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支援 TSP 業者掌握未來技術發展趨勢及客戶價值區隔之探索模式
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計畫主持人：楊士霆 助理教授(資訊管理學系)
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壹、中英文摘要

中文摘要

近年來，企業體普遍面臨產業轉型及競爭環境變革等挑戰，唯有提昇本身之研發技術能力才能改善其經營體質，並需因應時代與市場改變而達成永續經營之理想。在中小型企業居多的台灣，多數企業體無充分能力與人力整合其相關技術資源；在企業本身研發經費、技術人才及管理能力皆有限之情況下，多數業者實需仰賴技術與諮詢服務供應者之技術支援，以委外方式或協同合作導入其科技研發或移轉技術成果，進而增強企業本身之競爭力。然而，對於技術與諮詢服務供應業者之研發人員與業務人員而言，不論於探索技術研發方向及尋找合作客戶等課題上，皆缺乏客觀之建議與有效地協助。因此，本研究乃根據此些營運議題，結合其此類業者之研發及契約資料，進而建構「技術研發方向探索」、「重點/潛在客戶搜尋」推論法則，以協助此類業者之營運需求。

於「技術研發方向探索」方法論中，本研究乃分析技術移轉、推廣等研發資料並建構相關資料模式，以擷取所需之技術資訊，發展「技術研發方向」之探索模式，以探索技術發展趨勢、技術相關性及技術投資效益，進而提供研發人員技術發展之建議。而在「重點/潛在客戶搜尋」方法論中，本研究乃分析客戶合作契約等資料，並擷取所需之客戶、契約資訊，進而建構「重點/潛在客戶」搜尋方法論，以協助業務人員延續客戶契約與開拓新客源。整體而言，藉由此兩個模式之整合與串連，以提供技術與服務諮詢供應者更為客觀、系統化、有效率之業務發展建議，除解決此類業者的營運瓶頸，而能有效達成扶植產業與企業體之目標與願景。

關鍵字：知識管理、技術移轉、技術研發、顧客關係管理、分群、資料探勘

Abstract

For most SMEs (Small and Medium-Sized Enterprises, SMEs) in Taiwan, in order to reduce the R&D (Research and Development, R&D) investment, the technology and service providers (TSPs) are required to provide technical services. Owing to high variety of industry development, the TSPs are dedicated to development of applied technologies. The operation purposes of TSPs are to provide customized services and technologies that meet the various client requirements and to improve capability of their clients via various projects. Previously, the technology development strategies are determined by domain experts or sales through trials and errors. However, the project history is usually too complicated for R&D engineers and sales to utilize for business promotion. Concerning operation characteristics of TSPs, this research develops technology mining and critical customer mining models based on the project history.

The proposed technology mining model focuses on exploring technologies with higher client demands and significant R&D returns so that the TSPs can effectively expand and continue their business. In the critical customer mining model, customers are clustered into critical and non-critical customers and the features of critical customers are extracted. By application of critical customer mining model, the TSPs can efficiently target the critical and potential customers. In addition to the proposed methodologies, a Web-based system, namely

business information management system, is developed to evaluate the feasibility of the proposed models and techniques.

As a whole, by application of the technology mining and customer mining models, effective R&D and sales suggestions (i.e. technology development and potential customer suggestions) can be provided to the TSPs for accurate business promotion.

Keywords: Knowledge Management, Technical Transfer, Technology Development

貳、報告內容

1.研究背景、動機與目的

技術與諮詢服務供應者乃從事應用科技之研究、技術開發、成果推廣與輔導導入等工作。此類型技術與諮詢供應者除一般私人顧問公司外，尚包括一般研究型機構與財團法人單位；後者除從事主導性研究以發展特殊技術外，尚需針對一般企業技術發展及產品商業化之需求而予以協助，以提高業者之產品或技術於國際市場之競爭能力。但由於產業技術需求與發展之變化並非單一組織所能完全掌握、主導，導致技術與諮詢供應者推動技術研發及產業合作時，不論於研發、推廣技術類別或尋找易合作之客戶時皆缺乏客觀之建議，往往需依業務人員、領域專家之經驗判斷或人為試誤等方式決定「技術研發方向」與評選「合作客戶」。此種作法容易造成人力及資源浪費、決策準確度不高，且其推廣與研發效果往往事倍功半。因此，如何根據此類技術提供業者營運之特殊需求，結合其歷史契約資料，建構「技術研發方向探勘」與「重點客戶搜尋」法則，以作為此類業者於探索技術類別之發展趨勢與瞭解重點客戶群分佈之建議，乃為本研究所關注之課題。

然而，不同於以往針對個人客戶特質、實際產品商務之客戶/主力商品探勘模式，本研究乃著重於運用技術與諮詢服務供應者之歷史契約資料，亦即擷取其過去各技術發展、客戶契約與客戶基本資料之歷史資訊，以推論各類型技術需求及瞭解客戶偏好進行推廣。因此，本研究首先乃整理與歸納技術與諮詢服務供應者之客戶歷史契約資料特質（如：契約數或契約金額等）、客戶基本資料及營運狀況，以形成客戶之資料模式，並成為「技術研發方向探索」及「重點/潛在客戶搜尋」方法論之前端模式。

建立技術與諮詢服務供應者之資料模式後，本研究乃先行針對「技術研發方向探索」方法論進行探討。技術研發方向不明確所衍生之問題包括不瞭解市場技術需求趨勢、各技術類別效益不明及不知如何延續客戶技術需求等問題。是故，本研究根據以往有效之契約內容，配合時間移轉所形成技術潮流轉變，以發展契合此類業者技術類別發展之探索模式：

- 擷取近期發展趨勢上揚、需求較高之技術類別，以建議此類業者進行技術研發時賦予較高之權重。
- 尋找投資效益較大之技術研發類型及各技術效益之發酵年期，除建議技術供應者發展外，並提供效益預測，使技術供應者之收益提升。
- 瞭解各類技術發展之關聯性，使技術供應者可針對客戶之技術發展類別現狀，進行後續技術推廣。

於「重點/潛在客戶搜尋」之方法論中，本研究亦以所建構之資料模式配合此類業者於客戶搜尋作業上之瓶頸（不知如何尋找重點客戶及開發潛在客戶群）進行探討。故本研究針對技術服務供應者之「重點/潛在客戶搜尋」課題發展以下之模式：

- 推導重點客戶分群模式，以瞭解此些重點客戶之特徵，並建議業者針對該重點客戶群進行技術推廣或契約延續。
- 歸納並擷取重點客戶群中之代表性特質，以作為尋找潛在客戶群之依據。

整體而言，本研究首先整理並建構技術與諮詢服務供應者之服務資料模式以作為「技術研發方向探索」及「重點/潛在客戶搜尋」模式之輸入資料；其次，根據技術服務供應者營運所面臨之問題點，建構「技術研發方向探索」及「重點/潛在客戶搜尋」模式，以瞭解各類技術發展趨勢、探索投資效益、各技術之關聯性、瞭解重點客戶分佈與特質及發掘潛在客戶群，進而提供業者所需之營運建議。

2.文獻探討

本研究首先針對技術服務供應者之營運需求進行研究回顧，其次就技術發展趨

勢、需求及重點/潛在客戶之評選法則進行探討。

2.1 技術服務之領域範疇

對於技術開發與諮詢服務供應者，本研究乃針對國內、跨國性及學術界之技術提供單位進行相關文獻探討，以更深一層瞭解技術與諮詢服務供應者之營運模式。

對國內的技術與諮詢供應者而言，Tan（1995）對於客戶進行技術推廣時，應當考量客戶之公司經營策略、組織架構、創新能力及技術需求條件，作為技術推廣方向與合作模式之決策。相對而言，客戶於評選技術與諮詢供應者所考量者除了考量公司基本資料（如資本、營收狀態等）外，其過去合約執行能力、技術移轉能力與計畫執行成果，皆為影響評選結果的關鍵要因（Radosevic，1999）。而對於跨國性技術輔導組織而言，其所需考量者為不同國家之技術發展、語言與文化之差異，以建構符合不同需求之分析模式，將此等不同差異之因子（De Castro 等人，1995）納入技術發展之考量。King 等人（2003）亦以飛機製造技術輔導與移轉過程（由操作、維護到重新製造、改良原型及製造新機型等程序）說明技術發展、文化或需求之差異所衍生之衝擊與問題。Tucker 等人（1998）乃針對美國與澳洲之產業技術扶植難易程度加以比較，並歸納其特殊需求間之相關性。De Meyer（2001）與 Bozeman（2000）強調開發中國家（如中國）之知識創新、硬體/軟體/智慧系統研發等技術發展與移轉，須考量國家之整體政策體制、人員技術素質（Liu 等人，2001）及市場供需狀態。

此外，學術單位亦為業界技術來源之重要管道，但其成果對於相關業者是否皆能適用，已廣受質疑（Lee 與 Win，2004）。然 Kingsley 等人（1996）及 Fujisue（1998）則以合作之觀點，強調技術研發成果之產業適用性。其乃針對產學合作之特殊性提出協同 R&D 設計之互動模式，以提升技術研發成果導入產業界之時效性。

除上述主要提供技術之單位外，Bessant 與 Rush（1995）及 Asuka-Zhang（1999）指出為使技術移轉順利進行，需著重技術移轉過程前之準備工作（如人員訓練、物料供應、上下游廠商評選、資金需求與知識授），即技術導入之進程除因應顧客需求外，尚需配合技術發展所需之資源。此外，Buratti 及 Penco（2001）針對中小企業之資源短缺及其組織學習能力不足等問題，強調其諮詢輔導過程所呈現之問題較大型企業困難甚多。

2.2 技術發展及需求趨勢

技術之研發與發展除應考量「創新性」外，亦需考量技術之「實用性」。故關於此類議題之研究重點乃為探索技術之發展趨勢，並有效地運用相關之分析法則，將技術研發與企業需求相互結合，使企業獲得真正符合業務發展所需之技術。而本研究於技術發展及需求趨勢之文獻探討方面乃朝向技術生命週期區隔、量化因子評比及定性因素分析方向進行探討。

針對技術趨勢與需求分析之相關課題而言，Macharzina 及 Brodel（1996）指出技術發展軌跡呈現技術浮現（Emergence）、成長（Growth）及成熟（Maturity）三階段，並於技術接近成熟階段進行此種技術之移轉或推廣，其成功機率與效益亦較大。但 Tylecote（1996）則認為成長階段之技術最適合於產業界進行技術之研發與運用，因為於成長階段之技術具備高度可塑性與發展性，故於技術開發或技術移轉時，尚保有一定程度之發展空間及彈性，若企業於此階段予以導入，其技術發展可自行掌握，進而成為該企業之核心技術及具競爭性與區隔性之成熟技術。

Arnold 等人（l990）以量化形式表達技術之發展趨勢。該研究首先指出技術量化值乃受到「環境風險」與「產業獲利性」兩構面之影響，並以此兩構面細分為八類技術量化指標，分別為技術之本質、成本因素及契約因素等，進而予以量化、賦予不同

權重、加總，進而分析各技術對企業體之效益。而 Nagle（1995）亦提出一套分析技術價值之架構，該研究於「成本」與「價值」兩要件中擷取量化值；成本量化係以成本為基礎，考量移植技術、生產、原料及技術人員訓練等成本，並將此些因素之量化值予以加權。而價值量化則考量對應之客戶需求量、預期目標利潤及技術專利價值等，其主要目的乃反應技術價值所創造之利潤；待計算兩要件之量化值後，即可得各技術價值之指標值；是故，以此兩因素作為考量，可於技術研發過程中探索所有技術類別之發展趨勢，以決定可同步發展之技術。

亦有相關研究朝向以「定性要素」進行技術需求及趨勢之分析。Liu（2002）以國外各項技術移轉資料（含中介機構與產業界之交易紀錄）作為分析依據，再融入與相關領域專家訪談之意見，以情境預測方法，預測台灣往後三年至五年內之各類技術發展趨勢及熱門之技術移轉類別，進而提供台灣各企業、技術交易機構（含業界及政府技術中介機構）參考依據，使各技術研發朝向商業化型態發展。Clark 及 Guy（1998）以技術推力模式（Technology Push Model）和需求拉力模式（Demand Pull Model）分析各類技術之發展價值。於技術推力模式中，乃以促成近期之技術發展速度、技術複雜性、技術創新性及延伸性為分析基準。而需求拉力模式乃根據市場需求、影響經濟發展程度及對產業活動之影響程度為考量依據；將此兩模式交叉分析後，即可瞭解目前重點發展之技術類型，期望藉由結合技術創新及市場需求，進而提升至市場層次。

