科技部補助專題研究計畫成果報告
期末報告

供應鏈中的整合賣方與買方存貨模式在不同策略下的最佳訂購策略之簡化求解程序(第 2 年)

計 畫 類 別 ：個別型計畫
計 畫 編 號 ：NSC 101-2628-E-263-001-MY2
執 行 期 間 ：102 年 08 月 01 日至 103 年 07 月 31 日
執 行 單 位 ：致理技術學院企業管理系

計 畫 主 持 人 ：廖瑞容

計畫參與人員：碩士班研究生-兼任助理人員：周禹宗

處 理 方 式 ：
1.公開資訊：本計畫涉及專利或其他智慧財產權，2 年後可公開查詢
2.「本研究」是否已有嚴重損及公共利益之發現：否
3.「本報告」是否建議提供政府單位施政參考：否

中 華 民 國 103 年 10 月 07 日

中 文 摘 要 ： 面對現今競爭的商業環境中,許多企業已經漸漸的走向全球化經營並強調分工合作的營運模式。換言之，買方與賣方必須讓供應鏈的物流、資訊流與金流管理能夠成功的組織起來。事實上，大部分的賣方希望買方的需求是持續穩定的；相同的，大部分的買方亦希望賣方的供應是持續穩定的。由此可知，買方與賣方彼此會需要建立一種長期的合作關係。因此，在整合賣方與買方存貨模式中找出其最佳的訂購決策會是一個重要的意題。

在實務上，大多數產品的供應商為了增加自己的利潤，通常會提出一些價格策略來鼓勵買方增加其訂購量。從買方的角度來看，訂購量的多寡是由買賣雙方達成的價格折扣來決定；相對的，從賣方的角度來看，折扣計劃的執行可以找到最佳的價格來刺激買方增加其訂購量，再增加賣方本身的利潤。由此可知，將價格策略的影響納入整合存貨模式一併考慮是有其必要性的；因此，本研究將延續第一年研究計畫的賣方提供買方一固定的延遲付款優惠期限以及不同銷售價格策略的整合存貨模型，接著探討賣方提供不同的延遲付款給買方之情況，其中延遲付款將被視為一決策變數。最後，對於所建立的整合存貨模型，我們將利用利用成本函數的性質找出此存貨模式的最佳解。接著，建立一簡易的演算法以方便求解，以數值範例說明求解過程，並對重要的參數進行敏感性分析。

中文關鍵詞： 存貨、價格策略、整合存貨模型、延遲付款策略、供應鏈管理

英 文 摘 要 ：

英文關鍵詞：

行政院國家科學委員會補助專題研究計畫成果報告

(計畫名稱)

供應鏈中的整合賣方與買方存貨模式在不同策略下的最佳訂購策略之簡化求解程序

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中　華　民　國　**103** 年　**9**　月　**25**　日

行政院國家科學委員會專題研究計畫成果報告

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供應鏈中的整合賣方與買方存貨模式在不同策略下的最佳訂購策略之簡化求解程序

(英文計畫名稱)

The simplified solution for integrated vendor-buyer cooperative inventory models with variant strategies in a supply chain

中文摘要

面對現今競爭的商業環境中,許多企業已經漸漸的走向全球化經營並強調分工合作的營運模式。換言之，買方與賣方必須讓供應鏈的物流、資訊流與金流管理能夠成功的組織起來。事實上，大部分的賣方希望買方的需求是持續穩定的；相同的，大部分的買方亦希望賣方的供應是持續穩定的。由此可知，買方與賣方彼此會需要建立一種長期的合作關係。因此，在整合賣方與買方存貨模式中找出其最佳的訂購決策會是一個重要的意題。

在實務上，大多數產品的供應商為了增加自己的利潤，通常會提出一些價格策略來鼓勵買方增加其訂購量。從買方的角度來看，訂購量的多寡是由買賣雙方達成的價格折扣來決定；相對的，從賣方的角度來看，折扣計劃的執行可以找到最佳的價格來刺激買方增加其訂購量，再增加賣方本身的利潤。由此可知，將價格策略的影響納入整合存貨模式一併考慮是有其必要性的；因此，本研究將延續第一年研究計畫的賣方提供買方一固定的延遲付款優惠期限以及不同銷售價格策略的整合存貨模型，接著探討賣方提供不同的延遲付款給買方之情況，其中延遲付款將被視為一決策變數。最後，對於所建立的整合存貨模型，我們將利用利用成本函數的性質找出此存貨模式的最佳解。接著，建立一簡易的演算法以方便求解，以數值範例說明求解過程，並對重要的參數進行敏感性分析。

