國立雲林科技大學
九十二學年度研究所博士班招生考試試題

所別：工業工程與管理研究所、管理研究所
科目：統計學

I. Multiple Choice Questions (5 points each): Choose one correct answer

1. Let X and Y be two random variables, with Cov(X,Y) their covariance and ρ_{xy} their correlation. Which of the following statement is FALSE?

(a) ρ_{xy} may be zero in setting in which X and Y have an association.
(b) If repeated measurements on (X,Y) are perfectly aligned on a line with either a negative or positive slope, the magnitude of ρ_{xy} will be one.
(c) If X and Y are independent, $\rho_{xy}=0$.
(d) $-1 \leqq \mathrm{Cov}(X,Y) \leqq 1$.
(e) $\mathrm{Cov}(X,Y)=0$ if and only if $\rho_{xy}=0$.

2. Let X be a population random variable. $X_1,\ldots,X_n$ is a random sample corresponding to X, and $x_1,\ldots,x_n$ the observed values of that random sample. Which of the following statement is TRUE?

(a) The sample mean, $\overline{X}$, is a parameter.
(b) The sample median is the best measure of central tendency if the probability distribution of X is skewed.
(c) The method of moments estimate of the population variance is unbiased.
(d) A histogram is a graphical display constructed from the observed values of the random sample that reflects the shape of the cumulative distribution function of X.

3. An outdoor concert is scheduled on a day where the forecast indicates it might rain. The forecast says the probability of light rain is 0.3 and the probability of heavy rain is 0.2. There are three possible conditions:
   - If it does not rain, the concert will go on as scheduled and the producer will take $20,000 in ticket sales.
   - If it rains lightly, the concert will go on as scheduled and the reduced attendance is speculated to produce $12,000 in ticket sales.
   - If there is heavy rain, the concert will be canceled, resulting in $0 in ticket sales.

   Suppose that the cost of the producing the concert is $10,000, what is the expected profit in ticket sales that the producer would make?

(a) $ 0
(b) $ 3,600
(c) $ 10,000
(d) $ 13,600
(e) $ 20,000

4. Suppose that P(x,y,z) the joint probability mass function of the random variables X,Y, and Z, is given by

   P(1,1,1)=1/8 P(2,1,1)=1/4
   P(1,1,2)=1/8 P(2,1,2)=3/16
   P(1,2,1)=1/16 P(2,2,1)=0
   P(1,2,2)=0 P(2,2,2)=1/4

   Compute E(X|Y=2)=?

(a) 9/7
(b) 9/6
(c) 9/5
(d) 9/4

5. A weight-loss clinic wants to use regression analysis to build a model for weight-loss, y, of a client (measured in pounds). Two variables thought to affect weight-loss are client's length of time on the weight-loss program and time of session. The interaction model below is used to fit the collected data.

   $E(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_1 x_2 + \beta_5 x_1 x_3$, where

   y = Weight-loss (pounds)
   x_1 = Length of time in weight-loss program (months)
   x_2 = 1 if morning session, 0 if not
   x_3 = 1 if afternoon session, 0 if not (Base level = evening session)

   What null hypothesis would you test to determine whether the slope of the linear relationship between weight-loss (y) and time in the program (x_1) varies according to session time?

(a) $H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$
(b) $H_0 : \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$
(c) $H_0 : \beta_4 = \beta_5 = 0$
(d) $H_0 : \beta_2 = \beta_3 = 0$

6. Based on the interaction model in previous problem, give the change in weight-loss (y) for every one month increase in time in program (x_1) when attending the evening session in terms of the $\beta's$ in the model.

(a) β_1
(b) $\beta_1 + \beta_4$
(c) $\beta_1 + \beta_5$
(d) $\beta_4 + \beta_5$

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II. Problems (10 points each)

1. Let $X_1, X_2,\ldots,X_5$ be a random sample of size 5 from $N(0, \sigma^2)$. Find the constant k so that $k(X_1-X_2)/\sqrt{X_3^2+X_4^2+X_5^2}$ has a t-distribution.

2. Suppose that $Y_1, Y_2,\ldots, Y_n$ denote a random sample size n from a Poisson distribution with mean 2λ. Consider two point estimates for λ : $\hat{\lambda}_1=(Y_1+Y_2+Y_3)/6$ and $\hat{\lambda}_2=\overline{Y}/2$.

   Derive the efficiency of $\hat{\lambda}_1$ relative to $\hat{\lambda}_2$. Which estimate is more efficient?

3. For the simple linear model $Y=\beta_0+\beta_1 x+\varepsilon$, with $E(\varepsilon)=0$ and $V(\varepsilon)=\sigma^2$,

   (a) Show that $V(\hat{\beta}_0+\hat{\beta}_1 x_0)=\left[\frac{1}{n}+\frac{(x_0-\bar{x})^2}{\sum(x_i-\bar{x})^2}\right]\sigma^2$

   (b) For what value of x_0 will the confidence interval for $E(Y)$ attain its minimum length?

4. Consider the following model for the response measured for a randomized block design containing b blocks and p treatments:

$$Y_{ij}=\mu+\beta_i+\tau_j+\varepsilon_{ij}$$

where Y_{ij} = response taken on treatment j in block i

β_i = nonrandom additive effect due to the ith block, $\sum_{i=1}^{b}\beta_i=0$

τ_j = nonrandom additive effect due to the jth treatment, $\sum_{j=1}^{p}\tau_j=0$

and ε_{ij}, i =1,2,…,b and j =1,2,…,p, are independent normal random variables, with $E(\varepsilon_{ij})=0$ and $V(\varepsilon_{ij})=\sigma^2$.

(a) Give the expected value and variance of Y_{ij}.

(b) Let T_j and $\overline{T}_j$ be the total and mean of all observations receiving treatment j. Find the expected value and variance of $\overline{T}_j$.

5. Let X_1 and X_2 be independent normal random variables, each with mean 0 and variance σ^2. Define $U_1 = X_1 + X_2$ and $U_2 = X_1 - X_2$. Show that U_1 and U_2 are independent.

6. Suppose that $Y_1,\ldots, Y_n$ are independent normal random variables with $E(Y_i) = \beta_0 + \beta_1 x_i$ and $V(Y_i) = \sigma^2$, i = 1,…,n. Find the maximum-likelihood estimators of β_0 and β_1.

7. A density function sometimes used by engineers to model lengths of life of electronic components is the Rayleigh density, given by

   $f(y) = (2y/\theta)e^{-y^2/\theta}, y \geq 0$ and $f(y) = 0$, elsewhere.

   If Y has the Rayleigh density, find the probability density function for $U = Y^2$.

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一、在資本市場中，管理當局係扮演公司 insider 之角色 ，而投資人與債權人則為公司之 outsider，在這種情境下會產生資訊不對稱之情形，此時會計師就扮演非常重要之角色。

1. 資訊不對稱之情形下，會產生哪些代理成本(agency cost)?(6%)
2. 會計師提供相關服務給公司，並且由管理當局支付公費(fee)給會計師，管理當局付錢請人來查核他自己，這豈不矛盾？管理當局這麼作之理由何在？(5%)
3. 俗語說「拿人家的手軟，吃人家的嘴軟」，會計師應具備哪些條件他才能發揮此非常重要之角色？(5%)
4. 恩龍(Enron)事件中，恩龍的會計師事務所 Arthur Andersen，在事件後不久也跟著解體了，原因為何？請從實務面與理論面分別加以探討。(9%)

二、在真實世界理，理論上界定良好的(well-defined)淨利概念不存在。

If we can't prepare theoretically correct financial statements, at least we can try to make historical cost-based statements more useful.1966 年，美國 AAA 的基本會計理論公報(ASOBAT)，提出財務報導的決策有用性觀點(decision usefulness approach)，1973 年，美國 AICPA 的 Trueblood 委員會接受此觀點。

此種決策資訊有用性之觀點，隨著相關研究之發現，逐漸顯示其有限性(limit)，例如，Lev(1989) 指出，在考慮經濟體系事件影響後，盈餘資訊只解釋證券(股票)報酬變異的 2%-5%，這造成對財務報表資訊價值攸關性(value relevance)之探討，i.e. 探討財務報表資訊影響股票報酬及價格之程度。

1.歷史成本基礎財務報表，為何其價值攸關性竟然如此低？請以具體項目加以說明。(10%)

2.有鑑於此一發展，近年來美國與加拿大等國，會計準則制定團體已逐漸增加公平價值之採用。對此一轉變，請提出正面與反面之看法。(15%)

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三、A公司為中部著名的電子公司，擁有電子相關專利數十種。A公司因受董事長甲掏空，致公司經營陷入困境。為讓公司有機會東山再起，A公司計畫聲請重整。現請你就下列問題回答之。

（一）A公司聲請重整必須具備哪些要件？（9分）

（二）何謂重整債權？（2分）何謂重整債務？（2分）

（三）A公司經重整裁定後，應設置哪些機關？（6分）由何人任之？（6分）

四、試述我國現行有關員工分紅入股之相關規定？（10分）員工分紅入股應否列入費用，對此爭議你有何看法，請具體說明你的理由。（15分）

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1.績效評估一直是管理會計重要的研究議題，請問以錦標賽(tournament)排序的方式衡量衡量員工績效，有那些優點和缺點？ **20%**

2.何謂 Life Cycle Costing？採用此法的主要目的是什麼？ **20%**

3.用 ROI 衡量利潤中心的績效可能會產生那些缺點？你認為應如何改善？ **20%**

4.試說明過去廿年來有關管理會計的研究主題，以及相關的研究發現或研究結果。**40%**

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Read the paper, "公司績效與高階管理者離職之實證研究," in the subsequent pages. The paper is taken for this exam only.

1. Review the paper. (1) Summarize the paper. (10 points) (2) Then write down and explain your comments or suggestions. Be constructive as possible as you can. (50 points)

2. Managerial ownership is the focus of the paper. In addition to manager turnover discussed in the paper, the existing literature also postulates that managerial ownership may affect (1) mergers and acquisitions, (2) dividend policy, and (3) divestitures, and (4) capital structure. Discuss how managerial ownership may affect the four corporate activities. (10 points each, i.e. 40 points in total)

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公司績效與高階管理者離職之實證研究

壹、前言

美國與英國許多實證研究支持高階主管離職與績效呈現負向關係，Warner et al.(1988)與 Weisbach(1988)均發現在高階主管離職與前期股價績效之間為一負向關係。Denis et al.(1997)卻發現，高階管理者之所有權使得其離職較為不易，Dahya(1998)也指出英國公司之高階管理者持有權益大於 1%時，即可固守其職位，降低績效不好的高階主管去職之機率。Jensen and Murphy(1990)則認為強迫性之高階主管離職機率太小，以致於不能有效誘使管理者與股東間的利益一致。透過高階主管離職之可能性來管理其行為，雖然管理者的所有權有利於誘使管理者與股東利益一致，但也使得要免除一位不良績效管理者更形困難。國內是否亦有此種現象呢？績效不佳的高階主管可否透過持股比率降低其離職率呢？我國自 87 年以來，出現許多集團或公司財務危機事件，影響投資人與債權人的權益，導致我們必須重視不適任高階主管的管理問題。然而目前國內文獻較少著墨於此，國內文獻較多探討股權結構與公司內部控管之關連，很少討論高階主管持股比例對績效與高階主管離職關係的影響，少數探討高階主管離職的文獻，也都著重在高階主管離職後對公司的影響【賴汝鑑（民 75 年）、陳牡丹（民 86 年)】，或者外部董事對績效與高階主管離職關係的影響【林穎芬與劉維琪（民 89)】。本文則欲探討高階主管持股對公司績效與高階主管理離職間負向關係之影響，本

文以民國 85 年至 87 年底期間，上市公司中高階管理者異動與未異動的樣本，運用 logistic model 分別驗證高階管理者離職與前期績效、高階管理者持股比率股權結構及董事會組成間的關係，以瞭解影響高階管理者離職的主要因素，其中股權結構變數包括--高階管理者持股比率、大股東存在與否、機構法人股東持股比，而董事會組成變數包括--外部董事比率、董事長是否兼任總經理。其次，再由高階管理者離職面來探討，高階主管持股是否會降低績效不佳之高階主管離職之可能性。本文針對國內企業所有人持股的特性，將配偶、未成年子女目前所持有的股份也納入高階主管持股比率的計算，更能符合國內企業之狀況。

本文以下部分之架構如下：第二部份是相關文獻回顧，第三部分介紹本文的研究假說、研究之代理變數及本文採用之統計模型，第四部分陳述本文之實證結果，第五部分則為研究結論與建議。

貳、 文獻回顧

本文從高階管理者離職面，探討公司內部控管之效力，並分析不同股權結構以及董事會組成下，此一內部控管是否依然有效。本節將說明與本文研究有關的文獻，共分二部分，第一部分陳述績效與高階管理者離職關係之文獻，第二部分介紹不同股權結構以及董事會組成對高階主管離職之影響的相關文獻。

一、績效與高階管理者離職

在公司管理文獻中，很多研究皆指出績效與高階主管離職的機率事呈現負相

關，但也有一些未顯著性的結果。Warner 、Watts & Wruck（1988）的研究也指出，當公司股票績效表現不佳時，高階主管的離職更可能發生。兩者關係為負向。而 Puffer & Weintrop（1991）則以財務分析師的預期數字來代替董事會成員對高階管理者（CEO，Chief Executive Officer）經營績效的預期，他們發現當報導年度的每股盈餘低於預期時，離職就會發生。而 Gibbons & Murphy(1990), Janakiraman et al.(1992)實證則發現相對績效評估（RPE，Relative Performance Evaluation）與 CEO 離職率與顯著關係，此外，亦有研究驗證 RPE 運用於決定 CEO 報償的可能性，結果 Antle & Smith(1986)發現在 1947-1977 年間，39 家公司只有 16 家公司在衡量 CEO 報償時運用 RPE。在德國與日本也同樣發現，高階主管之績效與離職率為負向關係（Kaplan (1994), Kang and Shivdasani (1995)）。

至於績效的衡量方面，文獻多採用會計績效或市場績效。Venkatraman & Ramanujam（1986）曾將績效衡量分為三個層次，從最狹隘的財務績效指標，到最廣泛的組織績效。第一層次為最基本的財務性指標，可細分為會計資料指標、市場資料指標兩類：