2.3 重點客戶之選取法則

在現今微利時代下，企業體開始策略性地忽略不具經濟效益之客戶，並將有限的資源投注於具有高度營收價值之客戶群（即重點客戶群）。此類議題相關研究之重點乃為有效地區分既有客戶群之價值層級，並執行客戶分級管理，使企業能以有限之成本，提供不同層級客戶差異化之服務與品質，進而提升企業之獲利性。

Hughes（1994）以 RFM 分析法（當中，R（Recency）為最近購買日、F（Frequency）為購買頻率、M（Monetary）為購買金額），發展客戶之量化指標，進而依此區分客戶之價值。此外，Marcus（1998）亦發展一套適合中小型企業之顧客區分方法，該研究亦根據 RFM 觀點建構顧客價值分析矩陣，但此顧客價值矩陣起初僅採用購買次數（Frequency）及平均購買金額（Monetary）判定顧客價值，而購買日期（Recency）則以企業與顧客接觸時間（自訪談至簽約之期間）作為衡量標準，最後再量化顧客價值進而篩選重點客戶。上述兩項研究皆期望以 RFM 之分析法則，區隔獲利性高之顧客群，以投入較多之行銷資源，減少業者投注過多資源接觸獲利性低之顧客。

此外，就服務性行業而言，亦有相關研究從事客戶價值層級之區隔。如 Blattberg 及 Deighton（1996）協助美國長途電話公司建構區隔「高度獲利客戶群」之方法論，以提供特別的促銷優惠方案（如聘用熟悉該國語言之總機人員及減價時段等優惠措施）。Garbarino 及 Johnson（1999）則以紐約市一家非營利歌劇院為研究標的，該研究乃以顧客之訂票關係為考量因子。因此，該研究首先歸納現有客戶群中之長期訂票顧客（如持月票、季票等客戶），並視其為重點客戶群，進而提供較為貼心之服務（如電訪、贈品或活動告示等）。此外，Berry 與 Linoff（2000）則以連鎖零售商顧客資料庫之購買產品歷史資料為分析依據，並利用 80-20 法則區隔顧客價值層級。該研究之考量因子為顧客之消費金額、利潤程度（售價扣除成本）及顧客來店消費次數，其作法乃先針對此三項因子加以統計、排序，並根據排序結果給予權重並且加總，以獲得評估指標值；最後運用 80-20 法則評估顧客價值（評估指標值排名前 20%之客戶群為具利潤之顧客群）。此外，針對信用卡市場運作特質，Chen（2002）區分獲利性高之黃金級客戶。該研究乃以兩個年度之客戶消費資料為分析基礎，並以 80-20 法則進行重

點客戶之篩選（即消費金額總數排名前 20%之顧客為重點客戶）；待區隔客戶群後，將不符合黃金客戶條件要求之資料刪除，並保留適合之資料，以提供企業決策者適當之重點客戶名單。

上述之重點客戶分群法多運用實務界常用之 80-20 法則（排名前百分之二十之顧客往往可為企業帶來百分之八十之利潤），然而，Sherden（1994）則提倡修改 80-20 法則為 80-20-30 法則。因為 Sherden 認為百分之二十之顧客能為企業帶來百分之八十的利潤，但是企業大半利潤流失，乃為了服務剩下來最低端百分之三十無利可圖之顧客群；因此，若放棄最糟的顧客群，應更能改善企業的獲利性。

3.技術與客戶探勘模式之架構

為解決技術與諮詢服務供應業者（以下簡稱 TSP 業者）掌握技術研發方向及尋找客戶之既有營運問題，本研究乃建構一套「業務資訊管理系統」，以協助 TSP 業者適時掌握未來技術發展趨勢及客戶價值區隔。此業務資訊管理系統之核心功能模組乃包括「技術發展趨勢分析模組（TTM）」、「技術投資效益分析模組（RDM）」、「技術關聯分析模組（TRM）」、「重點客戶分群模組（CCM）」及「潛在客戶分析模組（PCM）」等五大模組，本研究期望藉由此五大核心模組之運作，提供 TSP 業者之技術研發與客戶搜尋之業務建議，以提升 TSP 業者之業務績效及協助 TSP 業者扶植產業之營運目標。

此業務資訊管理系統之架構如圖 3.1 所示。系統運作之初需匯入 TSP 業者之客戶基本資料及各類契約資料；其次，系統乃以「前置資料運算模組（FDM）」計算「客戶特徵值」、「攤算契約指標值」（包含「累計契約指標值」及「平移契約指標值」）及「技術分類結果」，以供後續各核心模組推論之用。

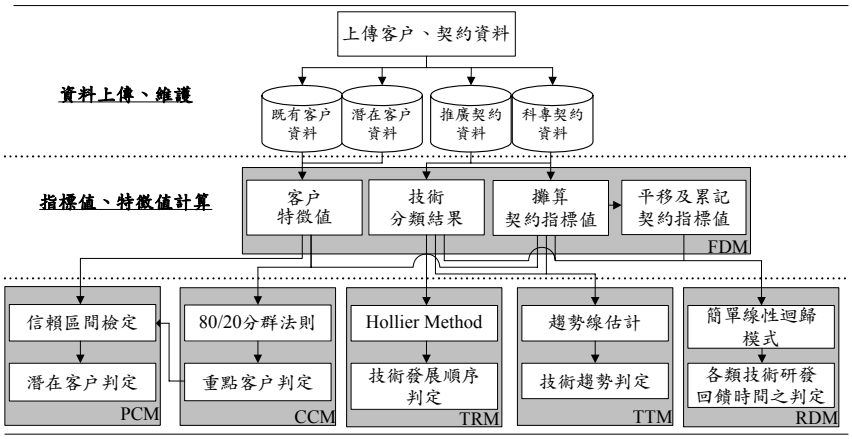


圖 3.1、業務資訊管理系統之核心模組

待 FDM 完成上述基礎量化值之運算後，技術發展趨勢分析模組乃以 FDM 所攤算之契約指標值及技術分類結果，計算各類技術之均攤指標值於各時間區間所構成之估計線斜率，進而預測各類技術於後續時期之業務量上升或下降趨勢。技術投資效益分析模組除考量 FDM 計算先期投資契約（如科專計畫）之指標值攤算結果及累計指標值結果外，尚考慮 FDM 所計算後期技術回饋之各項平移指標值，並以簡單線性迴歸分析模式，判定各類技術之最適效益回饋時間。技術關聯分析模組乃以 FDM 之技術分類結果為基礎，並依循「Hollier Mathod」之觀念，推論各類技術發展之順序關係。此外，重點客戶分群模組乃以 FDM 攤算之契約指標值為基礎，並以 80-20 法則為分群規則，釐清指標值表現較佳之客戶（即重點客戶群）。最後，潛在客戶群則以重點客戶之特徵值表現（即 95%信賴區間估計量），篩選具有相同表現但未具備合作關係之客戶群，進而判定潛在客戶群。

技術發展趨勢分析模組（TTM）

TTM 主要以 FDM 所攤算之契約指標值及技術分類結果，計算各類技術之均攤指標值於各時間區間所構成之估計線斜率，以得知目前各類技術需求之成長或下降之趨勢，進而預測各類技術之未來需求消長狀況，以作為 TSP 業者選擇研發技術類別之參考。

故TTM乃以各類技術T_i之各項契約指標D_j於各分割期間（即時間區間為$[P_{t-1}, P_t]$）所分配之總量化值（即$T_i[D_j]_{t-1}^{t}$）為分析資料（如表 3.1 所示），計算各類均攤指標值於各時間區間所構成之趨勢估計線斜率BT_i（參見公式(3.1)），以代表該類技術於未來之技術發展趨勢。

表 3.1、各類技術之契約指標均攤值

期間 / 技術類別	指標D_j				
	P_0~P_1	P_1~P_2	…	P_{t-1}~P_t	…
T_i	$T_i[D_j]_0^1$	$T_i[D_j]_1^2$	…	$T_i[D_j]_{t-1}^{t}$	…

$$\beta T_i = \frac{\sum_{all\ t}\left(\frac{P_{t-1}+P_t}{2}-\overline{P}\right)\cdot\left(T_i[D_j]_{t-1}^{t}-AveT_i[D_j]_{t-1}^{t}\right)}{\sum_{all\ t}\left(\frac{P_{t-1}+P_t}{2}-\overline{P}\right)} \tag{3.1}$$

其中，$\overline{P}$ 為規劃期間之時間平均值，$AveT_i[D_j]$為所考量契約指標之平均值。

如公式(3.1)所示，TTM 可判斷各類技術趨勢之正值斜率（即定義為「正向」趨勢）或負值斜率（即定義為「負向」趨勢）之斜率估計值。故若某類技術之估計線屬「正向」趨勢，即代表 TTM 推論此類技術為處於「成長中」之技術；若某類技術之估計線屬「負向」趨勢，即代表 TTM 推論此類技術為處於「衰退中」之技術。因此業務人員或研發人員可根據 TTM 所推論之技術發展趨勢結果，推廣或研發處於成長中之技術類型，進而提升所發展技術類別與業界合作之機率。

技術投資效益分析模組（RDM）

RDM 乃以 FDM 所攤算先期投資契約（如科專計畫）之指標值及累計指標值結果為期初投資資料，並以 FDM 所計算後期技術回饋契約（如推廣計畫）之平移各期指標值為投資回饋資料，以簡單線性迴歸分析之觀念，挑選最適之迴歸模式，進而判定各類技術之最適效益回饋時間。

故對於RDM欲分析之「現期成果」及「累積經驗」兩類技術投資指標值而言（即簡單迴歸模式之自變數），「現期成果」乃為FDM所攤算契約指標值及技術分類結果（即時間區間為$[P_{t-1}, P_t]$所分配之總量化值$T_i[D_j]_{t-1}^{t}$）；而「累積經驗」乃為FDM考量各類別技術先前之執行經驗（以觀測時點T為例，第T年之先期計畫經驗值即為至第T年為止所累積執行之契約指標值，$T_i[D_j]_0^T = \sum_{t=1}^{T} T_i[D_j]_{t-1}^{t}$）。此外，對於RDM欲分析之各類技術後期回饋契約指標值而言（即簡單線性迴歸模式之應變數），基於各技術類別之投資效益可能於後續數個時間區段發揮影響，故FDM乃將$T_i[D_j]_{t-1}^{t}$之均攤值修正為平移n個單位期間之分佈指標值（即$T_i[D_j]_{t-1+n}^{t+n}$）。此三類指標值彙整如表 3.2。

如表 3.2 所示，RDM可依照上述三項FDM之指標值運算結果，分別建構「現期成果」及「累積經驗」之簡單線性迴歸模式，並分別計算各技術類別於各平移期間之

R-Square值（分別為 $R^2_{a,n}$ 及 $R^2_{b,n}$），進而分別挑選最大之R-Square值，以判定「現期成果」及「累積經驗」下各類技術之最適投資回饋時間（即n^*值），進而使研發人員於技術投資與研發時，預知各類研發技術之「現期成果」及「累積經驗」的最佳投資回饋時間，並於對等之時點推廣該類技術予客戶，以提升專案合作機會。

表 3.2、簡單線性迴歸模式檢定表

應變數	自變數		平移 n 個單位期間之迴歸模式解釋力（R-Square 值）		
平移指標值	投資類別	指標值	n=1	n=2	…
$T_i[D_j]^{t+n}_{t-1+n}$	現期成果	$T_i[D_j]^{t}_{t-1}$	$R^2_{a,1}$	$R^2_{a,2}$	…
	累積經驗	$T_i[D_j]^{T}_{0}$	$R^2_{b,1}$	$R^2_{b,2}$	…

技術關聯分析模組（TRM）

TRM主要乃以FDM之技術分類結果為分析基礎，並運用Hollier Method之分析精神，推論任兩類技術之發展順序，進而使TSP業者可根據既有客戶現今合作契約之技術類別，判定該客戶應推薦之下一技術類別。故TRM乃分析FDM依技術類別分群後之契約資料內容，進而統計各客戶於各類技術之合作順序頻率（即技術類別T_i及T_j之接續頻率為$F[T_i,T_j]$），並且計算合作順序始於第i類技術之總頻率（即 $S^{From}(i)=\sum_{all\ i} F[T_i,T_j]$）及合作順序結束於第i類技術之總頻率（即 $S^{To}(i)=\sum_{all\ j} F[T_j,T_i]$），進而計算順序評斷係數（即$S^{From}(i)$與$S^{To}(i)$之比值$R[T_i]$），如表 3.3 所示。

