



國立高雄應用科技大學
企業管理系碩士班
碩士論文

低溫物流供應商之評選決策

A Study of Supplier Selection Decision for Cold
Logistics

研究生：涂鏡騰

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中華民國 103 年 6 月

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摘要

節省資源與減少成本為目前企業最注重的因素，由於運輸成本的增加，企業為了增加競爭優勢，將非核心活動外包成為企業降低成本的重要方式。過去評選物流供應商時，大多依賴決策者經驗判斷，或是單純考慮成本因素，故若要提升物流供應商評選的決策品質，應以較系統化、精確化的方式為之。

本研究提出一個模糊多目標供應商評選模式，以能見度、冷鏈品質與成本為準則，並考量資源可使用量之限制，建構出低溫物流供應商之評選模式。並以實務案例示範該模式之實用性，最後透過敏感度分析來瞭解能見度與能見度預算對評選績效之影響。

關鍵字：能見度，模糊多目標規劃，冷鏈品質，供應商評選

A Study of Supplier Selection Decision for Cold Logistics

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ABSTRACT

Resource saving and cost reduction have become key issues for enterprises. Due to the increase of transportation costs, enterprises have been outsourcing non-core activities in order to stay focus on their competent functions. To select appropriate suppliers require a systematic and efficient evaluation process so that decision quality can be enhanced.

In this research, we develop a fuzzy multi-objective programming model for the selection of cold logistics provider. Visibility, cold chain quality and cost are used as evaluation criteria. An illustrative example is utilized to show how the proposed model can be implemented. In addition, sensitivity analysis is conducted to study the impact of the visibility and its associated budget to the decision performance.

Keywords: Visibility, Fuzzy Multi-objective Programming, Cold Chain Quality, Supplier Selection

第一章 緒論

第一節 研究背景

近年來物流業經營環境複雜多變，企業須納入考慮的因素越來越多，以往在評選供應商時，大多依賴決策者經驗判斷，或是單純考慮成本因素導致物流供應商評選品質不佳，故若要提升物流供應商評選的決策品質，應以較系統化、精確化的方式為之。

隨著物流生產自動化的水準提高，生產系統趨於複雜，而物流被視為企業的第三利潤來源，資源節省與減少成本問題成為企業注重的關鍵因素。企業為了在全球化的經濟環境上滿足市場需求及提升競爭力，在供應鏈上越來越多大型公司將資源投入於核心事業，並將非核心的物流事業外包。近年來在日本，大約有 70% 的公司將主要的物流活動外包給第三方物流公司，在美國大約有 42% 的企業將物流作業外包。許多企業認為將物流外包能將供應鏈更有效率的整合(Chao, 2009)。

第三方物流 (Third Party Logistics, 簡稱 3PL) 於 1980 年後期由美國物流管理協會(Council of Logistics Management)首先提出的概念。第三方物流服務的層面寬廣，涵蓋物流活動各個環節，舉凡食品供應鏈 (Food chain)、冷鏈 (Cold Chain)，而其中冷鏈與日常生活息息相關在全球化的情況下勢必為不可或缺的一塊領域。

根據國際冷藏協會(International Institute of Refrigeration, IIR)於 2009 年的統計資料，已開發國家食品損失率 (包含作物收成之後的損失) 為 10%，開發中國家為 28%。IIR 認為，開發中國家若能取得與工業國家相同水準的冷藏設備，則超過 200 萬公噸的易腐食品即可被保存，大約是國家當時食品消耗量的 14%。根據世界衛生組織(World Health Organization, WHO)指出不安全的食品會造成嚴重及終生的疾病，包括腹瀉以及各種形式的癌症，WHO 估計，食物及

水源所引起的腹瀉能造成每年 220 萬人的死亡，其中有 190 萬人是小孩子，顯示出食品資源的浪費以及食品來源安全性的重要程度。

Fuller(1997)對冷鏈(cold chain)的定義，冷鏈是讓冷凍食品可以維持在正確溫度下的設備與作業方法，冷鏈可以維持食品品質，減少損耗，因此在配送流程中一直扮演關鍵角色。范姜証等（2012）認為冷鏈作業程序中，溫度的控管是最重要的一環，冷鏈處理不當將會導致食品有效安全日期縮短，繼而造成重大損失。