（1）會計績效指標

選擇會計績效指標如盈餘作為公司績效指標，可反映實務上高階管理者的獎酬契約，常以會計數字訂定的事實。為何會計盈餘會被選為績效衡量的標準？Watts & Zimmerman（1986）提出下列兩項原因來解釋：①公司的價值無法觀察，

由於公司大部分的債務，並沒有在公開市場上交易，因此公司整體價值（股票加債務）的改變無法得知。Ou & Penman（1989）則認為財務報表資訊含有若干未反映在股票價格價格內的資訊，利用在財務報表內的資訊可以看出公司的價值，也就是我們可以利用會計盈餘來預測公司的價值。②會計績效具可分割性，針對公司每個部門對公司整體價值所做的貢獻，我們可能無法確切得知其個別的貢獻。但會計盈餘對每個部門的績效、貢獻都能有較正確的評估。

不過使用會計盈餘還是存在著某些缺點，如：會計盈餘的衡量誤差太大，或會計盈餘與股東財富間只有相當微弱的關連性[Rappaport（1986）]。

(2)市場績效指標

市場績效指標乃指股票市場價格，通常以股票報酬率來衡量市場績效。多數學者認為股票報酬最能代表公司股東財富的變化，而建議應以股票報酬來代表公司的績效。Warner、Watts & Wruck（1988）認為儘管無法直接觀察高階管理者對公司價值的貢獻，但是股票報酬可以作為此一資訊的重要來源。

由上述說明可以得知，不少學者以財務資料作為績效指標，本研究亦採用會計資料與市場股價資料作為績效指標，來探討績效與高階管理者離職之關係。

二、股權結構、董事會組成與高階主管離職

本文探討在不同的股權結構、董事會組成下，公高階主管之離職率。其中本文的股權結構變數包括：高階管理者持股比率、大股東存在與否、機構法人持股

比。本文的董事會組成變數包括：外部董事的比率、董事長是否兼任總經理。以下分別說明股權結構變數及董事會組成變數與高階主管離職關係之相關文獻。

論及高階管理者持股比率與離職率的關係，Morck, Shleifer & Vishny（1989）發現高階管理者持股比率越高，其離職機率越低，乃因高階管理者持股比率可能與高階管理者的權力有關，其認為管理者的所有權與在公司的發展、在公司內的地位、較多的內部董事代表等屬性有關。而 Denis & Denis（1994）則更進一步指出在相似績效的兩個群體中，管理者持股比率較高的公司，其高階管理者離職的機率較低。Denis, Denis & Sarin（1997）及 Dahya, Lonie & Power（1998）的研究則指出，管理者本身持有權益會妨害公司的內部控管，因為當高階管理者持有大量股份，公司績效與高階管理者離職之間的強大關係將不可能存在。

關於大股東的存在對高階主管離職的影響亦是文獻探討的重點，Shleifer & Vishny（1986）提出一個模型，在模型中大股東為管理當局有效的監督者。Wruck（1989）則發現股價對發行消息的反應，是根據公司所有權集中程度，因此我們可以看出擁有一位大股東是被市場視為一項好消息。陳金鈴（民 86 年）也指出當股東持股增加後，由於公司經營成敗攸關個人財富消長，因此必然會主動關心並且監督公司的活動，例如：大股東會爭取擔任董監事之職務，以保障其個人利益。

亦有許多文獻探討機構法人持股比率對公司內部控管之影響，Brickley,

Lease & Smith（1988）發現機構法人持股比率與改善管理者之反接管行為之間呈現正相關。Pound（1988）曾對公司的機構法人股東提出效率監督假說，指出機構投資人因具備較完善之專業知識，相較於一般股東可以用較低的監督成本來監督管理階層，將使監督活動更有效率。McConnell & Servaes（1990）發現機構法人與 Tobin's Q 之間為正相關，推論其原因為在較高的機構法人所有權下，可以改善公司的監督效力，所以本文亦想瞭解機構法人持股對高階主管離職之影響。

面對代理問題時，董事會亦是公司內部解決代理問題之重要機制（Fama,1980；Williamson,1983；Wallance,1992）。獨立性及能力是影響董事會品質之主要因素，機構法人會影響董事會是否能發揮其應有的功能與品質。Delorme（1993）指出機構法人對董事會之獨立性及品質會有較嚴格的要求。Cordtz（1993）亦認為機構投資人特別注重公司長期績效及董事會之適切性。

有關董事長兼任總經理對控管效力之負面影響是文獻重視之問題，Rechner（1989）認為由董事長兼任總經理將會嚴重影響董事會之獨立性。而 Kesner & Dalton（1987）則認為董事長兼任總經理容易造成董事會被管理階層所支配，受支配的董事會因而喪失了自主性，成為管理者的橡皮圖章。因此，董事長兼總經理，甚至兩者具有親近的血緣關係時，會妨礙董事會的監督力量，無法發揮其應有的效用。徐木蘭（民 83 年）認為，當董事長兼任總經理時，容易造成董事會在執行監督考核功能時，失去超然獨立的立場。

就獨立性方面而言，如同上述董事長兼任總經理之情形，內部董事之身分亦會影響其績效評估之客觀性，至於外部董事則會加強控管效力。Fama（1980）由人力資源市場的角度來看，認為外部董事為了創造及維持其專家之聲譽，他們有誘因做好監督管理當局的工作。Gilson（1990）指出外部董事的存在可以使董事會更客觀及公正地做決策。Weisbach（1988）認為內部董事雖可藉職務之便，擁有較多的資訊以限制管理者的行為，但卻容易與管理者在互惠的動機下勾結，使得其客觀性受到質疑。相對地，外部董事在執行對管理者的監督控制時，往往能以較超然的立場發揮其監督的功效。Rechner（1989）認為內部董事一旦卸下董事之身分，即搖身一變為總經理之部屬，聽命於總經理之指揮，為顧及自身利益，內部董事必然不敢違逆總經理之意，如此一來將無法客觀地負起監督及評估高階管理者責任，嚴重影響到董事會的獨立性。因此本文亦試圖驗證董事派董事長兼任總經理與外部董事比率對高階管理者離職之影響。

參、研究假說與方法

一、研究假說

本文欲從績效與高階管理者離職關係說明內部控管之效力，但從文獻發現，高階管理者持股、大股東機構法人、董事長兼任總經理及外部大股東均會影響內部控管，所以本文發展下列待驗證假說並說明其推論過程：

根據前述文獻指出高階管理者離職的可能性應該會增加，故得出假說1。

H_1：其它條件不變下，高階管理者離職機率與公司前期績效之間呈現負相關。

管理者擁有所有權可能使其與股東利益一致，會努力增加公司價值。但其持有權益越高，卻也使得要將其免職更形困難。過去文獻指出，在初期時，管理者所有權對減緩代理問題可能有幫助。然而，當管理者所有權達到一臨界水準，即可能發生固守職位的效果。這是因為高階管理者持股比率可能影響高階管理者權力，例如：在公司的發展、在公司內的地位、較多的內部董事代表等（Morck et al.,1989）。上述推論指出，若管理者所有權降低內部控管機能的效力，本文預期在不良績效公司中，管理者高度所有權將減低高階管理者的離職。因此推論出待驗證之假說 2 與假說 3。

H_2：其它條件不變下，高階管理者本身持股水準與其離職機率之間呈現負相關。

H_3：其它條件不變下，高階管理者本身持股水準將降低與績效與高階管理者離職機率間之負向關係。

根據文獻，本文考量納入控制變項大股東的存在、機構法人股東的持股比率、董事長兼任總經理與外部董事佔董事會比率。

本文預測各自變數對高階管理者離職機率的影響方向如下表:

表 1：預期自變數對應變數（離職機率）的影響方向

自變數	預期對應變數的影響方向
前期績效	−
高階管理者持股比率	−
大股東的存在	+
機構法人股東持股比	+
董事長兼任總經理	−
外部董事比率	+

二、變數說明

（一）高階管理者：高階管理者（top executive）一般是指企業內部最高的決策者。就國外而言，高階管理者包括有執行總長（chief executive officer，簡稱 CEO）、董事長（chairman）、總裁（president）與副總裁（vice-president）等。本文的企業高階管理者，乃指總經理。至於其離職資料乃由台灣經濟新報社取得。

（二）前期績效（RETLAG）：由於市場及會計指標在衡量公司績效時各有優劣，故本文前期績效是以研究期間各上市公司高階管理者離職前一年底的股價報酬率與會計績效指標（調整後每股盈餘）作為衡量標準。選擇每股盈餘的原因在於，投資人通常以每股盈餘做為衡量企業績效的指標；並且每股盈餘可以消除公司規模的影響。資料來源由台灣經濟新報社取得。

（三）高階管理者持股比率（TMown）：高階管理者持股比率是以每年年底董事長、總經理所申報持有的股數為基準；另外對於配偶、未成年子女目前持

有的股份也納入高階管理者本身持股比率的計算。資料來源由每年的股東會年報取得。

（四）大股東（BloDum）：大股東定義為持股比率 5%以上的股東，若有大股東則 Dummy=1，否則 Dummy=0。資料來源由台灣經濟新報社取得。

（五）機構法人持股比率（Inst）：此處的機構法人持股比率包括公司法人持股比率與其它法人持股比率。資料來源由台灣經濟新報社取得。

（六）董事長兼任總經理（DceoDum）：若有董事長兼任總經理的情形，則 Dummy=1，否則 Dummy 為 0。

（七）外部董事比率（Nex）：外部董事定義為：外部董事為非兼任經理人職位的董事會成員，以研究期間每年年底的外部董事人數除以全體董事人數。資料來源由每年的股東會年報取得。

三、研究方法

（一）統計檢定方法

本文的應變數為高階管理者離職與否，採用虛擬變數，離職等於 1，未離職則等於 0。變數為績效、高階管理者自身的持股比率、股權結構與董事會組成變數。股權結構變數包括大股東的存在與否、機構法人股東的持股比率。董事會組成變數包括外部董事佔全體董事的比率、以及是否有董事長兼任總經理的情況發生。

我們先對自變數及應變數分別做基本敘述性統計分析和相關分析。而由於應變數—高階管理者離職與否，是 Dummy 變數，故我們採用 logistic model 檢測自變數對應變數的影響程度是否具有重大性。

我們以下式驗證 H_1 與 H_2，檢視績效與高階管理者離職機率之間是否呈現顯著的負相關。

$$\ln\{P(turnover)/1-P(turnover)\} = a + b\cdot RETLAG + c\cdot TMown + d\cdot Nex + e\cdot DceoDum + f\cdot Inst + g\cdot BloDum + \varepsilon \quad (1)$$

P(turnover)：高階管理者（董事長、總經理）離職機率。

RETLAG：前期市場調整後股票或會計報酬。

TMown：表高階管理者（董事長、總經理）持股比率。

Nex：外部董事佔董事會的比率

$$DceoDum\begin{cases}=1, \text{若董事長兼總經理}\\=0, \text{若董事長未兼總經理}\end{cases}$$

Inst：機構法人持股比。

$$BloDum\begin{cases}=1, \text{若有大股東存在}\\=0, \text{若無大股東存在}\end{cases}$$

ε：殘差項。

此外，為了驗證是否高階管理者本身持有權益會影響到績效不佳之高階主管離職率，我們估計了一個 logistic model，分析高階管理者本身持有權益如何影響公司績效與高階管理者離職之間的關係，模型如下：

$$\ln\{P(turnover)/1-P(turnover)\} = a + b \cdot TMownDum_1 + c \cdot TMownDum_2 + d \cdot RETLAG * TMownDum_1 + e \cdot RETLAG * TMownDum_2 + f \cdot Nex + g \cdot DceoDum + h \cdot Inst + i \cdot BloDum + \varepsilon \quad (2)$$

$TMownDum_1$=1，若高階管理者（董事長、總經理）持股介於 5%-10%之間；否則為 0。

$TMownDum_2$=1，若高階管理者（董事長、總經理）持股大於 10%以上；否則為 0。

（二）樣本選取

本文有關的資料來自各上市公司股東會年報和台灣經濟新報文化事業股份有限公司資料庫。選樣準則如下：

1、樣本乃選取在台灣證券交易所的上市公司。研究期間從民國 85 年至 87 年。共計 17 個類股（水泥、食品、塑膠、紡織纖維、電機機械、電器電纜、化學工業、玻璃陶瓷、造紙、鋼鐵、橡膠、汽車、電子、營造建材、運輸、觀光、百貨貿易、其它）。

2、金融保險類股由於會計處理方法與一般行業迥異，無法以其財務報表資料估算本文變數，故予以刪除。

3、在這段期間內，每年底的股票報酬率、會計報酬及相關所有權結構、董事會組成資料可以獲得。

4、每一公司每一年度高階管理者離職只選取一個樣本（同一年度發生兩次離職者，以第一個樣本為選取標的）。

四、樣本敘述性統計

本文研究期間由民國 85 至 87 年，故樣本取自 84 至 86 年年底的資料，表 2 顯示本文各年度的個別樣本數，三年共有 883 個樣本。

表 2：樣本來源表

樣本年度	84 年	85 年	86 年
樣本數合計	254	302	327

表 3 為樣本中各項董事會特性、股權結構變數的簡單敘述性統計。由表中可以看出，台灣上市公司在此三年的樣本期間股價報酬率的波動性很大，最高的達到 347.23%，最低的為-78.39%。而每股盈餘最高的達到 6.98，最低的為-5.29。

另外，針對高階管理者持股的部份，可以看出董事長或總經理的平均持股比率分別為 9.58%、5.60%。此數字與國內所做的有關研究相去不遠，例如：林峰成（民 85 年）以 82 年度的資料做出的總經理平均持股比為 4.07%，孫秀蘭（民 85 年）做出的高階管理者（實際參與業務董事及經理人）平均持股比為 5.16%。然而，此數字相對於國外的研究高出甚多，例如：Dahya et al.（1998）發現的高階管理者平均持股比率則只有 2.5%。