表 3.3、運用 Hollier Method 之技術類別順序關係表

迄 / 起	T_1	…	T_j	…	「起」總和	評斷係數
T_1	$F[T_1,T_1]$	…	$F[T_1,T_j]$	…	$S^{From}(1)$	$R[T_1]$
T_2	$F[T_2,T_1]$	…	$F[T_2,T_j]$	…	$S^{From}(2)$	$R[T_2]$
…	…	…	…	…	…	…
T_i	$F[T_i,T_1]$	…	$F[T_i,T_j]$	…	$S^{From}(i)$	$R[T_i]$
…	…	…	…	…	…	…
「迄」總和	$S^{To}(1)$		$S^{To}(j)$	…		

如表 3.3 所示，TRM乃基於Hollier Method觀念（即利用$S^{From}(i)$與$S^{To}(i)$之比值$R[T_i]$進行技術類別之先後順序關係判定，如公式(3.3)所示），推論各類技術之接續關係（即SP）。因此，對於任何一客戶而言，藉由TRM推論之各類技術需求順序，業務人員可根據對特定客戶最近簽約之契約技術類別T_i，推銷後續契約之技術合作類別，以提升專案合作機會。

$$SP = T_1 \rightarrow T_2 \rightarrow \ldots \rightarrow T_i \rightarrow \ldots \ where\ R[T_1] \geq R[T_2] \geq \ldots \geq R[T_i] \geq \ldots \quad (3.3)$$

綜合以上技術研發方向相關之三大模組所述，本研究於「技術研發方向」模組主要乃探索近期各技術類別之發展趨勢、投資效益及各技術類別之關聯性（利用 Hollier Method 觀念），藉以提供此類業者能掌握未來技術發展趨勢、瞭解客戶需求，進而提

升其與客戶合作之機率。

重點客戶分群模組（CCM）

CCM 模組乃以 FDM 模組攤算之契約指標值為基礎，並考量近期合作契約之重要性較高（即給予較大之權重值），而以 80-20 法則釐清指標值表現較佳之客戶（即重點客戶群），進而提升業務人員尋找合作客戶之成功率，以延續 TSP 業者與既有客戶之合作關係。

故CCM模組乃以各客戶C_i之各項契約指標D_j於各分割期間（即時間區間為$[P_{t-1}, P_t]$）所分配之總量化值（即$C_i[D_j]_{t-1}^{t}$）為分析資料。首先，CCM模組乃針對每一契約指標值所散佈於各時間區段之均攤值乘以對應該時段之時間權重值α_{t-1}^{t}，並累計時間加權後各客戶之各項契約指標值（即$C_i[D_j]$），如公式(3.4)所示。其次，針對各客戶C_i所累計之契約指標值大小，由高至低進行排序，並給予對應之排序值$R[C_i,D_j]$，CCM模組即可計算考量時間權重後各客戶C_i對於各指標D_j之$R[C_i,D_j]$排序值分佈，如表 3.4 所示。

$$C_i[D_j] = \sum_{all\ t} C_i[D_j]_{t-1}^{t} \times \alpha_{t-1}^{t} \quad \text{where} \quad \alpha_0^1 \le \alpha_1^2 \le \cdots \le \alpha_{t-1}^{t} \le \alpha_t^{t+1} \le \cdots \tag{3.4}$$

其中，時間權重值之分佈$\alpha_0^1 \le \alpha_1^2 \le \ldots \le \alpha_{t-1}^{t} \le \alpha_t^{t+1} \le \ldots$乃基於近期合作契約之重要性高於先前所合作之契約，故 CCM 模組給予對應時段較大之權重值。

表 3.4、加入時間權重之客戶指標值排序分佈

客戶 / 指標	C_1	C_2	…	C_i	…
D_j	$R[C_1,D_j]$	$R[C_2,D_j]$	…	$R[C_i,D_j]$	…

如表 3.4 所示，CCM乃依 80-20 分群法則之精神，挑選客戶指標值排名$R[C_i,D_j]$居前 20%者為重點客戶群；而業務人員可依此重點客戶分群名單，主動行銷TSP業者所發展各類之技術，以提升專案合作或成果推廣之機率。

潛在客戶分析模組（PCM）

PCM模組乃以重點客戶群特徵之估計量（即(1-α)*100%區間估計量），並於未具備合作關係之客戶群中，篩選具有相同特徵值表現之客戶群，進而判定為潛在客戶群，。故PCM模組乃以FDM模組所計算之客戶特徵值$C_i[B_k]$為分析基礎（B_k為重點客戶之特徵），並利用CCM模組所推論之重點客戶群C_i'，挑選重點客戶特徵值$C_i'[B_k]$，進而以區間估計之觀念，計算重點客戶特徵B_k之區間估計下限值與上限值$[L\{C'[B_k]\}, U\{C'[B_k]\}]$，如公式(3.5)所示。

$$L\{C'[B_k]\} = AveC'[B_k] - t_{\alpha/2,NC'-1} \cdot \frac{SeC'[B_k]}{\sqrt{NC'}}$$
$$U\{C'[B_k]\} = AveC'[B_k] + t_{\alpha/2,NC'-1} \cdot \frac{SeC'[B_k]}{\sqrt{NC'}} \tag{3.5}$$

當中，$AveC'[B_k]$及$SeC'[B_k]$分別為重點客戶群中特徵B_k之平均值與標準差，NC'則為CCM模組所推論重點客戶群之總客戶數。

綜合以上客戶價值掌握相關之 CCM 及 PCM 兩大模組所述，本研究於客戶價值掌

握之議題主要乃以 80-20 法則為分群規則探索價值高之重點客戶群，進而瞭解重點客戶所具備之特質，並於未具備合作關係之客戶群中篩選潛在客戶群，以使此類業者推廣、延續契約，或開拓新客戶群等任務得以順利進行。

4.業務資訊管理系統

本研究乃於網際網路環境下，發展 TSP 業者掌握未來技術發展趨勢及客戶價值區隔之業務資訊管理系統（以下簡稱業務資訊管理系統），進而利用此管理平台將各類資料集中管理、維護及進行人員權限控管；除使相關資訊得以妥善運用外，並兼顧系統之資訊安全性。

業務資訊管理系統主要處理之資訊可分為使用者資料（即系統內所有人員之基本資料）、業務基本資料（即此類業者之客戶及歷史契約資料）及業務建議資料（包含技術研發及客戶搜尋等推論建議）等。故業務資訊管理系統乃依使用者登入系統之使用者資訊，將系統人員劃分為一般使用者、研發（R&D）人員、業務人員及系統管理者等角色，並賦予不同之功能執行權限。就各類人員之角色歸屬而言，「一般使用者」之角色乃著重於各類資料（即 TSP 業者之客戶及歷史契約資料）之匯入及查詢（如圖 4.1 與圖 4.2 所示），可協助擴大資料庫現有之業務基本資料，以增進各核心模組之學習能力。其次，「研發人員」可執行「技術投資效益分析」、「技術關聯分析」及「技術趨勢分析」等模組功能，以獲得各類技術之最適效益回饋時間及各類技術之發展順序等推論結果建議（如圖 4.3 與圖 4.4 所示）。此外，其並可依經驗修正技術研發方向之各類推論參數（包含績效指標權重設定及時間權重設定，如圖 4.5 與圖 4.6 所示），以使各模組之推論結果更具正確性。上述三類人員皆可將其業務領域資料（含研發資料與契約資料）匯入系統，除可兼具資料維護之專業性外，亦可兼顧系統使用之彈性。

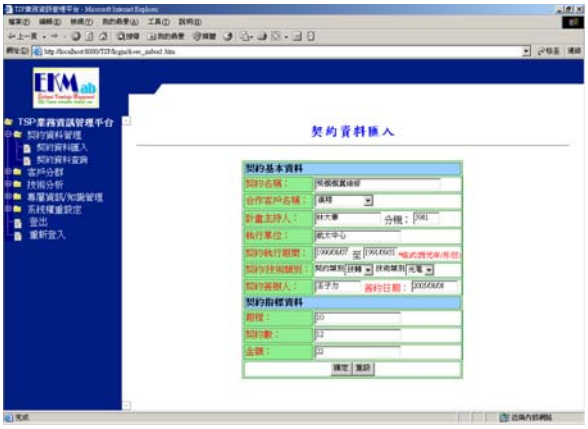


圖 4.1、契約資料匯入介面

圖 4.2、客戶資料新增介面

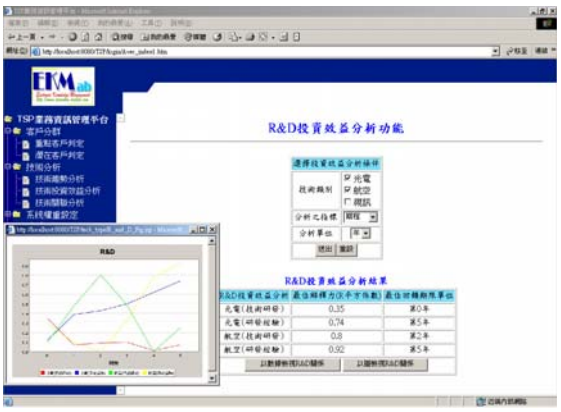


圖 4.3、技術投資效益分析功能結果

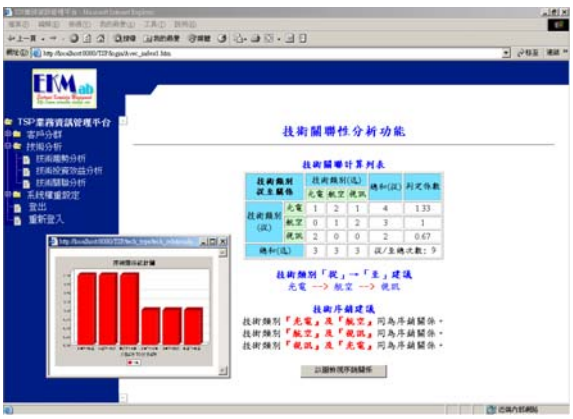


圖 4.4、技術關聯分析功能結果

圖 4.5、績效指標權重設定

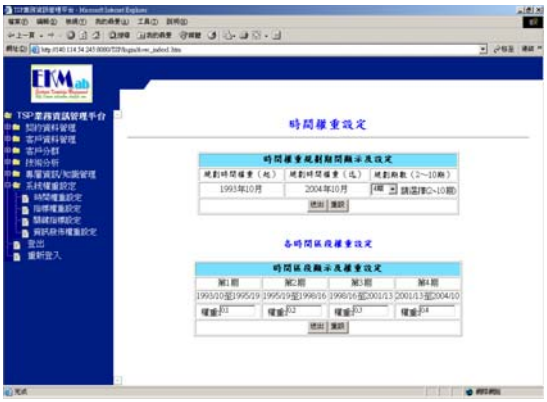


圖 4.6、時間權重設定

5.系統績效驗證與評估

為驗證本系統對於技術研發及客戶搜尋之推論效果，本研究乃以一法人單位為案例驗證對象，並將系統驗證與評估分為「系統驗證進行方式說明」及「系統驗證結果分析」等兩項目。以下即針對此兩個項目進行說明。

5.1 系統驗證進行方式說明

首先，本系統乃根據案例驗證對象所發展之技術發展類別為契約分類對象，將法人單位所有合作契約資料（其中包含 307 筆「推廣計畫」及 205 筆「科專計畫」資料）依各技術類別分為「引擎維修」、「通訊電子」及「視訊電子」等八類契約，並根據各契約之簽訂日期，於時間軸劃分為八個驗證階段（自 1993 至 2002 共 10 年，1993 與 1994 兩年為第一驗證階段，2000 與 2001 兩年為第七驗證階段，其餘驗證階段皆以一年為期，一個驗證階段之契約筆數約 30 至 50 筆）。其次，本研究先將客戶資料（總計 134 份既有客戶資料）匯入系統，再配合八個資料驗證週期，將契約資料依續匯入系統中，利用系統之技術分析及重點/潛在客戶搜尋兩項主要推論模組，進行推論「技術研發方向」及「客戶搜尋」中各項主題之業務建議，並觀察系統於技術分析及重點/潛在客戶搜尋兩項主要推論模組之結果與實際情況之差異，藉以佐證本研究所發展方法論之正確性。