EPC Global 統計數據顯示，每年透過運輸業者運送的需冷凍或冷藏商品超過 50 億個棧板，貨品總價值達 26,000 億美金，其中包括有冷凍肉品、冷凍海鮮、乳酪製品、農產品與對溫度敏感的藥品。冷凍肉或冷凍海鮮每年損失達 320 億美金，藥品每年損失也可達 54 億美金，而農產品雖然單價較低，但是每年損失卻高達 340 億美金（DigiTimes 企劃）。

以墨西哥新鮮黑莓運送到美國市場銷售過程來分析，長達 2 至 4 天的運送過程而店家需要 12 至 14 天的保存期限，對於農產業者是相當大的影響，單單運輸過程，就會發生 7% 的產品損失，其中店家本身因為冷藏監控不良的外部問題，又會再造成 10% 至 20% 的損失（TIOTA 物聯網應用聯盟，2012）。

資源的耗竭加上人們對食品藥物安全的重視儼然成為現代趨勢，產品在整個運輸過程中所造成的損害不僅為資源的浪費，更攸關人體健康安全，但由於全球資本結構的改變使得企業必須注重於核心領域，並將冷鏈這樣高成本的運輸工程外包給其他物流供應商，低溫物流供應商評選問題就此產生，因此本研究認為低溫物流供應商評選勢在必行。

第二節 研究動機

根據世界衛生組織報導，由於食品與水源感染每年大約造成 220 萬人死亡，其中大部分是在未開發的國家的兒童，由於全球化的趨勢，食品的生產、處理及運送漸漸受到重視。在管理上為了使食品更加安全並防止食品受到感染，

提高對食品溫度監控及控制，企業在供應鏈管理中對於溫度較敏感或是較容易腐壞的食品應設立冷鏈管理(Cold Chain Management, CCM)，但由於設立 CCM 的成本較高，因此企業多將 CCM 活動外包。

隨著飲食文化的改變，消費者對於低溫食品的需求大增，為了確保在製造、儲存、運輸及銷售等流通過程中保存低溫狀態、維持產品品質，須有完善的冷鏈設備及運送體系，而冷鏈即為了符合這需求而衍生出一種供應鏈體系。其中相對於冷藏與冷凍食品更重要的是產品品質，而在冷鏈中產品品質取決於運送時間與溫度變化(Zhang et al, 2003)，在實際面上，選擇低溫物流供應商時通常在考慮最低儲存成本及運送成本的同時並考慮產品最低需求品質，改善品質的首要關鍵即為投資更多的物流設備，然而大部分的公司為中小企業(Talluri and Sarkis, 2002)。這些中小企業為了要專注於本身核心能力並減少物流成本可能會將物流服務外包。

國際化的改變，運送貨品的數量日漸擴增且運送時間減少的需求，使得運輸成本的增加，加上資料的模糊性造成決策者評選難度提升，過去的供應商評選中鮮少關注低溫物流供應商評選問題，因此本研究致力於建立一模糊多目標低溫供應商評選模式。

第三節 研究目的

過去企業進行供應商評選時，鮮少對低溫物流供應商評選議題有所關注，本研究運用模糊多目標方法，參考相關文獻與企業實務運作，找出影響低溫物流供應商評選因素，建構出「低溫物流供應商評選一般化模式」。