關鍵詞：存貨、價格策略、整合存貨模型、延遲付款策略、供應鏈管理

Abstract

Facing a competitive commercial environment, many businesses establish the cooperative relationship in order to maximize the profit. In fact, many vendors and buyers would like to establish long term cooperative relationships to obtain stable sources of supply and demand to gain the optimum profit from each other. Consequently, the way to determine the optimal ordering policy for the integrated vendor-buyer system has become an important issue.

From the practical viewpoint, the order quantity is determined based on the discounted procurement cost per unit item to decrease the total cost from the buyer's viewpoint. On the other hand, from the vendor's viewpoint, the discount scheme is set up and implemented in the models to determine the optimal price for encouraging the buyer to increase the order quantity so as to finally increase the vendor's profit. Based on the above argument, the price strategy takes into account in the integrated inventory model is necessary. Consequently, this article will extend the plan of the first year which explored an integrated inventory model of the vendor offers a fixed permissible delay period and a variant pricing strategy to the buyer to explore an integrated inventory model of the vendor offers a variant permissible delay in payments to the buyer. Herein, the permissible delay in payment is considered as a decision variable in the model. To analyze the effect of the functional behaviors of the annual total cost under above conditions, then this article will find the optimal solutions. Next, the article will develop a simple, accurate and rapid algorithm for finding the optimal pricing and lot-sizing policy which the buyer and vendor can achieve a compromise solution acceptable to both sides.

Keywords: Inventory、Pricing strategy、Integrated inventory model、Delay payment strategy、Supply chain management

一、報告內容

（報告內容請依國科會結案報告格式撰寫，例如：前言、研究目的、文獻探討、研究方法、結果與討論。各節編號請自訂。）

1. Introduction

Most of the inventory models only aimed at the determination of the optimum solutions that minimized cost or maximized profit from the buyer's or vendor' side. In addition, the inventory models are studied only from the perspective of the buyer whereas in practice the length of the credit period is set by the vendor in these articles. However, in the modern global competitive market, the buyer and vendor should be treated as strategic partners in the supply chain with a long-term cooperative relationship. Goyal (1976) first developed a single-vendor single-buyer integrated inventory model. Banerjee (1986) extended Goyal's model and assumed that the vendor followed a lot-for-lot shipment policy with respect to buyer. Other researchers developed the integrated inventory models such as Goyal (1988), Li (195), Li et al. (1995), Ha and Kim (1997), Chakravarty and Martin (1998)、Pan and Yang (2002), Ouyang et al. (2004), Chang et al. (2006), Yang and Wee (2003) and Chung and Liao (2011). Most strikingly, the price strategy is usually adopted in the integrated inventory model. From the buyer's viewpoint, the order quantity is determined based on the

discounted procurement cost per unit item to decrease the total cost. On the other hand, from the vendor's viewpoint, the discount scheme is set up and implemented in the models to determine the optimal price for encouraging the buyer to increase the order quantity so as to finally increase the vendor's profit. Based on the above argument, the price strategy takes into account in the integrated inventory model is necessary.

Obviously, the above integrated vendor-buyer models are developed to determine the optimal order quantity under the considerations of the vendor's production rate or quantity, distribution function of lead time, the allowable shortage, and the allowable imperfect items. However, a permissible delay period in payments to buyer can promote order quantity, it is not incorporated into the vendor-buyer integrated model in the existing literature. That is, traditional integrated models for the vendor-buyer system do not consider the delay payment period in the model formulations. Abad and Jaggi (2003) provided a seller-buyer integrated inventory model under trade credit and followed a lot-for-lot shipment policy. Yang and Wee (2006) developed a vendor-buyer integrated inventory model for deteriorating items with permissible delay in payments. From the viewpoint of the vendor-buyer cooperation in the supply chain management, this article will explore an integrated inventory model of the vendor offers a variant permissible delay in payments to the buyer. Herein, the permissible delay in payment is considered as a decision variable in the model. A numerical example is used to illustrate the model proposed and sensitivity analysis is performed.