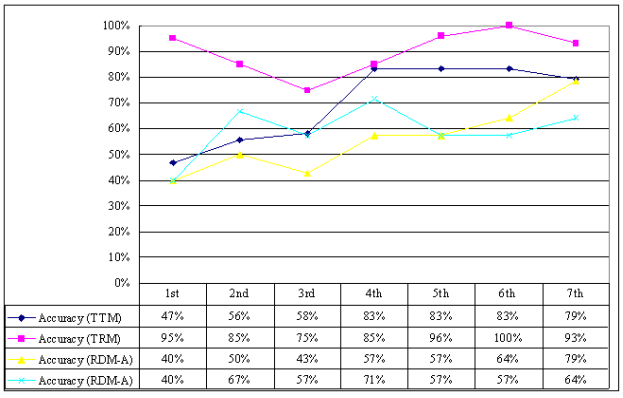
5.2 系統驗證結果分析

「技術研發」及「客戶搜尋」模式中各項驗證指標之系統執行績效趨勢整理如圖 5.1 及圖 5.2，由此可分別得知：

由圖 8 可知，系統之技術趨勢、技術關聯及技術投資效益分析模式推論乃具備學習之能力，待使用者匯入大於 100 筆之契約資料（即第三階段後）予系統後，此三個模組之推論即可呈現高準確度且推論效果穩定之成果。

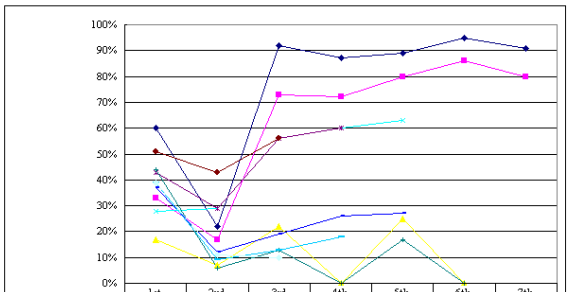
由圖 9 可知，重點客戶判定乃待使用者匯入大於 50 筆左右之契約資料、客戶資料予系統後，系統於重點客戶分群之推論即可呈現高度準確且穩定之效果；而潛在客戶判定於使用者匯入大約兩個階段之資料後，潛在客戶判定乃具備學習能力，並於五個資料驗證階段之契約資料匯入系統後，其所推論之潛在客戶群可保持 6 成左右之準確率且潛在客戶群可能於兩年後（即兩個資料驗證階段期間）與法人單位簽訂契約。

綜合而言，本系統於有限的歷史契約資料下，可使技術研發/業務推廣人員瞭解各類技術發展趨勢、各類技術之關聯性及各類研發技術之最佳投資回饋時間，推銷或研發後續可能發展之技術類型，並強化法人單位進行主動行銷、搜尋客戶之效能。



	1st	2nd	3rd	4th	5th	6th	7th
Accuracy (TTM)	47%	56%	58%	83%	83%	83%	79%
Accuracy (TRM)	95%	85%	75%	85%	96%	100%	93%
Accuracy (RDM-A)	40%	50%	43%	57%	57%	64%	79%
Accuracy (RDM-A)	40%	67%	57%	71%	57%	57%	64%

圖 5.1、各階段技術研發方向（TTM、RDM 及 TRM 模組）之平均準確率



	1st	2nd	3rd	4th	5th	6th	7th
Accuracy (CCM)	60%	22%	92%	87%	89%	95%	91%
Recall (CCM)	33%	17%	73%	72%	80%	86%	80%
Accuracy (PCM-1)	17%	7%	22%	0%	25%	0%	
Accuracy (PCM-2)	28%	29%	56%	60%	63%		
Accuracy (PCM-3)	43%	29%	56%	60%			
Accuracy (PCM-4)	51%	43%	56%				
Recall (PCM-1)	44%	6%	13%	0%	17%	0%	
Recall (PCM-2)	37%	12%	19%	26%	27%		
Recall (PCM-3)	39%	9%	13%	18%			
Recall (PCM-4)	39%	11%	10%				

圖 5.2、客戶分析（CCM 及 PCM 模組）之平均準確率與召回率

6.結論

整體而論，本研究乃根據技術與諮詢服務供應商之特殊需求及其契約資料特性，針對 R&D 人員建構「技術研發方向探索」推論模組，並針對業務人員建構「重點/潛在客戶搜尋」推論模組，以作為此類業者於探索技術研發方向、瞭解重點/潛在客戶群分佈、搜尋合作客戶與推廣各項業務之建議。首先，就技術與諮詢服務供應者之 R&D 人員而言，透過技術研發方向探索方法論之推論結果，可使其運用技術發展趨勢、技術投資效益及技術關聯性等建議資訊，進而發展技術之決策。其次，對技術與諮詢服務供應者之業務推廣人員而言，藉由重點客戶搜尋方法論之結果，皆可得知重點客戶分佈、重點客戶代表性特質及潛在客戶群特質等資訊，進而尋找易合作之客戶群。故本研究期望整合此些模式，解決此類技術與服務諮詢供應者的營運瓶頸，並透過本方法論之發展，提供此類業者更為客觀、系統化、有效率之業務建議，進而更有效地扶植產業與企業體。

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肆、計畫成果自評

於計畫成果之評論中，除上述分析本研究所提出之方法論與業務資訊管理系統功能模組之可行性外。本研究亦於個案單位之資料模式彙整過程中，釐清法人單位所維護資料之不足處，並已協助法人單位完成完整資料模式之建構（如協助法人單位將所有合作契約依各技術類別分為「引擎維修」等八類技術契約等）；此外，此「業務資訊管理」模式目前已通過法人單位之評估，法人單位已與業界之軟體公司共同合作並建構對應之輔助系統，並已實際地應用於法人單位之技術研發、技術推廣等營運任務中，足以見得本整合性模式對法人單位之實際應用貢獻。

附件一、可供推廣之研發成果資料表

☐可申請專利　☑可技術移轉　日期：98年11月11日

國科會補助計畫	計畫名稱：支援TSP業者掌握未來技術發展趨勢及客戶價值區隔之探索模式 計畫主持人：楊士霆 計畫編號：NSC 97-2218-E-343 -001 -　學門領域：資訊系統
技術/創作名稱	掌握未來技術發展趨勢及客戶價值區隔之探索模式 (業務資訊管理系統)
發明人/創作人	楊士霆
技術說明	於「技術研發方向探索」方法論中，本研究乃分析技術移轉、推廣等研發資料並建構相關資料模式，以擷取所需之技術資訊，發展「技術研發方向」之探索模式，以探索技術發展趨勢、技術相關性及技術投資效益，進而提供研發人員技術發展之建議。而在「重點/潛在客戶搜尋」方法論中，本研究乃分析客戶合作契約等資料，並擷取所需之客戶、契約資訊，進而建構「重點/潛在客戶」搜尋方法論，以協助業務人員延續客戶契約與開拓新客源。整體而言，藉由此兩個模式之整合與串連，以提供技術與服務諮詢供應者更為客觀、系統化、有效率之業務發展建議。 The proposed technology mining model focuses on exploring technologies with higher client demands and significant R&D returns so that the TSPs can effectively expand and continue their business. In the critical customer mining model, customers are clustered into critical and non-critical customers and the features of critical customers are extracted. By application of critical customer mining model, the TSPs can efficiently target the critical and potential customers. In addition to the proposed methodologies, a Web-based system, namely business information management system, is developed to evaluate the feasibility of the proposed models and techniques.
可利用之產業 及 可開發之產品	一般研究型機構、私人顧問公司或財團法人單位 技術推廣支援系統、客戶價值分析系統、業務資訊管理系統
技術特點	藉由本研究技術發展趨勢分析模式及客戶價值區隔探索模式之整合與串連，以提供業者更為客觀、系統化、有效率之業務發展建議。
推廣及運用的價值	可支援業者之 R&D 人員獲得技術發展趨勢、技術投資效益及技術關聯性等建議資訊，進而發展技術之決策。其次，可支援業者之業務推廣人員獲得重點客戶搜尋方法論之結果，皆可得知重點客戶分佈、重點客戶代表性特質及潛在客戶群特質等資訊，進而尋找易合作之客戶群。

※　1.每項研發成果請填寫一式二份，一份隨成果報告送繳本會，一份送　貴單位研發成果推廣單位（如技術移轉中心）。

※　**2.本項研發成果若尚未申請專利，請勿揭露可申請專利之主要內容。**

※　3.本表若不敷使用，請自行影印使用。

附件二、出席國際學術會議心得報告及發表之論文各一份

出席國際會議報告

98 年 6 月 16 日

報告人姓名	楊士霆	服務機關名稱（請註明系所）及職稱	南華大學資訊管理學系 助理教授
會議期間及地點	2009/6/3~2009/6/5 Russia（Moscow）	本部核定補助文號	NSC 97-2218-E-343-001
會議名稱	The 13th IFAC Symposium on Information Control Problems in Manufacturing		
發表論文題目	A BUSINESS MODEL FOR POTENTIAL CUSTOMERS IDENTIFICATION AND PERSONALIZED KNOWLEDGE PROVISION OF TSPS		

一、參加會議經過

此次 IFAC 研討會乃安排於俄羅斯（Russia）之莫斯科（Moscow）城市舉辦，配合研討會主辦單位之行程規劃與可行機位安排，個人於 5/30 上午即出發前往桃園國際機場，進行登記作業並前往首爾之仁川國際機場，抵達後轉機續飛往佔全球陸地總面積六分之一的俄羅斯，班機於晚上抵達俄羅斯富有北歐文化特色，具「北方威尼斯」之稱「聖彼得堡」，雖然俄羅斯慢台灣四小時（時差），而到聖彼得堡已經晚上 10：00 了（即台灣凌晨兩點），故辦理入境手續後搭車前往飯店休息。隔天 5/31 至 6/1 個人於聖彼得堡參觀「彼得夏宮－冬宮」（隱士盧博物館）、「凱薩琳宮」（琥珀廳）及「彼得保羅要塞」等觀光景點，並於 6/2 搭俄羅斯國內班機至俄羅斯首都「莫斯科」，先行辦理入境手續後並搭車前往飯店，之後乃參觀飯店周圍之景點，如宗教勝地謝爾蓋城「扎戈爾斯克」等地。

大會正式行程日期為 6/3~6/5 三日，正式發表日期亦為 6/3~6/5 三日。當中個人乃於 6/3 上午九點已至會場，並完成報到手續（如圖 1 及圖 2 所示）。本次研討會內容乃安排與此次會議主題相關之製造業資訊控制專題演講與論文發表，再依不同論文主題每天分多個時段 7 個或 8 個平行 Session 進行發表，並分數個 Poster Session 使各位學者可針對相關主題進行學術交流。個人的論文被安排於第一天（6/3）的晚上場次（編號 We-C6.5 Session）「Enterprise Modelling for Interoperability in Collaborative Networked Enterprise」發表，於發表後其他學者亦表示對此研究的高度興趣，詢問本研究之客戶分群方法論細節與行動商務技術的方法，個人並作完整回答，互動甚佳。此外個人亦參加多場與研究興趣較相關之發表場次，並對於其他學者發表內容提出詢問，對於網路企業流程、行動商務等課題觸發新的研究靈感（如圖 3 及圖 4 所示）。

除會議發表時間外，在其他交流活動時，個人與國際/國內學者亦有良好交流（如清華大學工工系蘇朝墩教授、侯建良教授、中原大學工工系陳建良教授、義守大學工工系江育民教授、大葉大學工工系陳偉星教授、余豐榮教授、朝陽科大資管系陳隆昇教授等人），因此瞭解許多國際/國內工業工程、資訊管理學者之研究方向，並規劃未來合作之可能作法，收穫極大。此外，藉由大會安排之晚宴與表演活動（參見圖 5 及圖 6），深刻感受到俄羅斯人的民族性，友善、溫和、快樂的民風讓人印象深刻。

圖 1、抵達 IFAC 會場(1)

圖 2、抵達 IFAC 會場(2)

