six. The store-to-store delivery service can be test by setting the concept node in an input vector to *S1* = (0.2, 0.2, 0.8,

0.95, 0.92, 0.85), *S1* is six by one matrix. After 24 iterations the concept of vector is like that: S24=(0.08, 0.34, 0.29, 0.82, 0.85, 0.73). Fig. 4 illustrates the dynamic analysis result consider about themselves for λ equal to 5. We can observe that the value of each concept will vibrate, and when the vibration would be stable after several runs. It is noticed that store-to-store delivery service provide by 7-11 remains competitive because the "delivery on time (*C6*)" concept still stay in good range if top management decides no changes in the operation. It indicates that the system was not stability at the beginning; such a partial explanation for this may lie in the fact that the "delivery service failure (*C2*)" is not stable. To increase the ability of store-to-store delivery service, we need about 15 iterations to adjust. After 20 iterations, we find that the ability of the concept *C6* is steady at 0.73 in the long run.

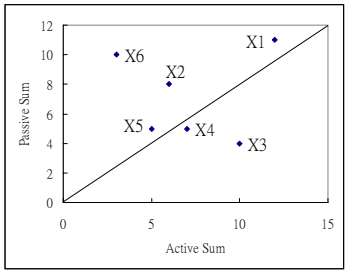

Fig. 2 System roles of the variables

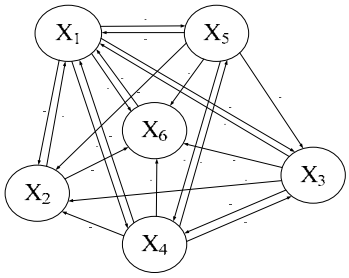

Fig. 3 FCM for research case

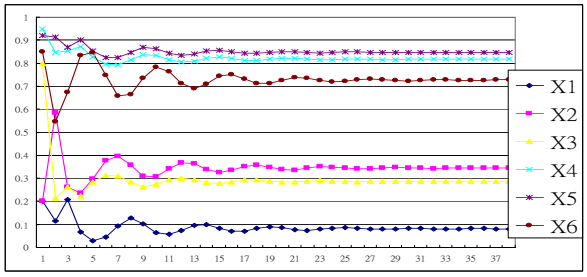

Fig. 4 Dynamic analysis result of FCM

Conclusion

The supply chain management has been widely studied in the academic as well as practical fields. In Taiwan, the store-to-store delivery service based on retail delivery could be quite common and popular these days. The logistics process of store-to-store service is complicated and has a lot of risks. Although the vulnerability is not a new concept of delivery risk analysis. However, there are fewer studies about the performance of magazine dealer. Based on the research background and motivations, the sensitivity model and fuzzy cognitive maps were chosen as the design methodologies to explore the concept of "delivery on time" of store-to-store delivery service. Through the many field trips to the selected companies of store-to-store delivery providers, in-depth interviews as well as discussions with experts, and literature reviews, this research constructs six concepts and explores the strength of causal relationship among them. We development fuzzy cognitive map including "frequency of communication and coordination", "delivery service failure", "store clerk failure", "stability of logistics information system", "stability of multimedia Kiosk" and "delivery on time". From sensitivity model, we find out that frequency of communication and coordination and store clerk failure are the critical concepts in store-to-store delivery system. The output of fuzzy cognitive maps has shown reasonable trends and effects in relation to the store-to-store delivery service. The frequency of communication and coordination helps the company to organize and control logistics activities effectively to realize the optional coordination and cooperation among them. We are hopeful that future research will be designed with much more sophisticated allowing the ability to differentiate different point of view.