在董事會特性變數方面，可以看出外部董事的比率，在本文中平均數達到 56%，比起國外的相關研究高了將近 10 個百分點，例如：Dahya et al.（1998）的研究指出外部董事平均數為 45%；Denis et al.（1997）的研究指出外部董事平均數為 47%。然而，我國董事會中外部董事所佔的實際比率應該遠低於此數字，

此乃因為我國股東會年報若干公司並未揭露其全部的經理人數，並且股東會年報中無法辨識出家族董事所致。至於，董事長兼任總經理在本文中平均為 0.23，即在我國約莫有四分之一的上市公司是董事長兼任總經理，此數字遠高於國外 Dahya et al.（1998）得出的 0.095。

在股權結構變數方面，可以看出在我國上市公司機構法人的持股佔有相當高的比重，平均而言達到 19.32%。此研究結果與國內其它研究差異不大，例如：楊俊中（民 86 年）的研究指出機構法人（公司法人加上其它法人）平均持股達到 19.09%。然而，此數字比起國外的相關研究仍有一段差距，例如：Denis et al.（1997）的研究指出機構法人持股高達 33.3%。而大股東在本文中平均數為 0.13，即平均而言在我國 100 家上市公司中只有 13 家具有大股東，此數字遠低於國外 Denis et al.（1997）做出的結果 0.46。進一步與葉銀華（民 88 年）之家族企業研究比對，發現這些有大股東存在的公司多為家族色彩較淡的公司。故我國大股東平均數偏低，可能肇因於國內上市公司多為家族企業，而家族成員掌握了大多數公司的股權，進而減少了流通在外的股權。

表 3： 各自變數的敘述性統計表

各變數	平均數	中位數	最小值	最大值
股價報酬率	13.65%	3.44%	-78.39%	347.23%
調整後每股盈餘	0.77	0.74	-5.29	6.98
董事長持股比	9.58%	5.99%	0.1%	58.48%
總經理持股比	5.60%	2.55%	0%	58.48%
外部董事比率	56%	60%	0%	96%
董事長兼任總經理	23%	0	0	1

機構法人持股比	19.32%	15.55%	0%	83.11%
大股東的存在	13%	0	0	1

註：董事長兼任總經理與大股東的存在採用 Dummy Variable

本文每一年只選取第一次離職樣本，研究期間共發生了 97 次的董事長離職以及 180 次的總經理離職，總經理離職的頻率約為董事長的兩倍。由表 4 可以看出，台灣上市公司高階管理者離職多半發生在高階管理者持股比率低於 10%以下。董事長及總經理約莫有 95%的離職發生在持股比率低於 10%以下。並且，持股比率越低離職發生的比率就越大。董事長有將近一半的離職發生在持股比率低於 1%以下；總經理則是有 73%的離職發生在持股比率低於 1%以下。而對於持股比率大於 10%以上的樣本，不論是董事長或總經理，其離職發生的比率都相當的低，約莫只佔樣本數的 5%。此結果與國外研究相當一致，即高階管理者持股比率越高，離職發生的機會就越低；並且當高階管理者持股比率在 10%以上時，離職比率會急速下降。

總體而言，表 4 的結果似乎暗示著在台灣的上市公司中，當高階管理者持股大於 10%時，固守職位的效果即可能發生。是否真是如此？本文將進一步以 logistic model 驗證高階管理者持股比率所造成固守職位的效果是否顯著。

表 4：高階管理者持股比與離職發生的比率

高階管理者持股比	總經理發生離職個數	總經理發生離職佔離職樣本%
<1%	132	73%

1%-5%	29	16%
5%-10%	11	6%
10%-30%	8	5%
>30%	0	0%
總計	180	100%

肆、實證結果與分析

一、Logistic Model 實證結果

本部分藉由前述所建立之 Logistic Model，來探討績效、董事會組成特性與股權結構等變數對高階管理者離職機率的影響。表 5 列示以總經理離職作為應變數之迴歸分析實證結果。

綜合表 5 之實證結果，可以得知績效與高階管理者本身持股對於高階管理者離職的機率呈現顯著的負相關，此實證結果與研究假說一、二的預期相一致。對於總經理而言，大股東、外部董事對其有發揮一定的監督效果，與研究假說 3、6 的預期一致。

至於其它因素對於總經理離職，並未具有顯著的影響力，可能原因如下：機構法人持股比率不論對董事長或是總經理而言，結果並不顯著，可能因為國外機構法人持股比率相對於國內機構法人高出甚多，而國內高階管理者持股比率相對於國外高階管理者又高出甚多，故機構法人的影響力可能相較於國外就不明顯了。

董事長兼任總經理此一變數不顯著的原因，可能是因為國內若干上市公司的

董事長與總經理雖非由同一人員所擔任，但公司的總經理與董事長彼此之間卻是具有親屬關係，故雖無董事長兼任總經理的情事，但實際上與同一人員擔任並無太大差異。然而，國內上市公司的公開說明書並非年年可取得，故此資料實際上有其取得之困難。

經由表 6 的 logistic 模型之實證結果，發現高階管理者持股比率仍然與其離職的機率呈現顯著的負相關。但前期股價（會計）績效與高階管理者持股比率交互作用下的係數，有些係數已經變成正，而即使係數依然為負者，其顯著水準也有明顯的下降，甚至變得不具顯著性。因此我們可以推論在高階管理者持股大於5%的所有權類型下，高階管理者離職機率與前期績效之間原本顯著的負相關已被削弱甚至完全不存在。此研究結論與 Dahya et al.（1998）及 Denis et al.（1997）所做出的結果相同。

本文以台灣上市公司之實證資料發現，高階管理者持股比率的確減少了內部控管的效力，我們預期在管理者具有高度所有權之公司，績效好壞對高階管理者離職之影響會變得較不顯著。亦即，當高階管理者持股比率高時，產生的固守職位效果，使得公司要免除一位不良績效的高階管理者更形困難。對於總經理而言外部董事比率與大股東的存在依然對其有一定的監督效果，然而對於董事長而言，其它的自變數依然是不具顯著性。

表 5：績效與高階主管離職之實證結果

自變數	模型一	模型二
截距	-0.4983*** [a]	-1.3102***
	(0.0001)[b]	(0.0001)
前期股價報酬率	-0.0087***	-0.0097***
	(0.0005)	(0.0002)
前期調整後每股盈餘	-0.2005**	-0.2214***
	(0.0117)	(0.0063)
總經理持股比	-0.2341***	-0.2159***
	(0.0000)	(0.0000)
外部董事比率		1.2178***
		(0.0055)
董事長兼任總經理		0.0267
		(0.9189)
機構法人持股比		-0.0018
		(0.7493)
大股東的存在		0.7553***
		(0.0045)

註： a:迴歸係數 b:P 值

、*分別表顯著水準達 0.05、0.01

表 6：高階主管持股對績效與高階主管離職關係之影響

自變數	模型三	模型四
截距	[a]-0.9101***	-1.6783***
	[b]（0.0000）	（0.0000）
$TMownDum_1$=1,假如	-1.7564***	-1.6403***
總經理持股介於 5-10%	（0.0000）	（0.0001）
$TMownDum_2$=1,假如	-2.0737***	-1.9590***
總經理持股大於 10%	（0.0000）	（0.0000）
前期股價報酬* $TMownDum_1$	0.0064	0.0066
	（0.2751）	（0.2795）
前期股價報酬* $TMownDum_2$	0.0041	0.0042
	（0.5371）	（0.5258）
前期調整後 EPS*$TMownDum_1$	-0.0795	-0.0418
	（0.7972）	（0.8963）
前期調整後 EPS*$TMownDum_2$	-0.0705	-0.0455
	（0.8253）	（0.8915）
外部董事比率		1.3008***
		（0.0023）
DceoDum=1，假使		-0.2668
董事長兼任總經理		（0.2882）
機構法人持股比		-0.0037
		（0.5048）
BloDum=1，假使		0.6560***
有大股東存在。		（0.0098）

註：　a:迴歸係數　b:P 值

、*分別表顯著水準達 0.05、0.01

伍、 結論

本文重點在於探討台灣上市公司高階管理者持股比率、績效與離職之間的關係。此外，還納入一些股權結構（機構法人持股比、大股東的存在）、董事會組成變數（外部董事比率、董事長是否兼任總經理）在本文中，進一步探討高階主

管持股是否降低績效與高階主管離職關係。

經過迴歸實證發現，其它條件不變下，高階管理者離職機率與公司前期績效（股價報酬率、調整後每股盈餘）之間呈現顯著負相關。同樣地，高階管理者離職機率與其持股比率之間亦呈現顯著負相關。而大股東的存在與總經理離職之間呈現顯著的正相關。但對於董事長而言，此係數並不具有顯著影響。加入董事會組成變數後，我們發現外部董事比率與總經理離職之間呈現顯著正相關。至於機構法人持股比、董事長兼任總經理此一變數，對台灣上市公司高階管理者離職，並無顯著影響。

整體而言，研究結果指出，高階管理者本身的所有權降低內部控管的效力，但外部董事比率、與大股東的存在，對總經理還是發揮了一定的監督作用。至於高階管理者離職之後，公司的股價報酬率有所改善，可見移除一位不良績效的高階管理者對公司的價值是有所助益的，市場投資者對此一事件之反應亦屬正面的。

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國立雲林科技大學
九十二學年度研究所博士班招生考試試題

所別：管理研究所
科目：經濟學理論

I. Microeconomics:

1. A firm has two plants with cost functions $c_1(y_1) = 3y_1^2$ and $c_2(y_2) = y_2^2$, where y_1 and y_2 are outputs of plant 1 and 2 respectively. What is the cost function for the firm? (20 points)

2. Describe and prove Roy's identity. (10 points)

3. There are two consumers A and B with the following utility functions and endowments:

$$u_A(x_A^1, x_A^2) = a \log x_A^1 + (1-a)\log x_A^2 \qquad \omega_A = (0,1)$$
$$u_B(x_B^1, x_B^2) = \min(x_B^1, x_B^2) \qquad \omega_B = (1,0).$$

Calculate the market clearing prices and the equilibrium allocation. (20 points)

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科目：經濟學理論

II Macroeconomics

1.假設金融市場價格變數受主要總體經濟變數之影響且受投資人預期(expectation)心理之影響，試：

(a)說明股票市場理性投機性泡沫(rational speculative bubbles)與狂熱追價(fad)現象之意義。 (6 points)

(b)利用總體經濟模型，分別分析貨幣供給增加與消費支出增加之衝擊下，股票價格可能不變，甚至可能下跌。 (10 points)

(c)利用總體經濟模型，分析貨幣供給減少與消費支出增加同時衝擊下，債券殖利率曲線(yield curve)可能呈現上升。 (9 points)

2.某經濟社會經濟成長有關資料如下：

(1) 生產函數爲 Cobb-Douglas 函數：

$$Y = F(K, AL) = K^{\alpha}(AL)^{1-\alpha} \quad , \quad 0 < \alpha < 1,$$

where Y = output

K = physical capital

A = knowledge

L = labor

(2) 各生產因素成長率分別爲：

$$\dot{K}(t) = sY(t) - \delta K(t),$$

$$\dot{L}(t) = nL(t),$$

$$\dot{A}(t) = \mu A(t),$$

where s, δ, n, μ are all constant.

試問：

(a) 如果上述 Cobb-Douglas 生產函數另一表達方式爲：

$$y = f(k) = k^{\alpha},$$

where $y = \dfrac{Y}{AL}$,

$$k = \frac{K}{AL},$$ (9 points)

則解出平衡成長軌跡(balanced growth path)下 k^*， y^*，與 c^* 之均衡值。

(b) 在平衡成長軌跡下，說明 K ， $\dfrac{Y}{L}$ ， $\dfrac{K}{AL}$ 等變數之成長率。 (6 points)

(c) 在黃金規則(golden-rule)下， k 值爲何？(5 points)

(d) 在黃金規則(golden-rule)下， s 值爲何？(5 points)

國立雲林科技大學
九十二學年度研究所博士班招生考試試題

所別：管理研究所
科目：資訊科技文獻

1. 如果 Reconfigurable Chips 的方向可行的話，那未來資科的教育方向應做何種的調整? (25 分)
2. Reconfigurable Chips 主要是利用何種想法以達到融合硬體及軟體的目的? (25 分)
3. 如果你要使用 codesign 的觀念設計一個多人多工的作業系統，這個作業系統的架構應如何設計，哪部分的功能應放在 configurable hardware 上。爲什麼？(25 分)
4. 如果你要使用 codesign 的觀念爲 Java 設計一個 JVM（Java Virtual Machine），這個 JVM 應如何設計，哪部分的功能應放在 configurable hardware 上。爲什麼？(25 分)

國立雲林科技大學
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所別：管理研究所
科目：資訊科技文獻

INTEGRATED ENGINEERING

Configurable Chips Meld Software and Hardware

Moshe Sipper and Eduardo Sanchez
Swiss Federal Institute of Technology, Lausanne

What would happen if you tossed a software designer and a hardware engineer into the same room and threw away the key? Once upon a time, you might expect to see smoke seeping out from under the door as the two engaged in a fiery debate. Today, such an argument would more likely require the services of a psychiatrist than a mediator, for, increasingly, a single person practices both professions.

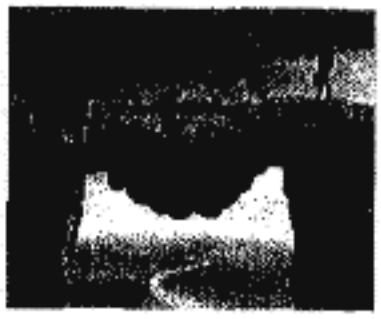
Nearly 10 years ago, Maurice Wilkes ("It's All Software, Now," *Comm. ACM*, Oct. 1990, pp. 19-21) observed that IC design had become mostly a software affair. He wrote that "Formerly, a circuit designer needed, when checking out a design, the practical skills associated with working at a laboratory bench. Now, certain software skills are necessary instead. The designer needs to be comfortable working with large software systems, and must know how to fight the system when that is necessary." He then predicted, "It seems likely that, in the future, all circuit designers will have a strong software background."