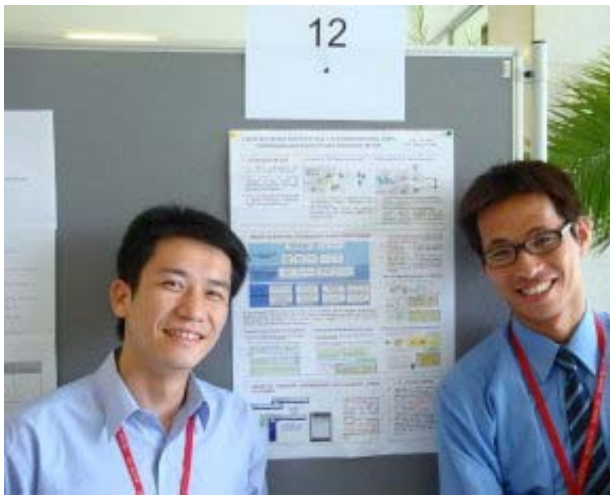

圖 3、IFAC 會場研討(1)

圖 4、IFAC 會場研討(2)

圖 5、IFAC 晚宴(1)

圖 6、IFAC 晚宴(2)

待研討會圓滿結束後（6/5），個人乃搭車前往機場並搭機飛返韓國首爾「仁川機場」（班機於 6/6 上午飛抵仁川機場），隨即轉機返回桃園國際機場（班機於 6/6 下午兩點半飛抵桃園國際機場），結束此次 IFAC 學術研討活動。

三、建議

此次會議中的各項活動安排都可發現主辦單位頗為用心，對於遠道造訪之學者給予多項貼心之服務，為國內學校爭取主辦國際型研討會可加以參考之長處。整體而言，本次大會舉辦頗為用心，個人於此行收穫豐富，且結識多位國際學者，希望能於未來建立更長遠的交流與合作。

四、攜回資料名稱及內容

1. 研討會論文集：含議程集 1 本、論文摘要集 1 本、論文集（評選為優秀論文）1 本，研討會光碟 1 片。
2. 國內外學者學術交流名片。

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A Business Model for Potential Customers Identification and Personalized Knowledge Provision of TSPs

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Abstract: Recently, enterprises have faced the pressure of industry transformation and high competency in the global market. In Taiwan, most small and medium sized enterprises (SMEs) cannot afford advanced R&D. In order to increase competency of SMEs, the technology and service providers (TSPs) play a critical role for innovative technology provision. Traditionally, the salesmen of TSPs have to evaluate the critical customers via trials and errors. In addition, although the personal digital assistant (PDA) has been widely used to promote business for its high mobility, the business information downloaded into PDA is actually rarely concerned. In order to increase efficiency and effectiveness of business promotion, this paper focuses on the development of a personal business information management (PBIM) model with four modules namely critical customer identification (CCI), potential customer identification (PCI), PDA user category determination (UCD) and PDA user busy level determination (UBD) for TSPs to identify potential customers and to provide personalized business information. A non-profit R&D institute in Taiwan is used to validate feasibility of the proposed modules via the developed PBIM platform. This paper presents a feasible PBIM approach for the TSPs to efficiently and systematically analyze the project history and PDA daily records for business outreach.

Keywords: Medium Sized Enterprises (SMEs), Technology and Service Providers (TSPs), Data Mining, Customer Relationship Management (CRM), PDA

1. INTRODUCTION

Owning to high variety of industry development, the technology and service providers (TSPs) including the private consultants or non-profit R&D organizations are dedicated to development of applied technologies in order to assist the small and medium sized enterprises (SMEs) to successfully implement advanced technologies that meet the their operation requirements. However, the technology development demands cannot be dominant simply by a limited number of organizations; thus, the TSPs require useful suggestions about technology development and potential customers. Traditionally, the critical and potential customers are evaluated via trials and errors of salesmen. Under the circumstance, several operation pitfalls (e.g., a lot of time and human efforts required, etc.) might occur. Therefore, this paper focuses on development of a customer identification model for TSPs to identify the critical and potential customers.

In order to increase efficiency of business promotion, the personal digital assistant (PDA) has been widely used as the carrier for personal memos and daily records for its high mobility. In addition, the business information can be synchronized with the user data stored in the PDAs. That is, the PDA has become a powerful and convenient carrier of personal data and business information storage to promote business. However, as a result of overloading data, the salesmen and employees still have to search the business information or training materials to fit their requirements from PDAs. Concerning importance of the personal information (including notes and daily schedule) stored in a PDA, this paper develops a user profile mining approach to explore PDA user's interests for personalized business information provision. As a whole, the objective of this paper is to integrate the PDA information mining and knowledge management methodologies to assist establishment of a mobile office environment.

To sum up, based on the operation characteristics of TSPs, the existing issues of TSPs can be summarized as follows:

- No objective references or guidelines exist for critical/potential customer identification and business promotion.
- The personal daily records and business information are not effectively applied for business promotion.

Since many efforts have to be devoted to business searching, consistency and accuracy of marketing decisions cannot be guaranteed. This research develops critical customer identification (CCI) and potential customer identification (PCI) modules to identify critical and potential customers to seize the business opportunities. Unlike the previous research that focuses mainly on personal customer mining or product sales, this paper applies the project history to explore the profiles of critical clients. That is, the existing customers of a TSP are classified into critical and non-critical customers. Based on the distributions of

distinct attributes of critical customers, representative features of critical customers can be extracted and the features can then be utilized to identify the potential customers. The issues about customer searching of TSPs can be summarized as follows:

- Systematical classification of existing customers
- Objective references or guidelines for potential customer identification

Taking advantage of the personal information, the user requirements for knowledge can be determined. This research develops PDA user category determination (UCD) and PDA user busy level determination (UBD) modules to explore user profiles and provide personalized business information (i.e., appropriate types and volume of knowledge documents). That is, this research presents an intelligent KM scheme by integrating the PDA information (including notes and daily schedule) mining model and mobile knowledge management mechanism. Based on the user profile mining technique, the PDA-ready knowledge that fits user requirements can be imported from the knowledge server to the client PDA. By application of the mobile KM technique, the organization knowledge can be seamlessly provided to the PDA user via the data synchronization process. The attempt of this paper is to present an applicable and intelligent mobile knowledge carrier for realization of the mobile office. The issues about personalized information provision can be summarized as follows:

- Personal information extraction and analysis
- Accurately importing appropriate types and volume of business information or training documents to the PDA users (i.e., personalized services for PDA users)

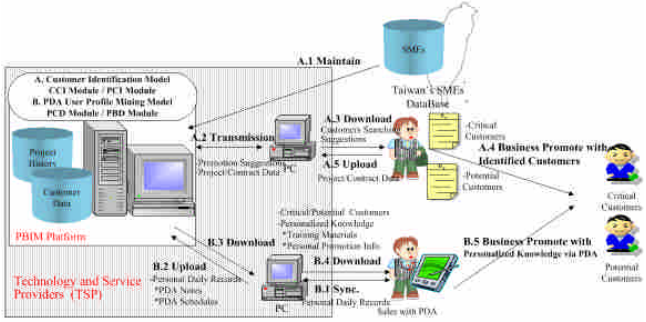

Fig. 1. The To-Be model for TSPs business promotion

Unlike the previous research that focuses mainly on personal customer mining or product sales, this paper applies the project history to explore critical customer profiles and applies the daily records to explore user requirements. As a result, via the automatically generated suggestions, the TSPs can reduce reliance on experienced salesmen for business promotion. The TO-BE model for business promotion of TSPs is depicted in Figure 1.

2. LITERATURE REVIEW

Based on the business operation background of TSPs, the PBIM model proposed in this paper consists of four typical issues including TSP technology transfer, customer searching and PDA application. The previous studies related to these three topics are reviewed in this section.

2.1 Technology Transfer of TSPs

In order to reduce R&D investments, most SMEs have to acquire innovative technologies from TSPs (e.g., private consultants or non-profit R&D organizations, etc.) to increase their competency in the market. Thus, the TSPs play a critical role for innovative technology provision and develop and transfer the advanced technologies to the enterprises to assist their customers to enhance their business operation performance (Buratti and Penco 2001). Bessant and Rush (1995) emphasizes the issues that should be considered for the TSPs to transfer their technologies. Asuka-Zhang (1999) figures out the customer requirements and the resources required for technology development and implementation are critical factors for successful technology transfer. The TSPs should explore the R&D energy, organization structure and operation strategies of the customers to effectively expand their technology transfer business (Tan, 1995). In addition, Radosevic (1999) indicates that allocation of the limited human resources and investments to the most appropriate technologies and customers is the another critical issue for technology transfer.

In addition to above critical factors for technology transfer, since the R&D technologies provided by academic organizations (e.g., the universities) can significantly improve the business operation efficiency of their customers, the applicability of academic R&D accomplishments in the real industry should be evaluated before technology implementation (Kingsley et al., 1996; Fujisue, 1998). On the other hand, for international non-profit organizations, previous studies regard that the different culture, language, technology applicability and technology development status, etc. of global customers are the key issues for worldwide technology transfer (King and Nowack, 2003; Bozeman, 2000; Liu and Jiang, 2001).

2.2 Customer Mining

Recently, most enterprises believe that their profits can only be increased by dedicating their limited resources (e.g., human resources and investments) to the customers with higher values (i.e., the critical customers). That is, the customers of low economic benefits (i.e., the non-critical customers) must be strategically ignored. Via the 80-20 principle (i.e., top 20% customers might induce 80% enterprise profits), the VIP customers can be identified based on customer transaction data in the credit card market (Chen, 2002) or cookies. In addition, Berry and Linoff (2000) also utilizes the 80-20 principle to classify the customer of high values based on the product transaction records in the retailers. Since the 80-20 principle is widely applied to identify the critical customers of organizations, Sherden (1994) points out that enterprises have to ignore the demands of non-critical customers (i.e., the low 30% customers; namely the 80-20-30 principle) in order to significantly reduce the costs of enterprises.

On the other hand, the RFM (i.e., Recency, Frequency and Monetary) approach can also be applied to identify the customers with higher profits to enterprises. Based on the

RFM concept, Macus (1998) develops an evaluation matrix for customer value analysis and derives the customer segments with higher profits. Hughes (1994) indicates that the RFM factors that denotes the customer business behaviors should be equally weighted. Therefore, the customers can be classified into five categories based on their RFM ranking. Besides, some studies focus on identifying the customer values for different markets. Garbarino and Johnson (1999) identify the critical customers of long-term relationship with theaters based on ticket ordering records. Therefore, the active marketing such as opera advertisement can be carried out for the critical customers.

2.3 Application of PDA

Development of the wireless network has facilitated application of PDA on information acquisition. As a result, the users can ubiquitously acquire information via their PDAs. Yuan and Tsao (2003) establish a mobile information publication server to provide customized advertisement to users with mobile phones or PDAs. In that research, a neural network methodology is used to learn and revise the user preferences in order to enhance the effectiveness of the published advertisement. Similarly, Yuan and Cheng (2004) apply a clustering algorithm to group customers and products and provide appropriate advertisement to mobile phones of customers based on the clustering results. In addition to commercial applications, the mobile devices have been used to realize distance learning and telemedicine (Elske, Anke, Bernd, & Reinhold, 2000).

3. PERSONAL BUSINESS INFORMATION MANAGEMENT MODEL

In order to assist the technology and service providers (TSPs) in efficiently promoting business, this research develops a personal business information management (PBIM) model for TSPs to identify critical customers and to provide personalized business information. In the proposed PBIM model, four critical issues including critical customer identification, potential customer identification, PDA user category determination and PDA user busy level determination are considered. Four heuristic modules, namely CCI, PCI, UCD and UBD modules, related to these issues are developed. The relationship between the four modules is depicted in Figure 2.

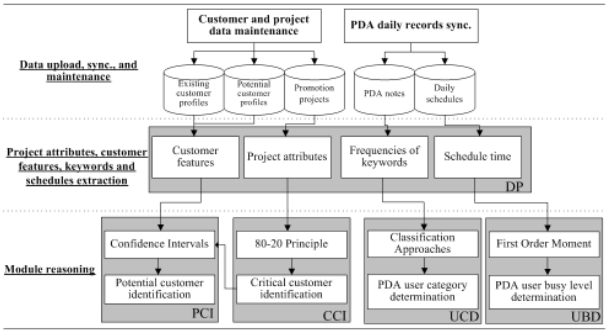

Fig. 2. Relationship between the four modules

Under the proposed PBIM architecture, the project history including project data and customer profiles can be maintained via the data maintenance module. Also, the PDA user's private information including notes and daily schedule can be maintained via synchronization procedure. After that, the data preprocessing (DP) module can determine the values of customer features, project attribute values, keyword frequencies of PDA notes and scheduling time of daily schedule.