2. Notations and Assumptions

A buyer's setup cost per order

S vendor's setup cost per production run

F fixed process cost to vendor of dealing with each order

h_v vendor's production cost per unit item

h_b buyer's holding cost rate per unit per year excluding interest charges

c buyer's procurement cost per unit item

p_b buyer's selling price per unit item ($c < p_b$)

D annual demand rate of the buyer

P annual production rate of the vender ($P > D$)

T replenishment time interval in year unit of the buyer (decision variable)

$$T = \begin{cases} T_1 & if \quad T \geq M \\ T_2 & if \quad T < M \end{cases}$$

M delay period in payment offered by the vendor

M_1 the extended delay period in payment in the integrated model

M_s the most permissible delay period in payment allowed by vendor in the integrated model

I_d annual interest rate of deposit for buyer

I_c annual interest charge to be paid per $ in stock to the bank

I_v annual interest rate for calculating the vendor's opportunity interest loss due to the delay payment

n frequency of buyer's replenishment during the vendor's production run of each batch

TB annual total cost for the buyer,

$$TB = \begin{cases} TB_1 & if \quad T \geq M \\ TB_2 & if \quad T < M \end{cases}$$

TV annual total cost for the vendor

TC annual total cost by adding TB and TV

(1) The lead time to replenish the buyer's order is zero.
(2) The replenishment is instantaneous.
(3) Demand rate is constant over time, and production rate is greater than the demand rate.
(4) The buyer deposits the sale income in a bank with the annual interest rate I_d before the payment is due. At the payment time, the buyer pays off the purchased products' cost to the vendor. The buyer has a loan from a bank for the unsold products' cost. During the period of delayed payment, the vendor has on opportunity interest loss with the annual rate I_v, where $I_v = I_d$.
(5) The integrated model only deals with a single vendor and single buyer for a single product.
(6) Shortages are not allowed.
(7) Time horizon is infinite.

Finally, the total cost of the integrated model is obtained as following：

$$TC(n,M,T) = \begin{cases} TC_1(n,M,T) & if \quad n \geq 1 \\ TC_2(n,M,T) & if \quad n \geq 1 \end{cases}$$

3. Conclusions

This study develops the integration model involving the permissible delay in payments. Moreover, this study explores the effect of the functional behaviors of the annual cost with variant permissible delay in payments. With the convexities, we can determine the optimal solution when the variant permissible delay in payments is considered in the integrated vendor- buyer cooperative inventory model. An associated algorithm to locate the optimal solutions is developed as well. Finally, numerical examples are used to illustrate all of the study results.

4. Self-Evaluation

This research corresponds to the original plan and has attained its aim. Hence, the study is of great academic value and suitable for publication in academic journals.

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科技部補助計畫衍生研發成果推廣資料表

日期:2014/10/07

科技部補助計畫	計畫名稱: 供應鏈中的整合賣方與買方存貨模式在不同策略下的最佳訂購策略之簡化求解程序
	計畫主持人: 廖瑞容
	計畫編號: 101-2628-E-263-001-MY2　　學門領域: 作業研究

無研發成果推廣資料

101 年度專題研究計畫研究成果彙整表

計畫主持人：廖瑞容	計畫編號：101-2628-E-263-001-MY2
計畫名稱：供應鏈中的整合賣方與買方存貨模式在不同策略下的最佳訂購策略之簡化求解程序	

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	0	0	100%		
		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	1	1	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%		
國外	論文著作	期刊論文	2	2	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	0	0	100%		
		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。)	無

	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	

科技部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。

1. 請就研究內容與原計畫相符程度、達成預期目標情況作一綜合評估

■達成目標

□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

說明：

2. 研究成果在學術期刊發表或申請專利等情形：

論文：□已發表 □未發表之文稿 ■撰寫中 □無

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）

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）

本研究探討賣方為了想與買方建立一長期的合作關係，分別提供不同的採購價格和不同的允許延遲付款優惠下，建構整合買方和賣方的供應鏈單位時間總成本函數，以達到雙方成本最小化的目的。研究所得的結果，期望能真實反映實際情況，並使其研究成果可供學術界參考以及實務界的存貨管理者或相關決策者在擬定存貨訂購策略時的參考依據。