FROM PROGRAMMABLE TO CONFIGURABLE CHIPS

It seems Wilkes' prophecy has been fulfilled, thanks to the maturation of field-programmable gate arrays and to recent advances in hardware synthesis tools—developments that have given rise to the new configurable-computing paradigm (J. Villasenor and W.H. Mangione-Smith, "Configurable Computing," *Scientific American*, June 1997, pp. 54-59).

Large and fast ICs, field-programmable gate arrays can be modified or configured at almost any point by the end user. FPGA technology brings about a primary distinction between *programmable* and *configurable* processors (Eduardo Sanchez et al., "Static and Dynamic Configurable Systems," *IEEE Trans. Computers*, June 1999, pp. 556-564). With programmable, general-purpose processors, you can change the software at any given moment via programming—but the hardware remains immutable once the processor leaves the foundry. Configurable processors, on the other hand, remain mutable at the hardware level: The elemental logic gates, interconnections, inputs, and outputs can be programmed and reprogrammed—configured and reconfigured—by the end user, in the field. FPGAs thus combine the prime advantage of general-purpose computers, programmability, with the prime advantage of application-specific integrated circuits, efficiency.

FPGAs now occupy a rather small niche in the computing industry; engineers are using them in applications like image processing, data encryption, and bio-inspired hardware, which make use of an FPGA's reconfigurability. Last year, one company announced a general-purpose microprocessor chip, 65 percent of whose surface is reconfigurable, with only 35 percent serving as a classic controller to manage the chip's operation (J. Turley, "Triscend E5 Reconfigures Microcontrollers," *Microprocessor Report*, Nov. 16, 1998, pp. 12-13). This trend will continue, with general-purpose processors incorporating more reconfigurable, on-chip surface. In a few years such hybrid programmable and configurable processors could play a major role within the computing industry.



Processors that can be configured by end users promise to combine hardware's speed and efficiency with software's flexibility.

MAKING HARDWARE SOFT

Programming either FPGAs or hybrid processors usually involves software. Today, the same trend that Wilkes observed over a decade ago has expanded to encompass a much larger scale: Configurable processors work hand in hand with a medley of software tools, and the typical hardware designer now relies more on a workstation than an oscilloscope. Hardware engineers thus find themselves increasingly using software tools, while a growing number of software designers have begun using configurable circuits.

Soft logic

Logic design—specifically the design of digital circuits—while not necessarily less hard today than in years past, is at least less hardware-intensive. For example, suppose you want to develop a

device that recognizes English characters. You could do so by writing a program in a high-level language such as C++ or Java, with the intent of running it on a standard PC or workstation.

Alternatively, you could take the hardware approach and use a configurable circuit and a high-level hardware description language, such as VHDL, to write your character-recognition program. Because the language you're using operates at a high level, you can design your circuit from the top down, choosing the level of abstraction at which you feel comfortable working. Doing so lets you use the hardware description language to shield you from most hardware design drudgery.

For example, with such software tools, *schematic capture*—the design of the circuit layout and interconnects—occurs automatically, generating the circuit design using a compiler that processes a high-level description. Yet circuit designers can still intervene directly from time to time to manually optimize the layout. Moreover, developers can now purchase intellectual-property hardware modules. These IP modules echo the traditional software packages, in which not everything is programmed from scratch, but consists in part of prebuilt software modules, known as packages or libraries. The hardware approach, however, offers a faster and more efficient character-recognition machine than the programmed-workstation version could provide.

Codesign codependencies

Logic designers who use such high-level software tools must, however, confront a new problem—*codesign*, which addresses the joint development of a system's software and hardware components. For example, today's technology would not permit our character-recognition machine to be implemented *entirely* in configurable hardware, because doing so would cost too much. To save money, we would still rely on software for some parts of our machine. How would the designer determine where to place this dividing line between software and hardware? Generally, an experienced codesigner would attempt to implement an application's time-consuming components in hardware, thus maximizing execution speed. Known as the *partitioning problem*, this issue is but one of several that confront codesigners.

Resources

For information on the **International Workshop on Hardware/Software Codesign (CODES)** see http://www.computer.org/conferen/proceed/codes/8442/8442toc.htm.

Two sites offer information on the **IEEE Symposium on FPGAs for Custom Computing Machines (FCCM)**, another international conference in the field of hardware-software codesign: http://www.fccm.org and http://www.computer.org/conferen/proceed/fccm/8900/8900toc.htm.

For more information on *Labomat* (from *laboratoire matériel*, French for hardware laboratory), see http://lslwww.epfl.ch/labomat.

Developments in configurable computing increasingly blur the line between hardware and software, a trend that represents a major shift in computing practice. To keep their offerings current and relevant, universities should modify their computer science curricula to better prepare students for this new era. Although hardware design is much more software-oriented now, aspiring computing students still need courses that cover hardware synthesis techniques, codesign methodologies, and module reuse strategies. Students should also experience working in teams.

At our institute, we have developed such a new curriculum. By offering several hardware courses at both the elementary and advanced levels, we help students obtain a deeper and broader knowledge of configurable hardware design. Moreover, over the past few years we have invested in the design and construction of several FPGA-based boards for use as teaching platforms. These boards let students gain hands-on experience with technologies they'll use in real-world jobs. For example, using our *Labomat* board, a three-student team designed and tested a simplified floating-point unit in five three-hour sessions. ✱

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國立雲林科技大學
九十二學年度研究所博士班招生考試試題

所別：管理研究所
科目：資訊科技

1. (a) 請定義何謂樹（tree）。 8%
   (b) 請以 ER 圖（ER diagram）或類別圖（class diagram）來表示樹，並說明你的想法。 8%
   (c) 請將(b)小題的 ER 圖或類別圖轉換成關聯式模式（relational model）的關聯表（relations），並說明你的想法。 8%
   (d) 請以 SQL 將(c)小題的關聯轉換成關聯式資料庫（realtional database）的資料表（tables），並說明你的想法。 8%
   (e) 請比較(a)小題樹的定義與(d)小題以 SQL 所建立的資料表，你認爲是否有些完整性限制（integrity constraints）未在(d)小題的資料表中表示出來？若有，你認爲這些完整性限制應該如何實作，請說明理由。 8%
   (f) 若(d)小題的資料表在資料載入後，即很少變動，大部份均是用來進行查詢，你認爲(d)小題的資料表宜以何種結構儲存於次級儲存體（secondary storage）中，請說明理由。 10%

2. 網際網路(Internet)主要所使用的通訊協定(Protocols)爲何？目前較常使用電子郵件的通訊協定(Protocols)有哪些？網路管理中較常使用的通訊協定(Protocols)又有哪些？ 10%

3. 無線區域網路依連線類型的不同主要可以分爲哪兩種？並簡述之。 10%

4. 目前電子商務網站最常使用的資料加密方式爲何？並說明其運作過程。 10%

5. 假設某家公司擁有一間工廠、業務部、及資訊部等 3 個單位，各自擁有 80 部、25 部及 15 部(內含三部主機)電腦。基於安全理由各單位的區域網路需各自獨立但必須相互連接，並且電腦所使用的網址(IP Address)只適合內部區域網路用不能真正連上網際網路。
   a) 試爲該公司規劃內部區域網路，並畫出區域網路架構圖。 12%
   b) 試爲該公司規劃連上網際網路的方式，並畫出如何連上網際網路。 8%

國立雲林科技大學
九十二學年度研究所博士班招生考試試題

所別：工業工程與管理研究所、管理研究所
科目：工業工程與管理文獻

The following questions are based on the attached paper entitled "PROMISE AND PROBLEMS OF SIMULATION TECHNOLOGY IN SCM DOMAIN" by Sam Bansal (*Proceedings of the 2002 Winter Simulation Conference*). Read through the paper and answer the following questions in either English or Chinese.

1. (10%) Outline the organization of this paper.

2. (20%) What are the *domains* and *contents* of supply chain optimization? What are the interrelations among these domains?

3. (20%) What are the supply chain optimization issues addressed by the author? What are your comments or solutions?

4. (20%) What are the *basis* and *contents* of supply chain opportunity assessment?

5. (20%) According to this paper, what is the promise and role of simulation in supply chain management (SCM)?

6. (10%) Although the literature associated with this paper is short, what can you find with respect to the author's background?

Proceedings of the 2002 Winter Simulation Conference
E. Yücesan, C.-H. Chen, J. L. Snowdon, and J. M. Charnes, eds.

PROMISE AND PROBLEMS OF SIMULATION TECHNOLOGY IN SCM DOMAIN

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ABSTRACT

This paper begins by identifying the potential Promise of Simulation domain. It also provides a brief review of this domain and modeling methodologies as applied to supply chain optimization. Problems and solutions of this area are discussed forming the rationale behind most of the industrial practice of this author. As a result most of the deterministic Business Process Reengineering and Opportunity Assessment work that needs to be done resorts to the "a priori methods". Building the simulation models costs more time and effort than implementing an equivalent solution from SAP such as APO or any part thereof in the domain of Supply Chain Management and Optimization. Against this environment and e-Supply Chain Management as a domain of the focus, this paper describes the methodology of doing Business Cases with Case Studies to illustrate how the Supply Chain Opportunity Assessment through the Blue Printing process is carried out.

1 PROMISE OF SIMULATION

Industry experts on manufacturing technology have recognized the importance of simulation and visualization. Simulation and modeling have been identified as one of two breakthrough technologies that will accelerate the grand challenges facing manufacturing in 2020. Fulfillment of the recommendation would provide fundamental building blocks for the dynamic models and 'real-time' simulations of 2020. It has been recognized by researchers and practitioners that techniques such as variation simulation analysis (VSA) and factory floor layout simulation can improve product performance. Assembly modeling can be used to complement simulations to determine if changing the order of steps in the assembly of a complex product can lead to labor savings and reduce variation. Combining three-dimensional product modeling with simulation techniques can help determine the cost of alternative manufacturing processes. Even the Semiconductor Research Corporation's (SRC) Factory Sciences board has also identified manufacturing simulation as a high payback area. Examples of current manufacturing simulation applications include: modeling and verification of discrete and continuous manufacturing processes (machining, injection molding, sheet metal forming, semiconductor fabrication, refining, etc.), offline equipment programming (robots), system layout planning, material flow analysis, process and system visualization, ergonomic analysis of work areas and manual tasks, evaluation of schedules, and business process modeling.

However while the manufacturing simulation software domain has huge future the present does not appear to be a robust market like ERP. Hundreds, if not thousands, of commercial simulation software products are currently marketed to support these and other areas. It is likely that the number and types of simulation applications will continue to grow rapidly in the coming years. For the most part, these software applications do not interoperate with each other, or with other manufacturing systems that need to share data. Independent economic studies have estimated the size of the manufacturing simulation and visualization software market in the range of $650 million dollars by the 2001 time frame.

Although studies have recognized the potential of manufacturing simulation and visualization, there are a number of technical and economic barriers that hinder the use of this technology. Industry expense for implementing simulation technology is much greater than the cost of computing hardware, peripheral devices, software licenses, and maintenance. Typically companies must factor in the cost of salaries and training for simulation and support staff, translation of existing company data, systems integration of applications, and development and maintenance of models. These costs are likely to be much greater than the initial acquisition costs for the simulation software and hardware.

2 FUNDAMENTALS OF SIMULATION AND MODELING FOR SUPPLY CHAIN OPTIMIZATION

2.1 Simulation Models

There are two types of modeling domains recognized for Simulation studies as applied to Supply Chains. These are:

1. Descriptive Models and
2. Normative/Optimization Models

Descriptive Models are of following types:

1. Forecasting Models
2. Cost Relationship Models
3. Resource Utilization Relationship Models
4. Simulation Models

Simulation Models describe how all or parts of the company's Supply Chain will operate over time as a function of parameter and policies.

Normative/Optimization Models on the other hand are mathematical models that are developed to make better decisions. The term normative refers to processes for identifying norms that the company should strive to achieve. Hence Normative Models are same as Optimization Models as the Optimization I the norm that every company strives to achieve. Further according to Operation Research Scholars these are considered same as Mathematical Programming Models. The construction of optimization models requires descriptive data and models as inputs.

Simulation Models have 2 more categories

1. Deterministic Simulation Models
2. Stochastic Simulation Models

Deterministic Simulation Models describe a system's dynamic behavior assuming there are no random effects. Stochastic on the other hand describe a system's dynamic behavior when there are random effects. It is also known as Monte Carlo Simulation Models.

2.2 Taxonomy of Supply Chain Optimization Modeling Domains

These are:

1. Strategic Optimization Modeling
2. Tactical Optimization Modeling
3. Logistics Optimization Modeling
4. Production Planning Optimization Modeling
5. Distribution Scheduling Optimization Modeling
6. Demand Forecasting and Order Management
7. Distribution Requirements Planning
8. Materials Requirements Planning
9. Enterprise Resource Planning

Of the above domains the first 2 specially are relevant to Business Planning for decision making with respect to whether

1. To go in Retail Distribution Business or Not
2. Or How to set up the overall Demand and Supply Network so that the Return on Investment is maximized

Hence the following description giving their salient features is described:

2.2.1 Strategic Optimization

This domain is concerned to analyze the resource acquisition and other strategic decisions faced by the company such as the construction of a new manufacturing facility, the break-even price for an acquisition, or the design of a supply chain for a new product. Its goal may be to maximize net revenue or return on investment.

2.2.2 Tactical Optimization

Here one determines an integrated supply/manufacturing/distribution/inventory plan for the company's entire supply chain over the next 12 months, or greater if desired. Its goal may be to minimize total supply chain cost of meeting fixed demand or to maximize net revenues if the product mix is allowed to vary. Raw materials, intermediate products and finished products are aggregated into product families. Similarly markets are aggregated into market zones.

2.2.3 Linkages Exist between

1. MRP and Production Scheduling Optimization Modeling
2. DRP and Logistics Optimization Modeling
3. Production Scheduling, Logistics and Tactical Optimization Modeling and
4. Strategic and Tactical Optimization Modeling

2.2.4 Strategic and Tactical Optimization Modeling

It will be described below as it is of importance to the present context:

The Strategic Optimization assists Sr Management in determining the most effective long-term conFigureuration of the company's entire supply chain network, existing in reality or being envisioned. It helps to analyze about major resource acquisitions and divestments and the manufacture and distribution of new and existing products over the

coming years. The implications of these decisions to next year's tactical plans are passed to the tactical optimization considerations, as shown below. Such data might include new facilities that will be available or products to be manufactured, distributed, and sold during that time frame. The tactical optimization models provide detailed feedback to the strategic system about how these facilities will be used and how market demand will be met over the first year of a strategic planning horizon.