本研究目的如下：

1. 建立一套低溫物流供應商評選模式，作為低溫物流供應商評選時的依據。
2. 期望研究結果能提供中小企業參考，使低溫物流供應商評選問題之決策更加合理化公平化。

3. 根據實證結果，對實施低溫物流供應商企業提出相關之遴選建議。

第四節 研究步驟與流程

為了達成本研究目的，研究流程設計如下圖 1-1：

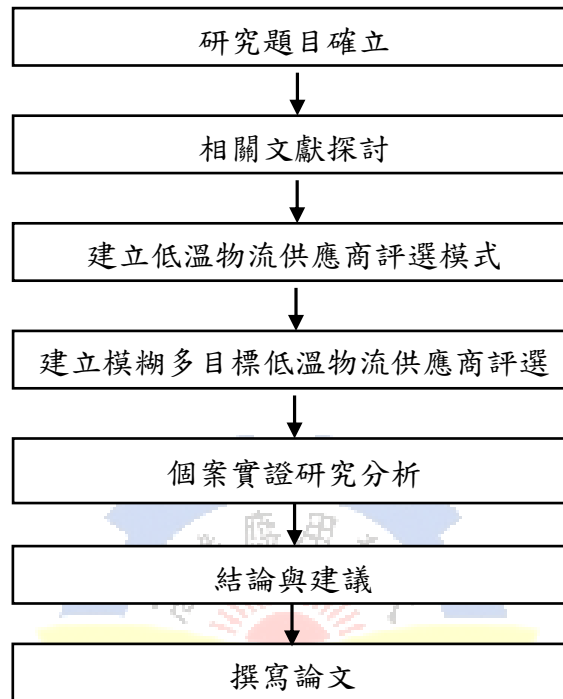


圖 1-1 研究流程

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網路部分

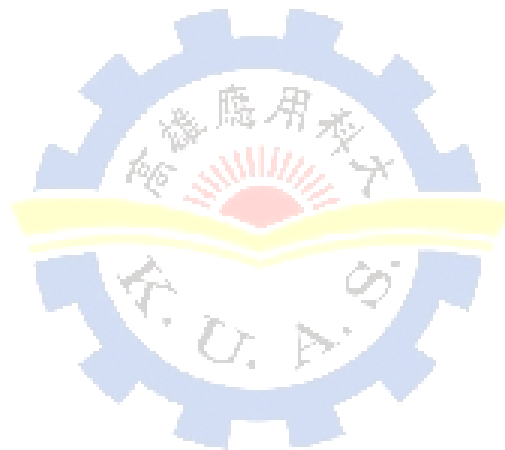
DigiTime 企劃

http://www.digitimes.com.tw/tw/dt/n/shwnws.asp?id=0000279495_XZL3YXTYLHP LCE43CSCQA&ct=1#ixzz1sA4TelFl (2014 年 1 月 19 日)

TIOTA 物聯網應用聯盟

http://www.digitimes.com.tw/tw/b2b/Seminar/shwnws_new.asp?CnlID=18&cat=99&product_id=051A10223&id=0000279495_XZL3YXTYLHPLCE43CSCQA#ixzz1sBxSUCoC (2013 年 12 月 30 日)

世界衛生組織(WHO) <http://www.who.int/foodsafety/en> (2013 年 11 月 25 日)



附錄一 冷凍貨櫃評分指標

CCQI Description	Points	Max-Points	Points awarded
Advisory services to customers			
Dedicated recommendations are available to customers concerning : -transport conditions of perishables and temperature sensitive products (PTSP) / typical container temperature set points - stowage of cargoes in reefer containers ("To Do" list) - check of containers before stuffing of the cargo	No: 0 Yes: 5	5	
	No: 0 Yes: 5	5	
	No: 0 Yes: 5	5	
	subtotal	15	
Technical maintenance / repairs of reefer containers			
-Maintenance and repairs of reefer containers are conducted according to a maintenance procedure (e.g. ACEP) - Preventive maintenance is conducted on the basis of analysis of causes for breakdowns of equipment	No: 0 Yes: 5	5	
	No: 0 Yes: 5	5	
	subtotal	10	

CCQI Description	Points	Max-Points	Points awarded
Hygienic maintenance			
Intensive cleaning of reefer containers is carried out		3	
-as deemed necessary after inspection	0		
-after every cargo voyage (dry or refrigerated)	3		
Instruction for PTIs			
Detailed written instructions concerning the performance of PTIs (Pre Trip Inspections) to repair	No: 0 Yes: 8	8	
shops / subcontractors are available			
Special Equipment			
Container operator offers specialized equipment for	No: 0 Yes: 2	2	
- super deep frozen cargo			
-controlled atmosphere	No: 0 Yes: 2	2	
	subtotal	15	

CCQI Description	Points	Max-Points	Points awarded
Age of Containers			
Age of Container series			
< 5 years	30		
>= 5 years and < 10 years	20	30	
>= 10 years and < 15 years	10		
>= 15 years	0		
	subtotal	30	
Cooling capacity			
Net cooling capacity is			
>= 10.0 kW at 1.7°C (35°F)	No: 0 Yes: 4	4	
>= 6.0 kW at -17.8°C (0°F)	No: 0 Yes: 4	4	
	subtotal	8	