In the CCI module, the 80-20 principle is applied to identify the critical customers. Based on distributed project attribute values over the project period, the customers with top 20% ranks can be regarded as the critical customers. Furthermore, by classifying the existing customers into critical and non-critical customers, the PCI module can filter out the key features of critical customers and estimate the confidence intervals of feature values. Finally, the estimated values of key features can be applied to identify the potential customers. In the UCD module, the correlation between the keywords and categories established by the domain experts or knowledge engineers is applied to determine PDA user category. Based on deriving the keyword frequencies in PDA notes, the correlation between the specified user and categories can be determined. Based on the schedule time of PDA user, the total busy time and variance of the free time are analyzed in the UBD module. Finally, a mapping table can be established to determine the occupancy scale of the specified user and suitable volume of knowledge documents can be provided to the PDA user.

By revising the algorithms proposed by Hou and Yang (2006) and Hou and Yang (2006), the CCI, PCI, UCD and UBD modules can be developed. Details of each decision module are described in the following.

3.1 Critical Customer Identification (CCI) Module

After deriving the distributed project attribute values via the DP module, the CCI module assigns the recent projects with higher weighting values. Furthermore, the 80-20 principle is applied to identify the critical customers with higher weighted project attribute values.

Concerning project history of each customer C_i, the project attribute D_j distributed over distinct time intervals (i.e., time period $[P_{t-1}, P_t]$) can be accumulated as. Here the time factor is concerned to accurately explore the importance of each customer. Therefore, the CCI module derives the weighted index value $C_i[D_j]$ via Equation (1). As shown in Equation (1), the index value $C_i[D_j]^t_{t-1}$ distributed over time interval $[P_{t-1}, P_t]$ is multiplied with a corresponding weighting value α^t_{t-1}. Finally, based on the results, the rank ($R[C_i,D_j]$) of each weighted index value can be obtained. As the time factor is introduced, the rank distribution of each customer C_i under index D_j can be tabulated in Table 1.

$$C_i[D_j] = \sum_{all\ t} C_i[D_j]^t_{t-1} \times \alpha^t_{t-1} \quad (1)$$

where α^t_{t-1} denotes the weighting value with respect to time period $[P_{t-1}, P_t]$.

Table 1. Ranks of customers for critical customer determination

Customers / Index	C_1	C_2	…	C_i	…
D_j	$R[C_1,D_j]$	$R[C_2,D_j]$	…	$R[C_i,D_j]$	…

As shown in Table 3.1, after deriving the ranking value $R[C_i,D_j]$ of each customer C_i under each performance index D_j, the customers with top 20% ranking are regarded as the critical customers (the 80-20 principle). In summary, the existing customers can be classified based on the performance indices of previous projects in order to identify the customers with long-term relationship (i.e., higher project duration) and promotion effectiveness (more budget allocated for projects).

3.2 Potential Customer Identification (PCI) Module

After classifying the existing customers into critical and non-critical customers, the PCI module can filter out the key features of critical customers and estimate the confidence intervals of feature values for critical customers. Finally, the estimated values of key features can be applied to identify the potential customers.

Based on the classification result of critical and non-critical customers, all the customer features are examined to figure out the key features for identifying critical customers. For each specific feature B_l, the gravity center of the critical customer cluster C' (i.e., the average of $B_l[C_i']$) can be derived. Similarly, the gravity center of the non-critical customer cluster can also be obtained. The distance between the gravity centers of the two categories (i.e., $W(B_l)$) and the feature deviation in critical customer cluster (i.e., $S(B_l[C'])$) can also be obtained. The ratio of above two coefficients (i.e., $CV(B_l)$) can be derived via Equation (2). According to the values of $CV(B_l)$, the customer features with top ranking are regarded as the key features for critical customer identification.

$$CV(B_l) = \left| \frac{W(B_l)}{S(B_l[C'])} \right| \tag{2}$$

After identifying the key features of critical customers, the (1-α)% confidence interval of each key feature B_k' for critical customers can be obtained via Equation (3) and can be regarded as an estimator for critical customers identification.

$$L\{C'[B_k']\} = AveC'[B_k'] - t_{\alpha/2,NC'-1} \cdot \frac{SeC'[B_k']}{\sqrt{NC'}}$$
$$U\{C'[B_k']\} = AveC'[B_k'] + t_{\alpha/2,NC'-1} \cdot \frac{SeC'[B_k']}{\sqrt{NC'}} \tag{3}$$

where $AveC'[B_k']$ and $SeC'[B_k']$ denote the average and the standard deviation of key feature B_k' for critical customers respectively and NC' denotes the total number of critical customers.

As the B_k value of a new customer falls in the (1-α)% confidence interval of key feature B_k', the new customer can be regarded as a potential customer; otherwise, the new customer is regarded as a non-critical customer. Based on the results derived via the PCI module, more business can be accurately outreached to potential customers by sales of TSPs.

3.3 PDA User Category Determination (UCD) Module

In UCD module, the personal information maintained in the PDAs of domain experts is regarded as the training documents for deriving the correlation between documents and categories. After deriving the frequencies of the keywords in the PDA notes via DP module, the correlation between the specified user and categories can be determined.

That is, after deriving the keyword (KW_i) frequencies $N(KW_i,ND_j)$ of the PDA notes (ND_j) via the DP module, UCD could at first determine the relation between specified PDA user (U_T) and categories (G_k.) based on the correlation between keywords and categories established by the domain experts or knowledge engineers.

According to the keyword–category relationship ($R(KW_i,G_k)$) established by the domain experts or knowledge engineers and keyword frequencies ($N(KW_i,ND_j)$) derived in DP module, UCM could determine the correlation $W_k'[U_T]$ of specified user (U_T) and categories (G_k.) via Equation (4). Since sum of the derived correlation coefficients between specified PDA user (U_T) and categories (G_k.) not equals to 1 (i.e., $\sum_{all\ k} W_k'[U_T] \neq 1$), The derived relationship $W_k'[U_T]$ can be normalized via Equation (5) to indicate the normalized correlation ($W_k[U_T]$) of specified user (U_T) and categories (G_k.) Furthermore, the correlation can be summarized in Table 2.

$$W_k'[U_T] = \frac{\sum_{all\ i,j} R(KW_i,G_k) \cdot N(KW_i,ND_j)}{\sum_{all\ i,j} N(KW_i,ND_j)} \tag{4}$$

$$W_k[U_T] = \frac{W_k'[U_T]}{\sum_{all\ k} W_k'[U_T]} \tag{5}$$

Based on the UCD module, the user's categories or interests can be determined and the knowledge center can automatically import appropriate knowledge documents that meet the user characteristics and requirements to each user (i.e., personalized services).

Table 2. Normalized correlation of users and categories

Categories / Users	U_1	U_2	……	U_T	……
G_1	$W_1[U_1]$	$W_1[U_2]$	……	$W_1[U_T]$	……
……	……	……	……	……	……
G_k	$W_k[U_1]$	$W_k[U_2]$	……	$W_k[U_T]$	……
……	……	……	……	……	……

3.4 PDA User Busy Level Determination (UBD) Module

In UBD module, the total busy time and variance of free time of specified user are analyzed. The higher total busy

time means that the specified user has less time to browse the documents provided by the knowledge center. Similarly, if the free time is allocated at different periods, the specified user has less flexibility to take advantage of the provided documents. That is, for a busier user (with a higher busy time and a less flexibility time), only documents of higher correlation with the specified user are provided to the user at the synchronization process.

In UBD module, the schedule time of specified user (U_T) can be extracted via DP module. After that, total busy time ($T[U_T]$) and variance of free time $\delta[U_T]$ of specified user (U_T) can be respectively computed in UBD module via Equation (6) and Equation (7). Based on the results, the rank value ($R\{T[U_T]\}$) of total busy time of specified user among all users can be derived according to descending busy time. Similarly, the rank values ($R\{\delta[U_T]\}$) of variance free time also can be determined according to ascending variance free time among all users. The derived ranking values (i.e., $R\{T[U_T]\}$ and $R\{\delta[U_T]\}$) of specified user (U_T) are respectively multiplied with corresponding weighting values (W_T and W_δ) via Equation (8) for regarding as the busy scale ($B[U_T]$) of specified user.

Therefore, a mapping table for user category (or occupancy scale) determination ($R\{B[U_i]\}$) can be established (as shown in Table 3) via ranking busy scale $B[U_i]$. In this table, the users with smaller ranks are regarded as busier users with less time to browse the imported documents in their PDA.

$$T[U_T] = \sum_{all\ i} E_i[U_T] \text{ where } E_i[U_T] \text{ denote the ith busy time} \quad (6)$$

$$\delta[U_T] = \frac{\sum_{all\ i}(EI_i[U_T] - Ave(EI[U_T]))^2}{n(EI[U_T]) - 1}, \text{ where } Ave(EI[U_T]) = \frac{\sum_{all\ i} EI_i[U_T]}{n(EI[U_T])} \quad (7)$$

$EI_i[U_T]$ denote free time between the (i - 1)th and ith busy period

$$B[U_T] = R\{T[U_T]\} * W_T + R\{\delta[U_T]\} * W_\delta \text{ where } W_T + W_\delta = 1 \quad (8)$$

Table 3. Busy mapping table

Users / Ranks	U_1	U_2	…	U_T	…
$B[U_i]$	$R\{B[U_1]\}$	$R\{B[U_2]\}$	…	$R\{B[U_T]\}$	

As a whole, in the UBD module, the user occupancy scales can be determined based on their daily schedule. According to the occupancy scale, the knowledge center can automatically provide appropriate volume of knowledge to the PDA users to prevent knowledge overloading.

4. PERSONAL BUSINESS INFORMATION MANAGEMENT (PBIM) PLATFORM

In order to demonstrate feasibility of the modules proposed in previous section, a Web-based personal business information management (PBIM) platform is developed in this research. Under the PBIM platform, the project history and personal daily records could be maintained and the user authorities are properly managed. Also, the business suggestions including critical/potential customers and personalized knowledge documents can be accurately provided to the TSP staff.

The information that is systematically processed by the PBIM platform includes the user data (e.g., the user profiles), project history (e.g., the project data and customer profiles), PDA user daily records (e.g., notes and daily schedule) and business promotion suggestions (e.g., critical/potential customers and personalized business information). Based on the user login information, the PBIM platform recognizes the user category (e.g., common user, salesman or system administrator) and provides the corresponding functions to the user. Under the PBIM platform, the common user can provide and access all project history including project data (Figure 3) and customer profiles to increase the data volume for business analysis and to improve the reasoning performance of CCI and PCI modules. Also, the common user can import knowledge documents and training materials to increase the volume of personalized business information for salesmen.

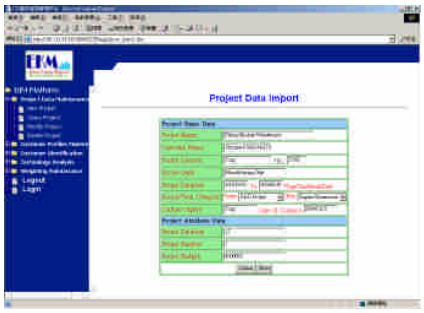

Fig. 3. Project data maintenance

For the salesman, in addition to importing and accessing project history, the salesmen also can derive the critical and potential customer suggestions (Figure 4) under the PBIM platform. Furthermore, the salesman also can generate distinct customer searching suggestions by setting different attribute weighting values (Figure 5) or feature weighting value based on their experience.

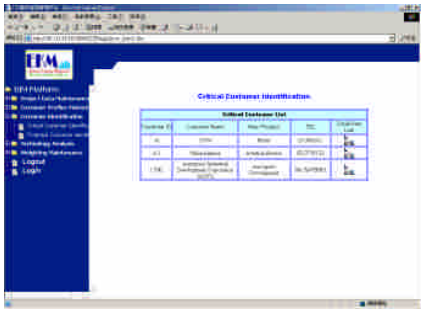

Fig. 4. Results of critical customer identification

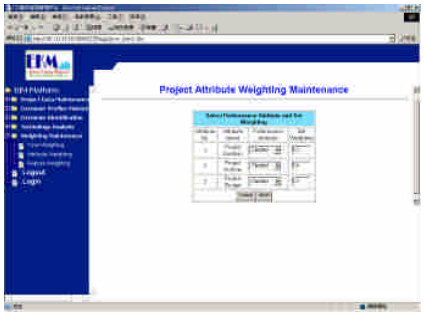

Fig. 5. Maintenance of project attribute weighting

Besides, the salesmen with PDA (PDA users) can update the latest domain knowledge (i.e. personalized business information) onto their PDAs (Figure 6) and the daily records can be synchronized to PBIM platform for exploring the user profiles (i.e., UCD and UBD modules). That is, the PBIM platform provides PDA user with the personal profile analysis and provision functions. With the personalized services, the members can efficiently acquire the latest news meeting salesmen interests. Finally, the system administrator can flexibly manage the user authority via the user administration function.