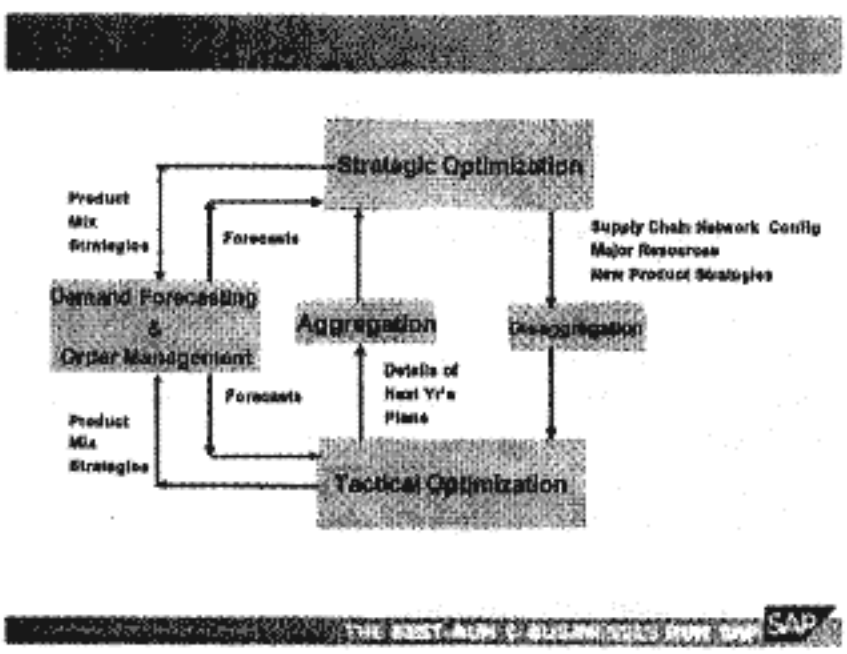

Figure 1: Strategic and Tactical Optimization Modeling

The demand forecasting and order management system provides medium and long-term demand forecasts to the tactical and strategic optimizer. Conversely, the strategic optimization provides the demand forecaster with feedback about the profitability of existing and new product lines. This information can be used to develop marketing strategies for increasing sales of profitable products. In fact the demand forecasting might well be extended to include marketing models to achieve this end.

Scenarios are created and used to analyze the impact of various future conditions to determine their effects on the objective functions.

The core of a case, along the above lines, developed some time ago, is described below. It core was a:

1. For decision making as to which technology to support and which to kill
2. Selected Technology's Initial Design was predicted by the Technical Model to cut the Product Design time

This was used:

1. For decision making as to which technology to support and which to kill
2. Selected Technology's Initial Design was predicted by the Technical Model to cut the Product Design time

Advantages were:

1. Reduction in exploratory cost
2. Reduction in Product Development time

Their interaction was as given in Figure 2:

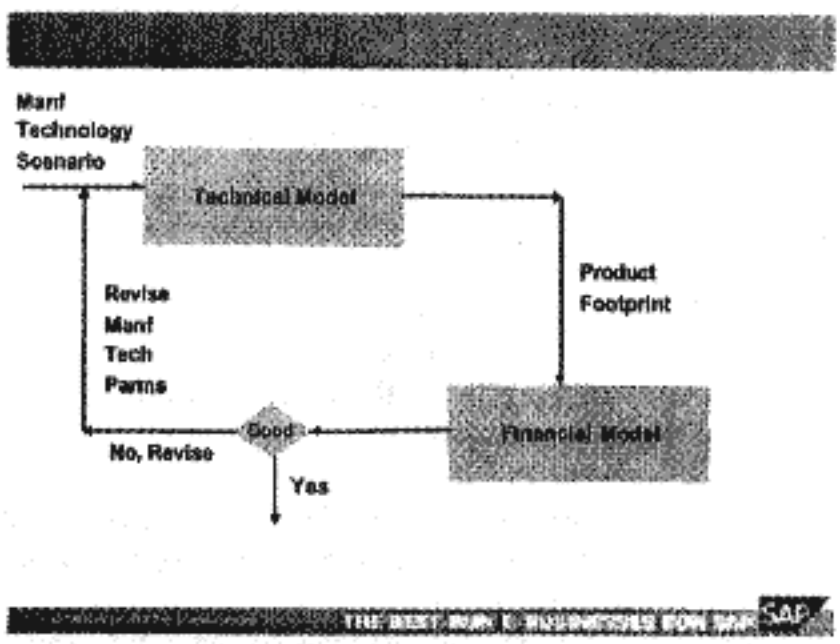

Figure 2: Cost Performance Modeling Paradigm

The point to be stressed is that Strategic and Tactical models must be integrated with Financial Models to get the Optimized Business Decisions.

2.3 Problems

In practice both types of models are used but the common problems that can be cited are:

1. The modeling experts are very few and far in between
2. The construction and usage when left to pseudo trained managers and analysts lead to far worse results than a priori methods
3. Even with the trained modelers the effort to construct good Descriptive or Optimization models is huge that most companies are unwilling to spend
4. Then the input data problem, be it static or dynamic, is as much time consuming as the construction and validation of the model itself

2.4 Solutions

Because of the problems mentioned above and in the interest of time the SOA methodology is adopted. Its basis is as follows:

1. Study the " As Is" scenario of the Supply Chain Performance with respect to Cost and Profitability
2. Also study the methods used in the company from Demand Forecasting to Distribution and all levels

of planning, Strategic, Tactical, Operational, Production Scheduling etc.

3. Construct the "To Be" Cost, Profitability vision against the company vision and bench marks
   a. Construct the "To Be" methods supporting the "To Be" cost and profit targets
   b. Fix the gaps between "As Is" and "To Be" by
      i. Process Improvement Initiatives and
      ii. Enabling Technology
   c. Business Blue Printing fro Enabling Technology
   d. Execute recommendations
      i. Process Improvements
      ii. Technology Solution Implementation

3 SUPPLY CHAIN MANAGEMENT

Supply Chain Management has caught more attention than did Artificial Intelligence in the early eighties. Like AI there in no other domain today, which gets more, talked about than Supply Chain in the boardrooms. Supply Chain's beginning can be traced to the early eighties when MRPII was being extended into ERP. At that time all the manufacturing planning and scheduling was still infinite model based. To alleviate the problems inherent in the infinite capacity based MPS etc. Finite Capacity model based techniques such as Factrol was introduced by Factor, an affiliate of Pritsker. Dynamic Scheduling was talked but not practiced. Early nineties began to see an awareness of holistic management of both the Capacity and the Inventory management. Some of the popular packages that have been introduced in this space to manage, Inventory, Capacity, Planning and Forecasting are from I2, Tyecin/Manugistics, Red Pepper/Peoplesoft, Paragon, SAP and most recently from Oracle. The essentials of this domain seem to have been lumped together in the "Supply Chain Management". These 3 words tend to embody the planning, management and optimization of Inventory, Capacity, Planning and Forecasting.

Supply Chain Council has put forward a supply chain model. This model SCOR stands for Supply Chain Operations Reference model. The Supply Chain is comprised of your supplier's supplier and your customer's customer. And each node of this chain must look at the enterprise functions such as Plan, Make, Purchase and Distribute, with respect to planning, managing and optimization. Thus, a well managed Supply Chain system will not only manage its own Plan, Make, Purchase and Distribute functions but it will Transmit and Receive, Planning and Inventory information with its supplier's suppliers and customer's customers.

3.1 Financial Impact of Supply Chain Costs

The importance of this domain can best be understood from the fact that depending upon the company and the sector, the SCM costs may range anywhere from about 4-22 % of the revenue or higher. If the reduction of 25% is achieved, it is annual and can contribute to almost 100% more bottom line profit for an average company running the SCM costs in the neighborhood of 20%, which is not uncommon. Studies have been made to establish the impact of glitches in Supply Chains and their impact on the Stock Prices of the companies. Accordingly it has been found that a glitch rumor influences the stock value by 19% within 2 days of the rumor on Wall Street and to a total of 23% within 4-5 days. With such an important area which corporate chief will not want his supply chains to be running smoothly?

For example this author studied 4 companies of the Silicon Valley engaged in the communications semiconductor business. All had high inventory, however the one with highest inventory was least profitable and the Wall Street was punishing the subject company most harshly, as is illustrated in the following graph:

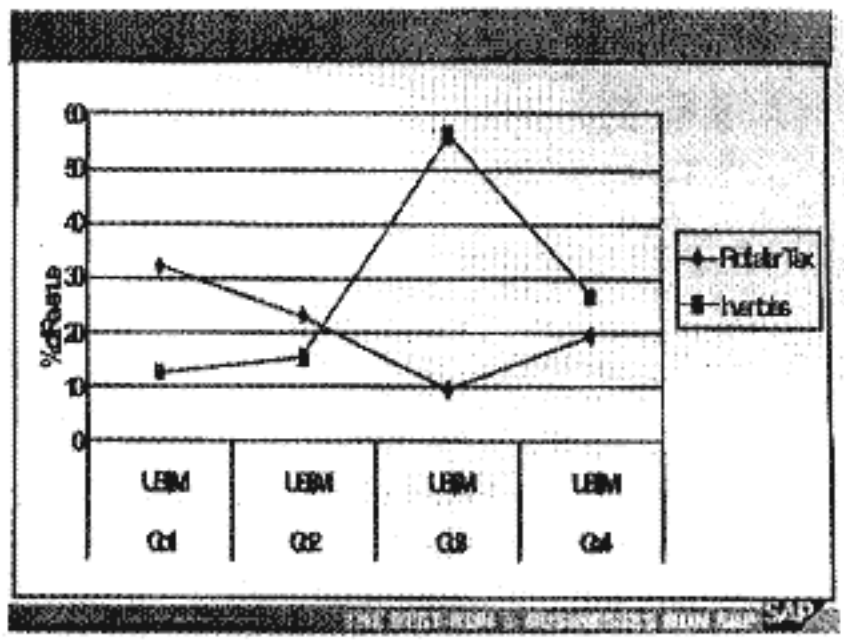

Figure 3: Adverse Impact of High Inventory on Profits

It is not only Inventory that creates profits. The entire value chain from value drivers to stock holders value is shown on Figure 4.

3.2 Opportunity Assessment

Opportunity Assessment or Supply Chain Opportunity Assessment is an age old cost benefit study but with a modern twist of formalism and lot of extensions. It essentially comprises of Fiscal Data Collection, Data Rationalization, Developing Understanding of the Problem, Developing Total Supply Chain Management Costs, Benchmarking SCM Costs, Estimating the Opportunities for Improvement and finally linking them to the enabling Tools and Technologies. OAs can be done at 2 levels as shown in Figure 5.

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Bansal

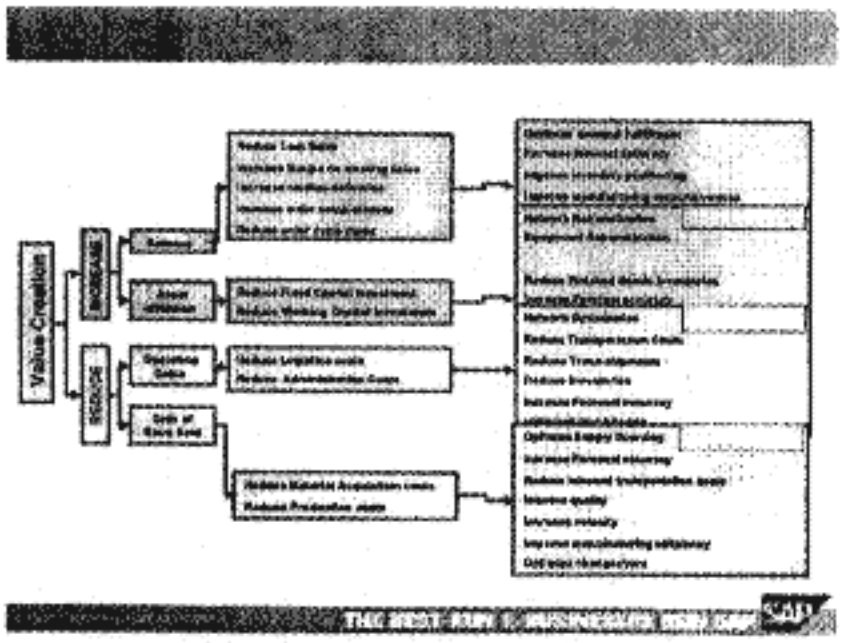

Figure 4: How Stock Holder Value is Created

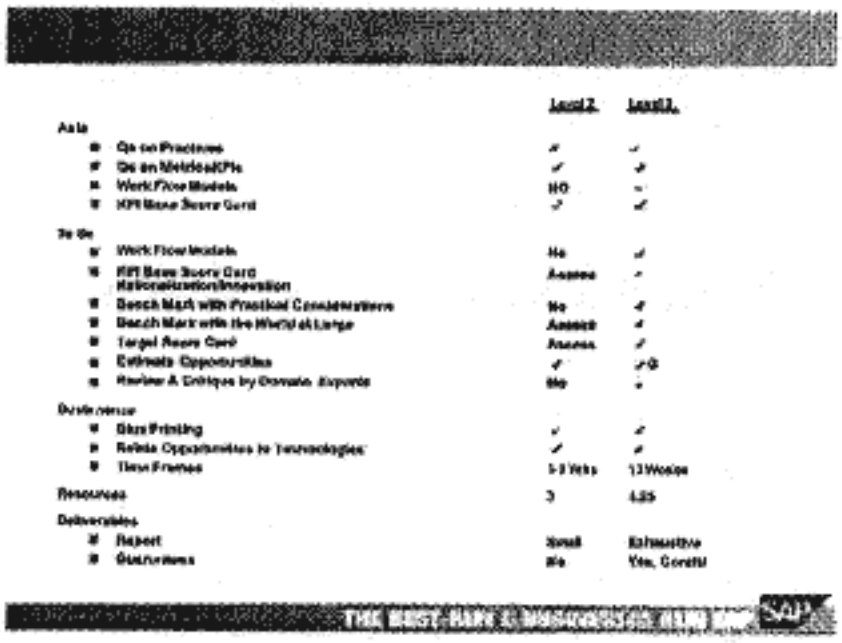

Figure 5: 2 Levels of Opportunity Assessment

At the enterprise level the KPIs of concern are Inventory Turns, Asset Utilization etc where as at the Process Levels the KPIs of attention become the Inventory Accuracy, Forecast Accuracy, BOM Accuracy, Schedule reliability, Drawing Accuracy, Routing, Accuracy, Supplier Reliability, and Information Availability etc. This relationship is as illustrated in Figure 6.