CCQI Description	Points	Max-Points	Points awarded
Equipment and accessories			
Container series is equipped with remote monitoring modems	No: 0 Yes: 10	10	
Reefer machinery is equipped with de-humidification option	No: 0 Yes: 2	2	
	subtotal	12	
Temperature monitoring / recording			
Container series is			
- not equipped with temperature recorders	0		
- equipped with chart recorders and/or data logger recording only one air temperature (supply or return)	5	10	
- equipped with data logger recording at least supply and return air temperature and power on/off periods	8		
-equipped with data logger recording at least supply and return air and ambient temperature and power on/off periods	10		
	subtotal	10	

附錄二 模糊供應商選加權模式

$$\max L = (1/10) \times \lambda_1 + (8/10) \times \lambda_2 + (1/10) \times \lambda_3$$

$$3.9 \times \lambda_1 \leq (5.68 \times Y_{11} + 7.5 \times Y_{12} + 6.28 \times Y_{13} + 5.68 \times Y_{21} + 7.5 \times Y_{22} + 6.28 \times Y_{23} + 5.68 \times Y_{31} + 7.5 \times Y_{32} + 6.28 \times Y_{33}) - 16.8$$

$$\lambda_2 \leq (85 \times Y_{11} + 90 \times Y_{12} + 86 \times Y_{13} + 85 \times Y_{21} + 90 \times Y_{22} + 86 \times Y_{23} + 85 \times Y_{31} + 90 \times Y_{32} + 86 \times Y_{33})$$

$$1365 \times \lambda_3 \leq 154453 - (5.68 \times 300 \times Y_{11} + 7.5 \times 400 \times Y_{12} + 6.28 \times 350 \times Y_{13} + 5.68 \times 300 \times Y_{21} + 7.5 \times 400 \times Y_{22} + 6.28 \times 350 \times Y_{23} + 5.68 \times 300 \times Y_{31} + 7.5 \times 400 \times Y_{32} + 6.28 \times 350 \times Y_{33} + 55.34 \times Q_{11} + 66.59 \times Q_{12} + 59.09 \times Q_{13} + 73.78 \times Q_{21} + 88.78 \times Q_{22} + 78.78 \times Q_{23} + 36.89 \times Q_{31} + 44.39 \times Q_{32} + 39.39 \times Q_{33} + 1800 \times Y_{11} + 1800 \times Y_{12} + 1800 \times Y_{13} + 1800 \times Y_{21} + 1800 \times Y_{22} + 1800 \times Y_{23} + 1800 \times Y_{31} + 1800 \times Y_{32} + 1800 \times Y_{33})$$

$$(1/6) \times 4.5 \times 300 \times Y_{11} + (4/6) \times 5.8 \times 300 \times Y_{11} + (1/6) \times 6.4 \times 300 \times Y_{11} + (1/6) \times 7.1 \times 400 \times Y_{12} + (4/6) \times 7.5 \times 400 \times Y_{12} + (1/6) \times 7.9 \times 400 \times Y_{12} + (1/6) \times 5.6 \times 350 \times Y_{13} + (4/6) \times 6.3 \times 350 \times Y_{13} + (1/6) \times 6.9 \times 350 \times Y_{13} \leq 2800$$

$$(1/6) \times 4.5 \times 300 \times Y_{21} + (4/6) \times 5.8 \times 300 \times Y_{21} + (1/6) \times 6.4 \times 300 \times Y_{21} + (1/6) \times 7.1 \times 400 \times Y_{22} + (4/6) \times 7.5 \times 400 \times Y_{22} + (1/6) \times 7.9 \times 400 \times Y_{22} + (1/6) \times 5.6 \times 350 \times Y_{23} + (4/6) \times 6.3 \times 350 \times Y_{23} + (1/6) \times 6.9 \times 350 \times Y_{23} \leq 2500$$

$$(1/6) \times 7.5 \times 300 \times Y_{31} + (4/6) \times 5.8 \times 300 \times Y_{31} + (1/6) \times 6.4 \times 300 \times Y_{31} + (1/6) \times 7.1 \times 400 \times Y_{32} + (4/6) \times 7.5 \times 400 \times Y_{32} + (1/6) \times 7.9 \times 400 \times Y_{32} + (1/6) \times 5.6 \times 350 \times Y_{33} + (4/6) \times 6.3 \times 350 \times Y_{33} + (1/6) \times 6.9 \times 350 \times Y_{33} \leq 2500$$