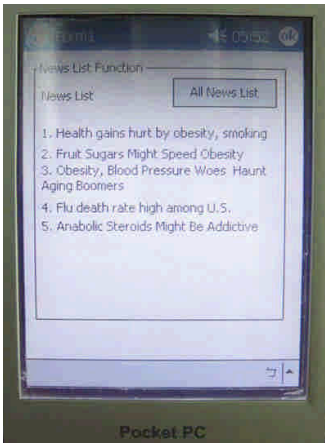

Fig. 6. Personalized business information displayed via PDA

5. CONCLUSIONS

Concerning the operation characteristics of the TSPs, this paper develops a personal business information management model with CCI, PCI, UCD and UBD modules for TSPs to identify the potential customers and provide personalized knowledge. Based on performance of the previous projects, the existing customers are classified into critical and non-critical customers via the 80-20 principle in the CCI module. After classifying the existing customers into critical and non-critical customers, the PCI module can filter out the key features and the corresponding confidence intervals to identify the potential customers. In addition, in order to increase the efficiency of business promotion. This research develops a PDA user mining model (i.e., UCD and UBD modules) on the basis of the user information (i.e., notes and daily schedule) stored in the fundamental PDA functions. Furthermore, according to the user profile, a mobile knowledge management center is established to silently provide knowledge that meets user demands and availability during the PDA synchronization process. A non-profit R&D center is used to validate feasibility of the proposed modules. This paper presents a feasible approach for the TSPs to analyze the project history and to explore user profile for provision of the personalized business promotion suggestions.

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出席國際會議報告

98 年 6 月 16 日

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會議名稱	The 13th IFAC Symposium on Information Control Problems in Manufacturing		
發表論文題目	A BUSINESS MODEL FOR POTENTIAL CUSTOMERS IDENTIFICATION AND PERSONALIZED KNOWLEDGE PROVISION OF TSPS		

一、參加會議經過

此次 IFAC 研討會乃安排於俄羅斯（Russia）之莫斯科（Moscow）城市舉辦，配合研討會主辦單位之行程規劃與可行機位安排，個人於 5/30 上午即出發前往桃園國際機場，進行登記作業並前往首爾之仁川國際機場，抵達後轉機續飛往佔全球陸地總面積六分之一的俄羅斯，班機於晚上抵達俄羅斯富有北歐文化特色，具「北方威尼斯」之稱「聖彼得堡」，雖然俄羅斯慢台灣四小時（時差），而到聖彼得堡已經晚上 10：00 了（即台灣凌晨兩點），故辦理入境手續後搭車前往飯店休息。隔天 5/31 至 6/1 個人於聖彼得堡參觀「彼得夏宮－冬宮」（隱士盧博物館）、「凱薩琳宮」（琥珀廳）及「彼得保羅要塞」等觀光景點，並於 6/2 搭俄羅斯國內班機至俄羅斯首都「莫斯科」，先行辦理入境手續後並搭車前往飯店，之後乃參觀飯店周圍之景點，如宗教勝地謝爾蓋城「扎戈爾斯克」等地。

大會正式行程日期為 6/3~6/5 三日，正式發表日期亦為 6/3~6/5 三日。當中個人乃於 6/3 上午九點已至會場，並完成報到手續（如圖 1 及圖 2 所示）。本次研討會內容乃安排與此次會議主題相關之製造業資訊控制專題演講與論文發表，再依不同論文主題每天分多個時段 7 個或 8 個平行 Session 進行發表，並分數個 Poster Session 使各位學者可針對相關主題進行學術交流。個人的論文被安排於第一天（6/3）的晚上場次（編號 We-C6.5 Session）「Enterprise Modelling for Interoperability in Collaborative Networked Enterprise」發表，於發表後其他學者亦表示對此研究的高度興趣，詢問本研究之客户分群方法論細節與行動商務技術的方法，個人並作完整回答，互動甚佳。此外個人亦參加多場與研究興趣較相關之發表場次，並對於其他學者發表內容提出詢問，對於網路企業流程、行動商務等課題觸發新的研究靈感（如圖 3 及圖 4 所示）。

除會議發表時間外，在其他交流活動時，個人與國際/國內學者亦有良好交流（如清華大學工工系蘇朝墩教授、侯建良教授、中原大學工工系陳建良教授、義守大學工工系江育民教授、大葉大學工工系陳偉星教授、余豐榮教授、朝陽科大資管系陳隆昇教授等人），因此瞭解許多國際/國內工業工程、資訊管理學者之研究方向，並規劃未來合作之可能作法，收穫極大。此外，藉由大會安排之晚宴與表演活動（參見圖 5 及圖 6），深刻感受到俄羅斯人的民族性，友善、溫和、快樂的民風讓人印象深刻。

圖 1、抵達 IFAC 會場(1)

圖 2、抵達 IFAC 會場(2)

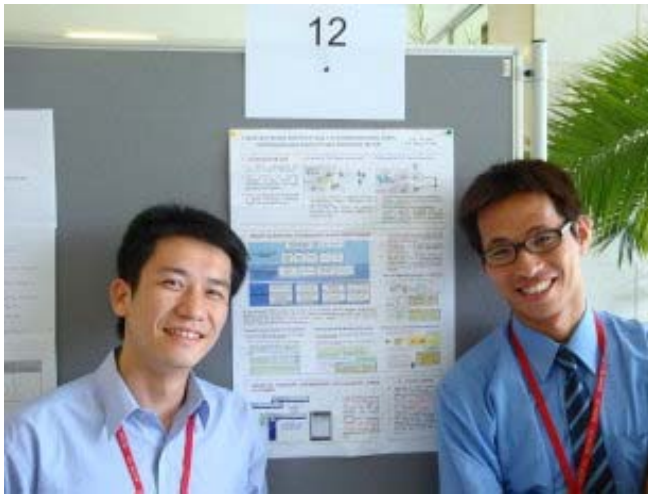

圖 3、IFAC 會場研討(1)

圖 4、IFAC 會場研討(2)

圖 5、IFAC 晚宴(1)

圖 6、IFAC 晚宴(2)

待研討會圓滿結束後（6/5），個人乃搭車前往機場並搭機飛返韓國首爾「仁川機場」（班機於 6/6 上午飛抵仁川機場），隨即轉機返回桃園國際機場（班機於 6/6 下午兩點半飛抵桃園國際機場），結束此次 IFAC 學術研討活動。

三、建議

此次會議中的各項活動安排都可發現主辦單位頗為用心，對於遠道造訪之學者給予多項貼心之服務，為國內學校爭取主辦國際型研討會可加以參考之長處。整體而言，本次大會舉辦頗為用心，個人於此行收穫豐富，且結識多位國際學者，希望能於未來建立更長遠的交流與合作。

四、攜回資料名稱及內容

1. 研討會論文集：含議程集 1 本、論文摘要集 1 本、論文集（評選為優秀論文）1 本，研討會光碟 1 片。
2. 國內外學者學術交流名片。

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A Business Model for Potential Customers Identification and Personalized Knowledge Provision of TSPs

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Abstract: Recently, enterprises have faced the pressure of industry transformation and high competency in the global market. In Taiwan, most small and medium sized enterprises (SMEs) cannot afford advanced R&D. In order to increase competency of SMEs, the technology and service providers (TSPs) play a critical role for innovative technology provision. Traditionally, the salesmen of TSPs have to evaluate the critical customers via trials and errors. In addition, although the personal digital assistant (PDA) has been widely used to promote business for its high mobility, the business information downloaded into PDA is actually rarely concerned. In order to increase efficiency and effectiveness of business promotion, this paper focuses on the development of a personal business information management (PBIM) model with four modules namely critical customer identification (CCI), potential customer identification (PCI), PDA user category determination (UCD) and PDA user busy level determination (UBD) for TSPs to identify potential customers and to provide personalized business information. A non-profit R&D institute in Taiwan is used to validate feasibility of the proposed modules via the developed PBIM platform. This paper presents a feasible PBIM approach for the TSPs to efficiently and systematically analyze the project history and PDA daily records for business outreach.

Keywords: Medium Sized Enterprises (SMEs), Technology and Service Providers (TSPs), Data Mining, Customer Relationship Management (CRM), PDA

1. INTRODUCTION

Owning to high variety of industry development, the technology and service providers (TSPs) including the private consultants or non-profit R&D organizations are dedicated to development of applied technologies in order to assist the small and medium sized enterprises (SMEs) to successfully implement advanced technologies that meet the their operation requirements. However, the technology development demands cannot be dominant simply by a limited number of organizations; thus, the TSPs require useful suggestions about technology development and potential customers. Traditionally, the critical and potential customers are evaluated via trials and errors of salesmen. Under the circumstance, several operation pitfalls (e.g., a lot of time and human efforts required, etc.) might occur. Therefore, this paper focuses on development of a customer identification model for TSPs to identify the critical and potential customers.

In order to increase efficiency of business promotion, the personal digital assistant (PDA) has been widely used as the carrier for personal memos and daily records for its high mobility. In addition, the business information can be synchronized with the user data stored in the PDAs. That is, the PDA has become a powerful and convenient carrier of personal data and business information storage to promote business. However, as a result of overloading data, the salesmen and employees still have to search the business information or training materials to fit their requirements from PDAs. Concerning importance of the personal information (including notes and daily schedule) stored in a PDA, this paper develops a user profile mining approach to explore PDA user's interests for personalized business information provision. As a whole, the objective of this paper is to integrate the PDA information mining and knowledge management methodologies to assist establishment of a mobile office environment.

To sum up, based on the operation characteristics of TSPs, the existing issues of TSPs can be summarized as follows:

- No objective references or guidelines exist for critical/potential customer identification and business promotion.
- The personal daily records and business information are not effectively applied for business promotion.

Since many efforts have to be devoted to business searching, consistency and accuracy of marketing decisions cannot be guaranteed. This research develops critical customer identification (CCI) and potential customer identification (PCI) modules to identify critical and potential customers to seize the business opportunities. Unlike the previous research that focuses mainly on personal customer mining or product sales, this paper applies the project history to explore the profiles of critical clients. That is, the existing customers of a TSP are classified into critical and non-critical customers. Based on the distributions of

distinct attributes of critical customers, representative features of critical customers can be extracted and the features can then be utilized to identify the potential customers. The issues about customer searching of TSPs can be summarized as follows:

- Systematical classification of existing customers
- Objective references or guidelines for potential customer identification

Taking advantage of the personal information, the user requirements for knowledge can be determined. This research develops PDA user category determination (UCD) and PDA user busy level determination (UBD) modules to explore user profiles and provide personalized business information (i.e., appropriate types and volume of knowledge documents). That is, this research presents an intelligent KM scheme by integrating the PDA information (including notes and daily schedule) mining model and mobile knowledge management mechanism. Based on the user profile mining technique, the PDA-ready knowledge that fits user requirements can be imported from the knowledge server to the client PDA. By application of the mobile KM technique, the organization knowledge can be seamlessly provided to the PDA user via the data synchronization process. The attempt of this paper is to present an applicable and intelligent mobile knowledge carrier for realization of the mobile office. The issues about personalized information provision can be summarized as follows:

- Personal information extraction and analysis
- Accurately importing appropriate types and volume of business information or training documents to the PDA users (i.e., personalized services for PDA users)

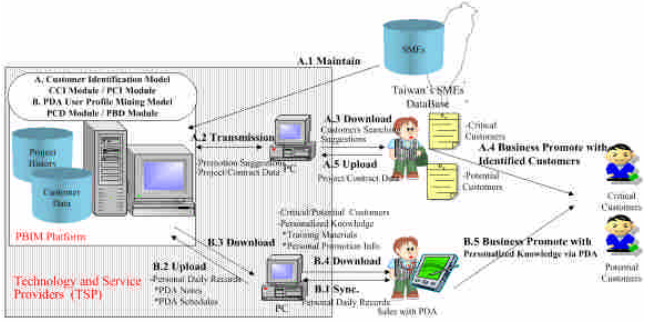

Fig. 1. The To-Be model for TSPs business promotion

Unlike the previous research that focuses mainly on personal customer mining or product sales, this paper applies the project history to explore critical customer profiles and applies the daily records to explore user requirements. As a result, via the automatically generated suggestions, the TSPs can reduce reliance on experienced salesmen for business promotion. The TO-BE model for business promotion of TSPs is depicted in Figure 1.