Acknowledgements

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（本計畫部分研究成果已被 EI 期刊 Applied Mechanics and Materials 所接受，上述的精簡報告即為被 Applied Mechanics and Materials 期刊所接受的文章內容）

國科會補助計畫衍生研發成果推廣資料表

日期:2012/08/31

國科會補助計畫	計畫名稱: 店到店配送系統脆弱度與回復力分析
	計畫主持人: 黃昱凱
	計畫編號: 100-2410-H-343-027- 學門領域: 交通運輸

無研發成果推廣資料

100 年度專題研究計畫研究成果彙整表

計畫主持人：黃昱凱	計畫編號：100-2410-H-343-027-
計畫名稱：店到店配送系統脆弱度與回復力分析	

成果項目			量化			單位	備註（質化說明：如數個計畫共同成果、成果列為該期刊之封面故事...等）
			實際已達成數（被接受或已發表）	預期總達成數(含實際已達成數)	本計畫實際貢獻百分比		
國內	論文著作	期刊論文	0	0	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	1	1	100%		馮正民、黃昱凱*、林維薇，整合羅吉特模式與聯合分析法探討網路拍賣賣家配送商擇行為，中華民國運輸學會100年學術論文國際研討會
		專書	0	0	100%		
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（本國籍）	碩士生	0	0	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
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國外	論文著作	期刊論文	1	1	100%	篇	Yu-Kai Huang*, Cheng-Chi Chung, Dynamic Analysis of Store-to-Store Delivery Service through Fuzzy Cognitive Map, Applied Mechanics and Materials (EI, 已接受).
		研究報告/技術報告	0	0	100%		
		研討會論文	1	1	100%		Y. K. Huang*, C. M. Feng, S. W. Shu and W. L

							Chung (2011), The Application of Fault Tree on Vulnerability Analysis of Store-to-Store Delivery System, 2011 International Conference Computer Science and Logistics Engineering (EI).
		專書	0	0	100%	章/本	
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（外國籍）	碩士生	0	0	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		
其他成果 (無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)		本計畫的部分研究成果獲得第九屆供應鏈管理論文獎碩士組優勝的獎勵，此碩士論文本計畫研究成果的一部份，該論文為與交通大學交通運輸研究所馮正民教授所聯合指導之碩士生，其論文題目為「台灣便利配配送流程脆弱度分析」					

	成果項目	量化	名稱或內容性質簡述
科教處計畫加填項目	測驗工具(含質性與量性)	0	
	課程/模組	0	
	電腦及網路系統或工具	0	
	教材	0	
	舉辦之活動/競賽	0	
	研討會/工作坊	0	
	電子報、網站	0	
	計畫成果推廣之參與（閱聽）人數	0	

國科會補助專題研究計畫成果報告自評表

請就研究內容與原計畫相符程度、達成預期目標情況、研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）、是否適合在學術期刊發表或申請專利、主要發現或其他有關價值等，作一綜合評估。

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□未達成目標（請說明，以 100 字為限）

□實驗失敗

□因故實驗中斷

□其他原因

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2. 研究成果在學術期刊發表或申請專利等情形：

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專利：□已獲得 □申請中 ■無

技轉：□已技轉 □洽談中 ■無

其他：(以 100 字為限)

本計畫的研究成果已發表一篇 EI 等級國際期刊（Applied Mechanics and Materials，已接受)，一篇 EI 等級國際研討會（2011 International Conference Computer Science and Logistics Engineering)，一篇國內學術研討會（中華民國運輸學會 100 年學術論文國際研討會，該論文並被推薦收錄到 TSSCI 運輸學刊中，其中一位審查委員已經通過，另一審查委員二審中)，另外投稿運輸計畫季刊（TSSCI)，審查中（題目為店配取貨物流系統之脆弱度評估）

3. 請依學術成就、技術創新、社會影響等方面，評估研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性)（以 500 字為限）

隨著電子商務的發展，其所衍生的物流需求也將日益複雜，鑑於以往對於電子商務環境下貨運需求之相關分析，多集中在揀貨模型、最佳路徑規劃等領域，較少針對店配物流所扮演的物流架構進行深入分析，基此，本研究藉由貝氏網路與模糊認知圖等分析技術來探討研究個案之物流系統的配送脆弱度議題。本研究之成果可供線上購物之配送需求分析、電子商務、物流需求選擇行為分析等研究領域參考，同時，亦可作為政府部門研擬有關企業 E 化相關經建計畫之參考，俾使經建計畫不至偏離廠商實際需求。