Upon close study one finds that the reason supply chain problems exist is because of the difference between the plans vs. the actuals, as is illustrated in Figure 7.

This delta is the root cause to create bad process level KPIs, which eventually transcend to bad enterprise, level KPIs such as high inventory, turn over and lower asset utilization. The enabling technology would be the one that can eliminate or minimize the effect of the difference between the plan and the actual.

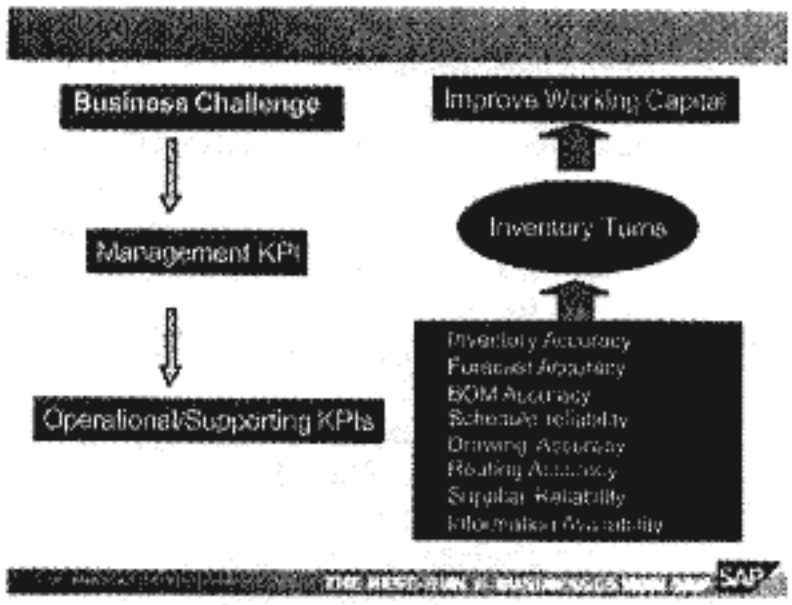

Figure 6: KPI Hierarchy

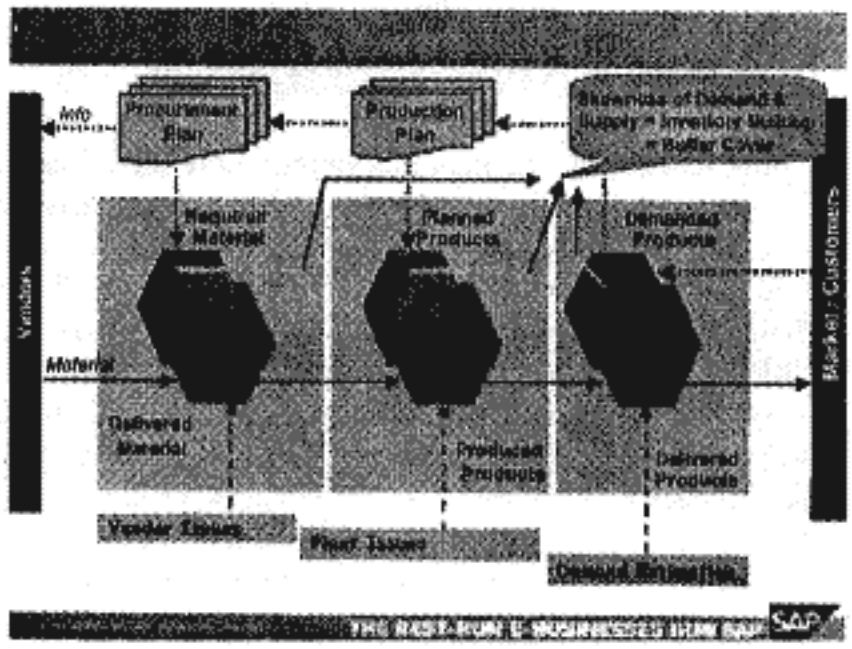

Figure 7: Supply Chain Paradox

3.3 For Example- Case Study

This client wanted and posed an interesting challenge:

1. We want you to study our three problems and give us the solution for them
   - During scoping and objective setting the client was completely unwilling to let us do a Business Case but as the project began, it was abundantly clear that what they needed most was the Business Case with ROI analysis
2. Hence the strategy that was adopted was to:
   - Study the causes of the problems
   - Measure the bottom line impact of the problems, benchmark the costs establishing the enabling technologies and
   - Create the solution

Figure 8 shows the causes creating the 3 problems

Theme	3 Problems		
	[illegible]	[illegible]	[illegible]
Demand planning: Forecast accuracy	✓✓	✓✓	✓
Demand planning: Option forecasting	✓✓	✓✓✓	✓✓
Collaboration with suppliers	✓✓	✓✓	✓✓✓
Capacity planning as an integral part of the planning process	✓	✓	✓✓✓
Alert systems to enable rapid response to variances	✓	✓✓	✓✓✓
Decision support tools, what if capabilities	✓	✓	✓✓
Integration of support planning with production planning			✓✓✓

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Figure 8: Causes of the 3 Problems

The quantification and benchmarking effort leads to Figure 9, which clearly establishes the bottom line impacts. These are very high as compared against the competition. So they offer the opportunities to improve. Figure 8 establishes the causes creating the problems; Figure 9 establishes the magnitude of the problem.

Figure 10 once again shows the linkage from the 3 problems to the benefits, as quantified in Figure 9.

The target reductions and the reduction modeling are given in Figure 11.

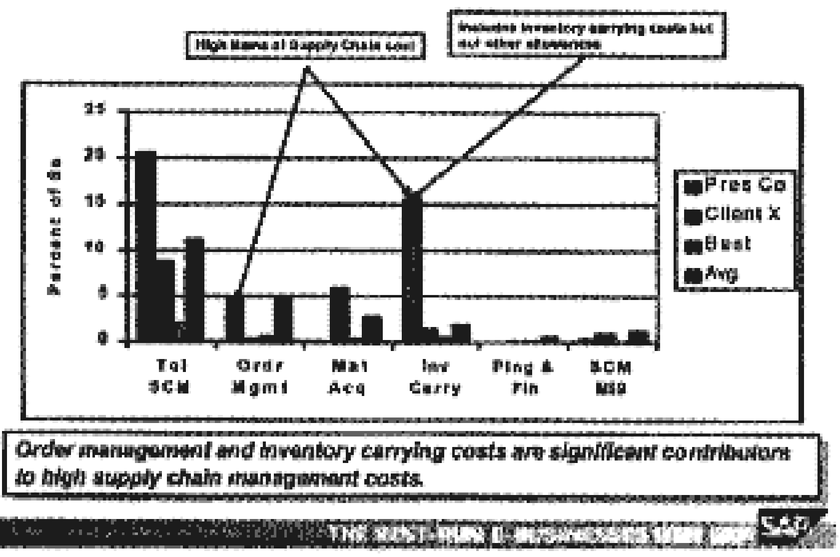

Figure 9: Benchmarking the Supply Chain Management Costs

3 Problems	Strategies	Capabilities	Solution Enablers
Reduced Inventory (Finished, WIP, Raw)	Improved visibility of demand; [illegible]; Improved collaboration; From push to pull; Improve tracking capabilities	[illegible]; Collaborative demand planning; Statistical forecasting; Global ATP Check	[illegible]; Collaboration scenarios; Sequenced JIT management; Tracking server; Action handler
Increased Asset Utilization	[illegible]	[illegible]	Sequenced JIT management; Action handler; [illegible]; Action handler
Reduced Production Costs	[illegible]	[illegible]	Collaboration scenarios; [illegible]; Sequenced JIT management

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Figure 10: Solution Enablers

	As-Is Value Dollars	Rate Percent	As-Is Cost Dollars	Present Client Reduction Amount Dollars	Present Client Reduction Percent	SAP Target Reduction Amount Dollars	SAP Target Reduction Percent
Total Factory Inventory	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dealer Side Inventory	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Manufacturing Efficiency Improvement by [illegible] dollars per tractor			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Capacity Increase Due Cycle Time [illegible] percent [illegible] used for additional market share, will create [illegible] of today's profit of [illegible] percent on additional capacity				no credit		[illegible]	
Supply Network Optimization, Industry Practice of 2.5 Percent/year cost reduction, due Contracts & [illegible]			[illegible]	no credit		[illegible]	
Improved Delivery Performance							
Total Net Improvement				[illegible]		[illegible]	

Note: Reduction Amounts for Inventories in Both cases, Present Client as well as Study Target, are Dollar Values, their carrying cost (only) is included in the Total Net Improvement line

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Figure 11: Total Benefits

4 CONCLUSIONS

State of the art practice of Business Consulting focused in the Supply Chain domains has been discussed. Opportunity Assessment methodology starting from investigation of the problems to establishing and benchmarking their impact on the bottom line as well as the reduction modeling has been discussed and amplified by the case studies. It should be stressed that the correlation between the qualitative assessments of the problem's impact to quantitative assessment has been found to be extremely close.

5 RESEARCH ISSUES

Research issues that can be cited based on the above work are:

1. New Departments have to be formed that would be dedicated to integrating the Analytic IT, doing

Model Based Optimization with the Transactional IT the ERP etc.

2. Financial Planning Models themselves, that are pretty descriptive of the companies' Supply Chain Performances
3. Integration of Financial Planning Models with the Supply Chain Models dealing with the Strategic and Tactical optimization of the Supply Chains
4. Usage of Supply Chain and Financial Planning Optimization Models for Business Planning such as to go in this business or not, build the new infrastructure or not

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AUTHOR BIOGRAPHY

SAM BANSAL has 36 Years of full Life Cycle Business Transformation Services experience, involving Diagnosis, Solutioning and Implementation focused at delivering identified benefits. He is a World Class Expert at Opportunity Assessment to Blue Printing unleashing quantum improvements in cost reduction and value creation. Sam has led numerous Mega Global projects in the Supply Chain Optimization area of High Tech, Automotive and Manufacturing sectors.

Sam is currently working as a Director of Business Transformation Services of SAP Americas. His previous roles have been Principal Research Fellow, CIO, Managing Director, President etc of several MNCs in the Asia Pacific and North American region.

Sam's degrees are in Chemical Engineering, has Published over 80 papers in refereed international journals and has been a frequent invited key note speaker. He authored a book on Computer Integrated Manufacturing, was a contributing editor of a Controls magazine and created methodologies for Manufacturing and Business Transformation consulting practices.

Sam has been advising on the Business Transformation for over 9 years to the who's who of the Semiconductor/High Tech and Automotive companies in Value Modeling and Value Driven Future Architectures in the Supply Chain Management Domain. His email address is <satya.bansal@sap.com>.

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科目：資訊管理文獻

Questions: （作答時，請注意各題之比例配分並標示題號）

1. What is the definition of "web quality" authors gave and why they gave this definition? (10%)

2. Why authors mentioned "web site quality measurement is neither simple nor straightforward"? (15%)

3. The web quality representative items was dropped from 102 to 25, please indicated each stage what the authors have done? (30%)

4. What are the conclusion pointed out by the authors after reviewed of the literature and why they pointed out these conclusions? (15%)

5. Please comment on how this web quality instrument can be used to enhance the effectiveness of electronic commerce. (15%)

6. What have you learned most from this research, could you apply it, please give an example, to any research topics you are interested in? (15%)

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Developing and validating an instrument for measuring user-perceived web quality

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Abstract

Many of the instruments to measure information and system quality were developed in the context of mainframe and PC-based technologies of yesteryears. With the proliferation of the Internet and World Wide Web applications, users are increasingly interfacing and interacting with web-based applications. It is, therefore, important to develop new instruments and scales, which are directly targeted to these new interfaces and applications. In this article, we report on the development of an instrument that captures key characteristics of web site quality from the user's perspective. The 25-item instrument measures four dimensions of web quality: specific content, content quality, appearance and technical adequacy. While improvements are possible, the instrument exhibits excellent psychometric properties. The instrument would be useful to organizations and web designers as it provides an aggregate measure of web quality, and to researchers in related web research.

Keywords: Internet; Electronic commerce; Web site quality; Instrument development; Web measures; Web design

1. Introduction

The last few years have witnessed a technological revolution fueled by the wide spread use of the Internet, web technologies and their applications. The literature is replete with accounts about organizations from various types and sizes integrating web technologies into their operations [9,20,27,34,44,47]. This wide interest in the subject is attributed to the fact that organizations are becoming aware of the possible implications of the Internet on their work. Potentialities of web applications are remarkable leading many organizations to spend awesome amounts of money on these technologies. Using web technologies, an organization can reach out to customers and provide them with not only general information about its products or services but also the opportunity of performing interactive business transactions. Organizations investing in web technologies and applications are looking forward to realizing the benefits of these investments, however, this would not be possible without an appropriate tool for measuring the quality of their web sites.

Construct measurement in general and in the context of web technologies and applications in particular is a challenging task, hence, deserves more attention from researchers interested in this phenomenon. However, web site quality measurement is neither simple nor straightforward. Web quality is a complex

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concept; therefore, its measurement is expected to be multi-dimensional in nature. Current research on web quality seems to pay less attention to construct identification and measurement efforts. Only limited academic research exists, but it is fragmented and usually only discusses the *meaning* of some aspects of web quality. At the practitioner level, several commercial ranking systems are available to rate web sites according to certain quality attributes, e.g. Web Awards (www.webaward.org) and The Web Awards (www.thewebawards.com). These ratings, however, lack clarity in terms of criteria used and the ranking methodology. The problem is exacerbated by the paucity of systematic and empirically derived systems for rating the quality of web sites. Today no multi-item scale is available to measure *users'* perceived web quality. The provision of such a scale will further enhance management's ability to exploit the full potential of the Internet.