$$(1/6) \times 4.5 \times Y_{11} + (4/6) \times 5.8 \times Y_{11} + (1/6) \times 6.4 \times Y_{11} + (1/6) \times 7.1 \times Y_{12} + (4/6) \times 7.5 \times Y_{12} + (1/6) \times 7.9 \times Y_{12} + (1/6) \times 5.6 \times Y_{13} + (4/6) \times 6.3 \times Y_{13} + (1/6) \times 6.9 \times Y_{13} \geq 5$$

$$(1/6) \times 4.5 \times Y_{21} + (4/6) \times 5.8 \times Y_{21} + (1/6) \times 6.4 \times Y_{21} + (1/6) \times 7.1 \times Y_{22} + (4/6) \times 7.5 \times Y_{22} + (1/6) \times 7.9 \times Y_{22} + (1/6) \times 5.6 \times Y_{23} + (4/6) \times 6.3 \times Y_{23} + (1/6) \times 6.9 \times Y_{23} \geq 4$$

$$(1/6) \times 7.5 \times Y_{31} + (4/6) \times 5.8 \times Y_{31} + (1/6) \times 6.4 \times Y_{31} + (1/6) \times 7.1 \times Y_{32} + (4/6) \times 7.5 \times Y_{32} + (1/6) \times 7.9 \times Y_{32} + (1/6) \times 5.6 \times Y_{33} + (4/6) \times 6.3 \times Y_{33} + (1/6) \times 6.9 \times Y_{33} \geq 4$$

$$Z_1 = 5.68 \times Y_{11} + 7.5 \times Y_{12} + 6.28 \times Y_{13} + 5.68 \times Y_{21} + 7.5 \times Y_{22} + 6.28 \times Y_{23} + 5.68 \times Y_{31} + 7.5 \times Y_{32} + 6.28 \times Y_{33}$$

$$Z_2 = 85 \times Y_{11} + 90 \times Y_{12} + 86 \times Y_{13} + 85 \times Y_{21} + 90 \times Y_{22} + 86 \times Y_{23} + 85 \times Y_{31} + 90 \times Y_{32} + 86 \times Y_{33}$$

$$Z_3 = 5.68 \times 300 \times Y_{11} + 7.5 \times 400 \times Y_{12} + 6.28 \times 350 \times Y_{13} + 5.68 \times 300 \times Y_{21} + 7.5 \times 400 \times Y_{22} + 6.28 \times 350 \times Y_{23} + 5.68 \times 300 \times Y_{31} + 7.5 \times 400 \times Y_{32} + 6.28 \times 350 \times Y_{33} + 55.34 \times Q_{11} + 66.59 \times Q_{12} + 59.09 \times Q_{13} + 73.78 \times Q_{21} + 88.78 \times Q_{22} + 78.78 \times Q_{23} + 36.89 \times Q_{31} + 44.39 \times Q_{32} + 39.39 \times Q_{33} + 1800 \times Y_{11} + 1800 \times Y_{12} + 1800 \times Y_{13} + 1800 \times Y_{21} + 1800 \times Y_{22} + 1800 \times Y_{23} + 1800 \times Y_{31} + 1800 \times Y_{32} + 1800 \times Y_{33}$$

$$Q_{11} \times (Y_{11}) + Q_{12} \times (Y_{12}) + Q_{13} \times (Y_{13}) = 800$$

$$Q_{21} \times (Y_{21}) + Q_{22} \times (Y_{22}) + Q_{23} \times (Y_{23}) = 600$$

$$Q_{31} \times (Y_{31}) + Q_{32} \times (Y_{32}) + Q_{33} \times (Y_{33}) = 1200$$

$$0 \leq L_1 \leq 1, 0 \leq L_2 \leq 1, 0 \leq L_3 \leq 1$$

$$Q_{ij} \leq 1000000000 \times X_{ij}, i = 1, 2, 3, 4, j = 1, 2, 3, 4, 5$$

$$\sum_j Y_{ij} = 1$$

$$Q_{ij} \geq 0$$

$$p_{ij} = 1800, i = 1, 2, 3, j = 1, 2, 3$$

$$Q_{ij} \geq 0 \text{ and integer } i = 1, 2, 3, j = 1, 2, 3$$

$$Y_{ij} \in \{1, 0\}$$