The objective of this study is to develop an instrument to measure perceived web quality from the perspective of Internet users. This instrument and proposed scale would be valuable to researchers and practitioners interested in designing, implementing, and managing web sites. The rest of the paper is organized as follows. The next section reviews prior research related to quality in IS/IT and more specifically, web quality. The following sections and its various subsections describe the measurement and the various steps involved in scale development. The final section discusses applications of the proposed scale.

2. The concept of quality in IS research

Quality is not a new concept in information systems management and research. Information systems practitioners have always been aware of the need to improve the information systems function so it can react to external and internal pressures and face the critical challenges to its growth and survivability [1]. Moreover, information systems scholars have been concerned with definitions of quality in information systems research. Information systems researchers have attempted to define data quality [21], information quality [23], software/system quality [35], documentation quality [14], information systems function service quality [22], and global information systems quality [31]. More recently, there has been some effort to define quality in the context of the Internet [25]. However, the web quality concept remains underdeveloped.

Web quality is a vastly undefined concept. For the most part, existing scientific research discusses the *meaning* of some aspects of web quality in a descriptive manner without delineating its major dimensions or providing tested scales to measure it. For example, Liu and Arnett [25] named such quality factors as accuracy, completeness, relevancy, security, reliability, customization, interactivity, ease of use, speed, search functionality, and organization. Huizingh [19] focused on two aspects of web quality: content and design. Wan [45] divided web quality attributes into four categories: information, friendliness, responsiveness, and reliability. Rose et al. [36] provided a theoretical discussion of technological impediments of web sites. The authors highlighted the importance of factors such as download speed, web interface, search functionality, measurement of web success, security, and Internet standards. Misic and Johnson [29] suggested such web-related criteria as finding contact information (e.g. e-mail, people, phones, and mail address), finding main page, speed, uniqueness of functionality, ease of navigation, counter, currency, wording, and color and style. Olsina et al. [33] specified quality attributes for academic web sites. These authors took an engineering point of view and identified factors such as cohesiveness by grouping main control objects, direct controls permanence, contextual controls stability, etc. Bell and Tang [5] identified factors such as access to the web, content, graphics, structure, user friendliness, navigation, usefulness, and unique features. Another useful stream of research is by Ho [18] and Sakaguchi et al. [38] where they investigate key web-site characteristics on the purpose and value dimensions. While the purpose dimension relates directly to the contents of the site, the value dimension relates more to the quality aspects.

The trade press and Internet sources also discussed some aspects of web quality attributes. For example, Schacklett [39] proposed nine tips for improving web site quality, including effective use of graphics and colors, 24/7 web site accessibility, and ease of web site use and navigation. Levin [24] offered tips to help a company with web site design including fast web page

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download, web page interactivity, and current content, among other factors. Wilson [48] recommended avoiding seven mistakes relevant to web site design. Furthermore, based on their own personal experience, Barron et al. [4] recommended 39 guidelines relevant to web site graphics, text, links, page size and length, and multimedia.

Three conclusions can be drawn from the above review. First is that past web quality research, albeit useful, is fragmented and focuses only on subsets of web quality. For example, Rose et al. [36] list six factors, and Bell and Tang [5] mention eight factors. Misic and Johnson's [29] study was more extensive, but it missed several critical factors such as web security, availability, clarity, and accuracy, to name a few. Liu and Arnett [25] list 11 items and two dimensions of web quality—information and system quality. Like the other studies, several important quality dimensions are missing from the authors' list. Second, past research lacks rigor when it comes to measuring the web quality construct. In some cases, an ad hoc web quality tool was suggested [5,25,29]. However, it is not clear to the reader what is the domain of the measured construct or what refinement, validation, and normalization procedures were employed. For example, Liu and Arnett's scale included items about information to support business objectives, empathy to customers' problems, and follow-up services to customers. These items loaded on the same factor, which they called "information quality". In addition, double barreled items can be found in their scale, e.g. security and ease of use. Third, the majority of the suggested web quality attributes and scales are relevant to web designers than to web users; like for instances, the ideas and scales proposed by Liu and Arnett [25] and Olsina et al. [33].

The previous discussion underscores the fact that the web quality construct lacks a clear definition and web quality measurement is still in its infancy. With this background, we embark on developing a sound instrument to measure user-perceived web quality.

3. The measurement process

A number of psychometric researchers have proposed several procedural models to help other researchers develop better scales for their studies, e.g. [3,7]. Applying these concepts, MIS researchers have developed several instruments, e.g. the end user computing satisfaction by Doll and Torkzadeh [11] and the microcomputer playfulness instrument by Webster and Martocchio [46]. Straub [42] described a process for creating and validating instruments in IS research, which includes content validity, construct validity and reliability analyses. Three generic steps common in all these models include (1) conceptualization, (2) design, and (3) normalization. Conceptualization focuses on content validity, involves such activities as defining the construct of interest and generating a candidate list of items from the domain of all possible items representing the construct. The second step, design focuses on construct validity and reliability analysis. It pertains to the process of refining the sample of items from the previous step to come up with an initial scale, deciding on such operational issues as question types and question sequence, and pilot-testing the initial scale that has been developed in the preparation stage. The third and last step concerns the effort to normalize the scale that has been developed. It involves the important steps of subsequent independent verification and validation. Unfortunately, this step is omitted in many scale development efforts. In the conduct of these steps, several analytical techniques can be used such as factor analysis and reliability analysis as we will describe next.

3.1. Conceptualization

The first step in our measurement process is conceptualization. This step involves delimiting the domain of the construct and generating sample items representing the concept under consideration. In order to ensure content validity, the instrument needs to draw representative items from a universal pool [8]. In the present study, we define perceived web quality as users' evaluation of a web site's features meeting users' needs and reflecting overall excellence of the web site. This definition is important to delimit the domain of web quality and determine relevant literature from which the researcher can generate sample items for the web quality construct.

Overall, our review of the academic literature and relevant trade press articles identified three dimensions of web quality: technical adequacy, web content, and web appearance; and yielded 102 representative

items. The sample items were initially assessed using a Delphi method. Two information systems scholars were asked to evaluate the items and make changes to eliminate repetitive items, technical/non-user oriented items, and sub-attributes of higher level attributes. After three evaluation rounds, 55 web quality attributes remained in the list. The experts deleted items such as: relative versus absolute links, invalid internal links, invalid external links, make paragraph text flush left, disclaimer note, quality of link phrase, color of hyperlinks, what's new feature, counter availability, long domain name, time and date, vertical scrolling, horizontal scrolling, errors free site, etc. Table 1 summarizes web quality dimensions and sample items.

3.2. Design

The second step in our model is scale design. As mentioned earlier, the focus here is on construct validity and reliability analysis. These are in essence operational issues and investigate whether the measures chosen are true constructs describing the event or merely artifacts of the methodology itself [6,8]. Several tests were conducted in order to refine the instrument. We started out by arranging the selected items in a questionnaire format in preparation for data collection. The items were measured using a seven-point scale ranging from (1) "extremely not important" to (7) "extremely important". Following Churchill's [7] recommendations, we subjected the instrument to a two-stage data collection and refinement procedure. The first stage was used for design and the second stage for normalization.

In first stage of data collection, the 55-item instrument was administered to student web users enrolled in three different sections of an introductory information systems class at a business school. A total of 104 web users participated in our study. Of these, we collected usable responses from 101 web users. All of the students in the sample were from 18 to 21 years of age. Approximately, 64% of the respondents are females, and 36% are males. Of the students that participated, a majority were business majors.

We first computed reliability coefficients of the scales using Cronbach's alpha. The alpha values for technical adequacy, web content, and web appearance came as 0.77, 0.70 and 0.59, respectively. Reliability tests suggested that screening the data along Churchill's recommendations would improve reliability levels. We screened the collected data by discarding items that showed very low corrected item-total correlations, i.e. <0.40. After several screening attempts, 30 items remained in our pool of items. Reliability levels for the reduced web quality dimensions came as 0.89, 0.86 and 0.81 for technical adequacy, web content, and web appearance, respectively.

Next, we factor analyzed the 30-item instrument to examine the dimensionality of the construct. In our

Table 1
Major web quality dimensions

Dimension	Sample items	Sample support references
Technical adequacy	Security; ease of navigation; broadcast services; limited use of special plug-ins; search facilities; anonymity; availability; valid links; reliability; browser sniffing; personalization or customization; speedy page loading; interactivity; ease of access; multi-language support; protected content; bookmark facility	[25]; [10]; [13]; [15]; [24]; [33]; [36]; [43]; [12]
Web content	Usefulness of content; completeness of content; clarity of content; uniqueness of content; broadness of content; originality of content; currency of content; conciseness of content; accuracy of content; finding contact info.; finding people without delay; finding site maintainer; finding links to relevant sites; finding firm's general info.; finding products/services details; finding customers' policies; finding customer support; finding FAQ list; finding free services; using limited registration forms; finding online help; diversity of content; finding free info	[25]; [26]; [29]; [37]; [41]; [4]; [5]; [17]
Web appearance	Attractiveness; distinctive hot buttons; changing look; organization; proper use of fonts; proper use of colors; proper use of graphics; graphics-text balance; proper use of multimedia; style consistency; proper choice of page length; good labeling; text-only option; proper use of language/style; color consistency	[19]; [30]; [39]; [28]; [29]; [40]; [2]; [4]; [17]

quest for a stable factor structure, we followed an iterative procedure that began with submitting the items to a factor analysis procedure with varimax rotation. Hair et al. [16] suggest that item loadings >0.30 are considered significant, >0.40 are more important, and >0.50 are considered very significant. There are no accepted "absolute" standards for the cut-offs; the choice is based on judgment, purpose of the study, and prior studies. Since our goal is to examine the most significant loadings in interpreting the factor solution, we decided to use a cut-off point of 0.50 for item loadings and eigenvalue of 1. After the first iteration, we examined items loadings and eliminated items that did not meet the loading cut-off or loaded on more than one factor. We then resubmitted the remaining items to another round of factor analysis. The process went on until we reached a meaningful factor structure. The factor analysis revealed seven factors with eigenvalue of ≥ 1 (see Table 2). The scree test, however, indicated that a four-factor solution was appropriate. At the end of the factor analysis procedure, 25 items remained.

The results showed that there were four web quality dimensions not three, as proposed earlier. It was found that web content is not unidimensional, but comprises two dimensions: specific content and content quality. Specific content (five items) reflected concerns related to finding specific details about products/services,

Table 2
Principal component analysis with varimax rotation—first study

	Component						
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Security	0.70	0.05	0.14	0.22	0.06	0.38	−0.06
Ease of navigation	0.74	0.07	0.13	0.12	0.15	0.19	0.17
Broadcast services	0.12	0.19	0.32	0.07	0.44	0.06	0.47
Search facilities	0.76	0.15	0.09	0.14	0.05	0.04	−0.03
Availability	0.78	0.08	0.08	0.10	−0.19	0.01	−0.09
Valid links	0.77	−0.12	0.08	0.13	0.00	0.12	0.11
Reliability	0.21	−0.03	−0.10	−0.18	0.01	0.70	0.37
Browser sniffing	0.25	−0.06	0.25	−0.04	0.71	0.01	0.09
Personalization or customization	0.69	−0.02	0.02	0.01	0.10	−0.03	0.08
Speed of page loading	0.78	0.11	0.24	0.01	0.20	−0.15	−0.09
Interactivity	0.69	0.07	0.10	0.01	−0.19	−0.11	0.44
Ease to access the site	0.72	0.13	0.20	0.11	0.22	0.02	−0.07
Usefulness	0.13	0.14	−0.03	0.77	0.08	−0.01	−0.02
Completeness	0.21	0.10	0.08	0.71	0.05	−0.17	−0.03
Clarity	0.02	0.18	0.12	0.81	−0.08	−0.04	0.06
Currency	0.07	0.08	0.16	0.73	−0.12	0.10	−0.12
Conciseness	0.04	0.17	0.15	0.78	0.08	0.06	−0.06
Accuracy	0.16	−0.02	−0.02	0.66	−0.20	−0.02	0.24
Finding contact information	0.07	0.89	0.03	0.12	0.04	−0.02	−0.30
Finding firm's general information	0.06	0.85	−0.02	0.15	−0.08	0.08	0.22
Finding products/services	0.07	0.89	0.03	0.12	0.04	−0.02	−0.30
Finding customers' policies	0.11	0.77	−0.06	0.17	−0.08	−0.13	0.12
Finding customer support	0.04	0.81	−0.05	0.14	−0.01	0.14	0.33
Attractiveness	0.26	0.01	0.74	0.02	−0.05	−0.07	0.19
Organization	0.24	0.05	0.70	0.09	0.06	0.19	−0.12
Proper use of fonts	0.07	−0.08	0.85	0.15	0.04	−0.04	−0.05
Proper use of colors	0.08	0.04	0.82	0.06	−0.05	0.10	0.00
Proper use of multimedia	0.13	−0.09	0.81	0.11	0.05	0.06	0.07
Style consistency	−0.02	0.10	0.29	0.13	−0.68	0.05	0.10
Good labeling	0.03	0.04	0.31	0.03	−0.05	0.70	−0.20
Eigenvalue	5.28	3.83	3.69	3.63	1.46	1.37	1.18
Variance explained	0.176	0.127	0.123	0.121	0.049	0.046	0.039

customer support, privacy policies, and other important information. Content quality consisted of five items and dealt with such attributes as information usefulness, completeness, accuracy, and so on and so forth. Another round of reliability tests resulted in alpha values of 0.91, 0.91, 0.85 and 0.87, for technical adequacy, specific content, content quality, and appearance, respectively.

3.3. Normalization

To verify and validate the four dimensions of perceived web quality, the 25-item instrument was tested using another independent data set. A sample of 127 students web users enrolled in four different sections of an introductory information systems class at a business school were asked to participate in second study and to indicate their agreement or disagreement with the 25 statements. The users were assigned to four different groups to evaluate the sites of a bank (25 students), a bookshop (31 students), a car manufacturer (34 students), and an electronics retailer (37 students). The goal was to examine reliability of the proposed instrument across web types. Before completing the questionnaire, the users were asked to read a brief overview of the study and were instructed to navigate through the assigned web site for some time. At the end of this exercise, we collected usable responses from all the participants. Of the students that participated in second study, a majority were business majors and 61% were females. All of the students in the second sample, like in the first sample, were from 18 to 21 years of age.

Reliability scores were 0.92, 0.94, 0.88 and 0.88, for technical adequacy, specific content, content quality, and appearance, respectively. The overall reliability of the 25-item scale was 0.91. Cronbach's alpha of the same scale for the bank subgroup is 0.95, for the bookshop subgroup is 0.91, for the electronics retailer subgroups is 0.70, and for the car manufacturer subgroup is 0.92. These scores are above the reliability cut-off points suggested by Nunnally [32].

Testing for convergent and discriminant validity allowed us to further assess construct validity. Convergent validity was first examined by submitting each scale's items to a principal component analysis procedure with varimax rotation to explore the underlying dimensions of the construct. The usual cut-off point of 0.50 for item loading and eigenvalue of 1 were used in second study like first study. All sub-scales of perceived web quality showed adequate convergent validity (Table 3). In every factor analysis run, each scale's items converged cleanly on the same factor representing these items. The results of the factor analysis procedure were consistent with the results of the first study. Table 3 shows that there are four factors explaining 67% of the variance in perceived web quality.

We also used the multitrait-multimethod matrix (MTMM) approach [6] to evaluate the convergent and discriminant validity of the instrument. Convergent validity determines whether associations between scales of the same group are higher than zero and large enough to proceed with discriminant validity tests. In the present case, for every single variable, the correlations in the validity diagonal (i.e. items of the same variable) are higher than zero. All 71 correlations between items within the variables were significant at the 0.01 level. The smallest within-variable correlations for the various variables are technical adequacy: 0.436, specific content: 0.442, content quality: 0.655, and appearance: 0.515.

We examined discriminant validity for each item by counting the number of times an item correlates higher with items of other variables than with items of its own variable. For instance, the lowest own-variable correlation for technical adequacy is 0.436, and none of the correlations of technical adequacy with items of other variables are >0.436, i.e. number of violations is zero. Campbell and Fiske suggest that: for discriminant validity, the number of violations should be <50% of the potential comparisons. We retain items where violations are <50% as per this criterion, and reject items where violations are >50%. Discriminant validity results showed that all of the tests exceeded the benchmark and were at 0% violations and this was true for all four sub-scales. Thus, the factor and scale structure reported in the first study was corroborated in the second study.

As further evidence of the validity of the perceived web quality (PWQ) construct and its four dimensions, we examined the relationship between the construct scale ratings and users' overall quality rating (OQR) for a well-known web site. The web users in second study were also asked to evaluate the overall quality

Table 3
Principal component analysis with varimax rotation—second study

	Component			
	Factor 1	Factor 2	Factor 3	Factor 4
Security	0.73	0.08	0.27	0.11
Ease of navigation	0.80	0.13	0.14	0.06
Search facilities	0.77	0.20	0.17	−0.02
Availability	0.75	0.08	0.17	0.02
Valid links	0.81	−0.04	0.16	0.08
Personalization or customization	0.73	0.03	0.05	0.01
Speed of page loading	0.77	0.18	0.04	0.15
Interactivity	0.75	0.04	0.08	0.09
Ease of accessing the site	0.69	0.26	0.11	0.14
Usefulness	0.20	0.28	0.72	0.10
Completeness	0.23	0.07	0.74	0.07
Clarity	0.12	0.10	0.85	0.08
Currency	0.09	0.09	0.79	0.06
Conciseness	0.08	0.22	0.77	0.14
Accuracy	0.21	0.04	0.70	0.07
Finding contact information	0.10	0.91	0.13	0.12
Finding firm general information	0.16	0.87	0.15	0.08
Finding products/services details	0.09	0.90	0.13	0.12
Finding customers' policies (e.g. dispute policies)	0.14	0.82	0.18	0.04
Finding customer support	0.19	0.83	0.13	0.09
Attractiveness	0.20	0.08	0.05	0.76
Organization	0.16	0.17	0.08	0.74
Proper use of fonts	0.01	0.05	0.17	0.84
Proper use of colors	−0.01	0.11	0.04	0.85
Proper use of multimedia	0.08	−0.01	0.13	0.85
Eigenvalue	5.49	4.13	3.85	3.44
Variance explained	0.219	0.165	0.154	0.137

of the web site on a three-point scale: (1) fair, (2) good and (3) excellent. Table 4 summarizes our results and reports the correlation matrix along with variables' means and standard deviations. The four dimensions of perceived web quality correlated significantly with each other and with the overall index of perceived web quality: PWQ. The highest correlation between the variables comprising the four dimensions perceived web quality was between technical adequacy and content quality (Pearson's $r = 0.38$), whereas the

Table 4
Correlations among constructs and descriptive statistics

	Appearance	Specific content	Content quality	Technical adequacy	Perceived web quality	Overall quality rating
Specific content	0.23**					
Content quality	0.25**	0.35**				
Technical adequacy	0.23**	0.32**	0.38**			
Perceived web quality	0.57**	0.65**	0.76**	0.72**		
Overall quality rating	0.43**	0.30**	0.53**	0.73**	0.73**	
Mean	4.37	4.42	4.38	4.49	4.41	2.28
S.D.	1.10	1.09	1.08	1.19	0.71	0.61

** $P < 0.01$.

Table 5
The user-perceived web quality instrument

	Strongly disagree						Strongly agree
1. _____'s web site looks secured for carrying out transactions (e.g. uses SSL, digital certificates, etc.)	1	2	3	4	5	6	7
2. _____'s web site looks easy to navigate through	1	2	3	4	5	6	7
3. _____'s web site has adequate search facilities	1	2	3	4	5	6	7
4. _____'s web site is always up and available	1	2	3	4	5	6	7
5. _____'s web site has valid links (hyperlinks)	1	2	3	4	5	6	7
6. _____'s web site can be personalized or customized to meet one's needs	1	2	3	4	5	6	7
7. Web pages load fast in _____'s web site	1	2	3	4	5	6	7
8 _____'s web site has many interactive features (e.g. online shopping, etc.)	1	2	3	4	5	6	7
9. _____'s web site is easy to access (i.e. has a reflective and widely registered name)	1	2	3	4	5	6	7
10 The content of _____'s web site is useful	1	2	3	4	5	6	7
11 The content of _____'s web site is complete	1	2	3	4	5	6	7
12. The content of _____'s web site is clear	1	2	3	4	5	6	7
13. The content of _____'s web site is current	1	2	3	4	5	6	7
14 The content of _____'s web site is concise	1	2	3	4	5	6	7
15. The content of _____'s web site is accurate	1	2	3	4	5	6	7
16. In _____'s web site, one can find contact information (e.g. e-mail addresses, phone numbers, etc.)	1	2	3	4	5	6	7
17. In _____'s web site, one can find firm's general information (e.g. goals, owners)	1	2	3	4	5	6	7
18. In _____'s web site, one can find details about products and/or services	1	2	3	4	5	6	7
19. In _____'s web site, one can find information related to customers' policies (e.g. privacy and dispute details)	1	2	3	4	5	6	7
20. In _____'s web site, one can find information related to customer service	1	2	3	4	5	6	7
21. _____'s web site looks attractive	1	2	3	4	5	6	7
22. _____'s web site looks organized	1	2	3	4	5	6	7
23. _____'s web site uses fonts properly	1	2	3	4	5	6	7
24. _____'s web site uses colors properly	1	2	3	4	5	6	7
25. _____'s web site uses multimedia features properly	1	2	3	4	5	6	7

lowest correlation was that between technical adequacy and appearance (Pearson's $r = 0.23$). In addition, the four dimensions of perceived web quality correlated significantly with users' overall quality rating for the web site; the association between OQR and technical adequacy was the highest (Pearson's $r = 0.73$), whereas the association between OQR and specific content was the lowest (Pearson's $r = 0.30$). The results clearly give further credence to the sound psychometric properties of the instrument.

The final 25-item instrument for user-perceived web quality is shown in Table 5. We believe that the instrument, having undergone extensive evaluation and validation, represents significant progress towards the development of a standard instrument for measuring perceived web quality. Moreover, the instrument is precise and easy to use. It can be utilized to evaluate web quality at an aggregate level. The model/instrument could also serve as a starting point for a detailed evaluation of web sites.

4. Conclusion and implications

Past web quality research has focused on general description of some specific aspects of web quality and paid little attention to construct identification and measurement efforts. In this study, we moved beyond descriptive and narrative evidence to empirical evaluation and verification by developing a multidimensional scale for measuring user-perceived web quality. The results of the two-phased investigation uncovered four dimensions of perceived web quality (technical adequacy, specific content, content quality, and appearance) and provided evidence for the psychometric properties of the 25-item instrument.

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Another contribution is that while past web quality research focuses mostly on the perspectives of web developers and designers, the current study targets the web users. In this era of intense competition and customer responsiveness, the users are major stakeholders and should not be ignored.

The limitations of the study include those customarily associated with instrument-building and survey methods. However, the extensive testing and validation improved the internal validity, and using several groups of subjects improved the external validity and generalizability of the instrument to a larger population. Nevertheless, instruments are always subject to further improvement and we encourage fellow researchers to do so.

The web quality model/instrument has practical as well as theoretical and research applications. In terms of practical applications, a validated instrument provides an important tool for assessing the quality of web site. The Internet is hosting hundreds of millions of web sites varying widely in terms of quality. The scales might be used to assess the quality of a given web site. This could be carried out at the overall quality level using the 25-item instrument or at a specific quality dimension level, e.g. using a sub-scale of one of the four dimensions of perceived web quality. This evaluation may provide a fast and early feedback to the firm. If the firm finds itself lacking in any of the dimensions, then it may do a more detailed analysis and take necessary corrective actions. The four dimensions and the 25-items of the instrument may also be used by web site designers in a proactive manner. The dimensions and the items may be considered explicitly in the site design. Additionally, a firm may want to assess the relative importance of the four quality dimensions and the specific items in its own context. While this study provided their relative importance based on its own sample, each firm is unique based on its products, services, customers, business strategies, etc. Such an evaluation would facilitate the design of a quality web site in the first place.

國立雲林科技大學
九十二學年度研究所博士班招生考試試題

所別：工業工程與管理研究所、管理研究所
科目：生產管理

1. A manufacturing company plans to use a transportation model to solve the short-term aggregated planning problem. The following information should be considered: (1)Three planning periods are included in this model. (2)Demands for three time periods are known and given (i.e. D_1, D_2, and D_3). (3)Capacities for each time period involves the normal time capacity (i.e. N), over time capacity (i.e. O), and subcontract capacity (i.e. S). All capacities are fixed and given. (4)Unit manufacturing costs include normal time cost (i.e. r), over time cost (i.e. s), and subcontract cost (i.e. t). (5)Unit inventory cost per period (i.e. i) and unit backorder penalty per period (i.e. b) are fixed and given. (6)Beginning inventory (i.e. P) is given and known. Ending inventory (i.e. Q) is also required.

(a)Construct a transportation tableau using the given symbols. (十分)

(b)Formulate this linear programming problem including the objective function and the required constraints. Define all decision variables if necessary. (十分)

2. The historical sales quantities of product M indicate a typical curve of life cycle. Three significant periods can be identified, i.e. Growth period, Saturation period, and Decline period. Suggest an appropriate forecasting model for each period and explain the reason why it is chosen. (十分)

3. A single plant location decision has been made using a popular, subjective decision-making tool as indicated in Table 1 and Table 2. This tool may be called as the "Weighted Scoring Method". Construct a stepwise solution procedure based on the approach used in Table 1 and Table 2. (十分)

Table 1

Weight	Factor	Score		
		Minneapolis	Winnipeg	Springfield
0.25	Proximity to customer	95	90	65
0.15	Land and construction prices	60	60	90
0.15	Wage rates	70	45	60
0.10	Property taxes	70	90	70
0.10	Business taxes	80	90	85
0.10	Commercial travel	80	65	75
0.08	Insurance costs	70	95	60
0.07	Office services	90	90	80

Table 2

Factor	Weighted Score		
	Minneapolis	Winnipeg	Springfield
Proximity to customers	23.75	22.50	16.25
Land and construction prices	9.00	9.00	13.50
Wage rates	10.50	6.75	9.00
Property taxes	7.00	9.00	7.00
Business taxes	8.00	9.00	8.50
Commercial travel	8.00	6.50	7.50
Insurance costs	5.60	7.60	4.80
Office services	6.30	6.30	5.60
Sum of weighted scores	78.15	76.65	72.15

4. Show that an exponential smoothing forecasting method is a special type of weighted moving average forecasting method. (十分)

(Hint: $F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1})$ and $F_t = \sum_{i=t-n}^{t-1} w_i * A_i$, $\sum_{i=t-n}^{t-1} w_i = 1.00$)

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5. A company has started selling through its online channel along with its retail stores. Management has to decide which products to carry at the retail stores and which products to carry at a central warehouse to be sold only via the online channel. The company currently has 900 retail stores across the country. Weekly demand for product A at each store is normally distributed with a mean of 800 and a standard deviation of 100. Each product A costs $30. Weekly demand for product B at each store is normally distributed with a mean of 50 and a standard deviation of 50. Each product B costs $100. The Company has a holding cost of 25 percent of product value. The Company manages all inventories using a continuous review policy and the supply lead-time for both products is 4 weeks. The targeted cycle service level is 95 percent. Assume demand from one week to the next to be independent.

(1) How much safety Inventory reduction in holding cost per unit sold can the company expect on moving each of the two products from the stores to the online channel? (10%)

(2) Which of the two products should the company carry at the stores and which at the central warehouse for the online channel? Why? (15%)

6. Assume you are the production manager of a manufacturing company.

(1) What are the appropriate procedures of generating production plan of your company? (10%)

(2) In above production plan, what factors and procedures you need consider in order to generate a good production schedule. (15%)