2. LITERATURE REVIEW

Based on the business operation background of TSPs, the PBIM model proposed in this paper consists of four typical issues including TSP technology transfer, customer searching and PDA application. The previous studies related to these three topics are reviewed in this section.

2.1 Technology Transfer of TSPs

In order to reduce R&D investments, most SMEs have to acquire innovative technologies from TSPs (e.g., private consultants or non-profit R&D organizations, etc.) to increase their competency in the market. Thus, the TSPs play a critical role for innovative technology provision and develop and transfer the advanced technologies to the enterprises to assist their customers to enhance their business operation performance (Buratti and Penco 2001). Bessant and Rush (1995) emphasizes the issues that should be considered for the TSPs to transfer their technologies. Asuka-Zhang (1999) figures out the customer requirements and the resources required for technology development and implementation are critical factors for successful technology transfer. The TSPs should explore the R&D energy, organization structure and operation strategies of the customers to effectively expand their technology transfer business (Tan, 1995). In addition, Radosevic (1999) indicates that allocation of the limited human resources and investments to the most appropriate technologies and customers is the another critical issue for technology transfer.

In addition to above critical factors for technology transfer, since the R&D technologies provided by academic organizations (e.g., the universities) can significantly improve the business operation efficiency of their customers, the applicability of academic R&D accomplishments in the real industry should be evaluated before technology implementation (Kingsley et al., 1996; Fujisue, 1998). On the other hand, for international non-profit organizations, previous studies regard that the different culture, language, technology applicability and technology development status, etc. of global customers are the key issues for worldwide technology transfer (King and Nowack, 2003; Bozeman, 2000; Liu and Jiang, 2001).

2.2 Customer Mining

Recently, most enterprises believe that their profits can only be increased by dedicating their limited resources (e.g., human resources and investments) to the customers with higher values (i.e., the critical customers). That is, the customers of low economic benefits (i.e., the non-critical customers) must be strategically ignored. Via the 80-20 principle (i.e., top 20% customers might induce 80% enterprise profits), the VIP customers can be identified based on customer transaction data in the credit card market (Chen, 2002) or cookies. In addition, Berry and Linoff (2000) also utilizes the 80-20 principle to classify the customer of high values based on the product transaction records in the retailers. Since the 80-20 principle is widely applied to identify the critical customers of organizations, Sherden (1994) points out that enterprises have to ignore the demands of non-critical customers (i.e., the low 30% customers; namely the 80-20-30 principle) in order to significantly reduce the costs of enterprises.

On the other hand, the RFM (i.e., Recency, Frequency and Monetary) approach can also be applied to identify the customers with higher profits to enterprises. Based on the

RFM concept, Macus (1998) develops an evaluation matrix for customer value analysis and derives the customer segments with higher profits. Hughes (1994) indicates that the RFM factors that denotes the customer business behaviors should be equally weighted. Therefore, the customers can be classified into five categories based on their RFM ranking. Besides, some studies focus on identifying the customer values for different markets. Garbarino and Johnson (1999) identify the critical customers of long-term relationship with theaters based on ticket ordering records. Therefore, the active marketing such as opera advertisement can be carried out for the critical customers.

2.3 Application of PDA

Development of the wireless network has facilitated application of PDA on information acquisition. As a result, the users can ubiquitously acquire information via their PDAs. Yuan and Tsao (2003) establish a mobile information publication server to provide customized advertisement to users with mobile phones or PDAs. In that research, a neural network methodology is used to learn and revise the user preferences in order to enhance the effectiveness of the published advertisement. Similarly, Yuan and Cheng (2004) apply a clustering algorithm to group customers and products and provide appropriate advertisement to mobile phones of customers based on the clustering results. In addition to commercial applications, the mobile devices have been used to realize distance learning and telemedicine (Elske, Anke, Bernd, & Reinhold, 2000).

3. PERSONAL BUSINESS INFORMATION MANAGEMENT MODEL

In order to assist the technology and service providers (TSPs) in efficiently promoting business, this research develops a personal business information management (PBIM) model for TSPs to identify critical customers and to provide personalized business information. In the proposed PBIM model, four critical issues including critical customer identification, potential customer identification, PDA user category determination and PDA user busy level determination are considered. Four heuristic modules, namely CCI, PCI, UCD and UBD modules, related to these issues are developed. The relationship between the four modules is depicted in Figure 2.

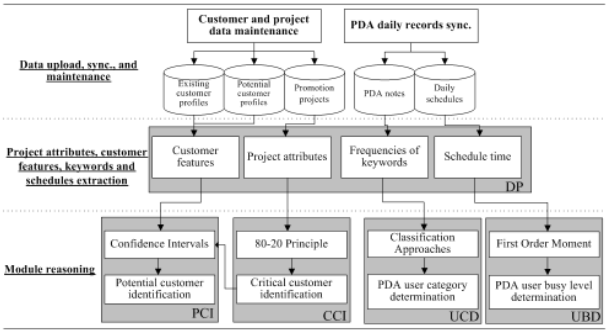

Fig. 2. Relationship between the four modules

Under the proposed PBIM architecture, the project history including project data and customer profiles can be maintained via the data maintenance module. Also, the PDA user's private information including notes and daily schedule can be maintained via synchronization procedure. After that, the data preprocessing (DP) module can determine the values of customer features, project attribute values, keyword frequencies of PDA notes and scheduling time of daily schedule.

In the CCI module, the 80-20 principle is applied to identify the critical customers. Based on distributed project attribute values over the project period, the customers with top 20% ranks can be regarded as the critical customers. Furthermore, by classifying the existing customers into critical and non-critical customers, the PCI module can filter out the key features of critical customers and estimate the confidence intervals of feature values. Finally, the estimated values of key features can be applied to identify the potential customers. In the UCD module, the correlation between the keywords and categories established by the domain experts or knowledge engineers is applied to determine PDA user category. Based on deriving the keyword frequencies in PDA notes, the correlation between the specified user and categories can be determined. Based on the schedule time of PDA user, the total busy time and variance of the free time are analyzed in the UBD module. Finally, a mapping table can be established to determine the occupancy scale of the specified user and suitable volume of knowledge documents can be provided to the PDA user.

By revising the algorithms proposed by Hou and Yang (2006) and Hou and Yang (2006), the CCI, PCI, UCD and UBD modules can be developed. Details of each decision module are described in the following.

3.1 Critical Customer Identification (CCI) Module

After deriving the distributed project attribute values via the DP module, the CCI module assigns the recent projects with higher weighting values. Furthermore, the 80-20 principle is applied to identify the critical customers with higher weighted project attribute values.

Concerning project history of each customer C_i, the project attribute D_j distributed over distinct time intervals (i.e., time period $[P_{t-1}, P_t]$) can be accumulated as. Here the time factor is concerned to accurately explore the importance of each customer. Therefore, the CCI module derives the weighted index value $C_i[D_j]$ via Equation (1). As shown in Equation (1), the index value $C_i[D_j]^t_{t-1}$ distributed over time interval $[P_{t-1}, P_t]$ is multiplied with a corresponding weighting value α^t_{t-1}. Finally, based on the results, the rank ($R[C_i,D_j]$) of each weighted index value can be obtained. As the time factor is introduced, the rank distribution of each customer C_i under index D_j can be tabulated in Table 1.

$$C_i[D_j] = \sum_{all\ t} C_i[D_j]^t_{t-1} \times \alpha^t_{t-1} \quad (1)$$

where α^t_{t-1} denotes the weighting value with respect to time period $[P_{t-1}, P_t]$.

Table 1. Ranks of customers for critical customer determination

Customers / Index	C_1	C_2	…	C_i	…
D_j	$R[C_1,D_j]$	$R[C_2,D_j]$	…	$R[C_i,D_j]$	…

As shown in Table 3.1, after deriving the ranking value $R[C_i,D_j]$ of each customer C_i under each performance index D_j, the customers with top 20% ranking are regarded as the critical customers (the 80-20 principle). In summary, the existing customers can be classified based on the performance indices of previous projects in order to identify the customers with long-term relationship (i.e., higher project duration) and promotion effectiveness (more budget allocated for projects).

3.2 Potential Customer Identification (PCI) Module

After classifying the existing customers into critical and non-critical customers, the PCI module can filter out the key features of critical customers and estimate the confidence intervals of feature values for critical customers. Finally, the estimated values of key features can be applied to identify the potential customers.

Based on the classification result of critical and non-critical customers, all the customer features are examined to figure out the key features for identifying critical customers. For each specific feature B_l, the gravity center of the critical customer cluster C' (i.e., the average of $B_l[C_i']$) can be derived. Similarly, the gravity center of the non-critical customer cluster can also be obtained. The distance between the gravity centers of the two categories (i.e., $W(B_l)$) and the feature deviation in critical customer cluster (i.e., $S(B_l[C'])$) can also be obtained. The ratio of above two coefficients (i.e., $CV(B_l)$) can be derived via Equation (2). According to the values of $CV(B_l)$, the customer features with top ranking are regarded as the key features for critical customer identification.

$$CV(B_l) = \left| \frac{W(B_l)}{S(B_l[C'])} \right| \tag{2}$$

After identifying the key features of critical customers, the (1-α)% confidence interval of each key feature B_k' for critical customers can be obtained via Equation (3) and can be regarded as an estimator for critical customers identification.

$$L\{C'[B_k']\} = AveC'[B_k'] - t_{\alpha/2,NC'-1} \cdot \frac{SeC'[B_k']}{\sqrt{NC'}}$$
$$U\{C'[B_k']\} = AveC'[B_k'] + t_{\alpha/2,NC'-1} \cdot \frac{SeC'[B_k']}{\sqrt{NC'}} \tag{3}$$

where $AveC'[B_k']$ and $SeC'[B_k']$ denote the average and the standard deviation of key feature B_k' for critical customers respectively and NC' denotes the total number of critical customers.

As the B_k value of a new customer falls in the (1-α)% confidence interval of key feature B_k', the new customer can be regarded as a potential customer; otherwise, the new customer is regarded as a non-critical customer. Based on the results derived via the PCI module, more business can be accurately outreached to potential customers by sales of TSPs.

3.3 PDA User Category Determination (UCD) Module

In UCD module, the personal information maintained in the PDAs of domain experts is regarded as the training documents for deriving the correlation between documents and categories. After deriving the frequencies of the keywords in the PDA notes via DP module, the correlation between the specified user and categories can be determined.

That is, after deriving the keyword (KW_i) frequencies $N(KW_i,ND_j)$ of the PDA notes (ND_j) via the DP module, UCD could at first determine the relation between specified PDA user (U_T) and categories (G_k.) based on the correlation between keywords and categories established by the domain experts or knowledge engineers.

According to the keyword–category relationship ($R(KW_i,G_k)$) established by the domain experts or knowledge engineers and keyword frequencies ($N(KW_i,ND_j)$) derived in DP module, UCM could determine the correlation $W_k'[U_T]$ of specified user (U_T) and categories (G_k.) via Equation (4). Since sum of the derived correlation coefficients between specified PDA user (U_T) and categories (G_k.) not equals to 1 (i.e., $\sum_{all\ k} W_k'[U_T] \neq 1$), The derived relationship $W_k'[U_T]$ can be normalized via Equation (5) to indicate the normalized correlation ($W_k[U_T]$) of specified user (U_T) and categories (G_k.) Furthermore, the correlation can be summarized in Table 2.

$$W_k'[U_T] = \frac{\sum_{all\ i,j} R(KW_i,G_k) \cdot N(KW_i,ND_j)}{\sum_{all\ i,j} N(KW_i,ND_j)} \tag{4}$$

$$W_k[U_T] = \frac{W_k'[U_T]}{\sum_{all\ k} W_k'[U_T]} \tag{5}$$

Based on the UCD module, the user's categories or interests can be determined and the knowledge center can automatically import appropriate knowledge documents that meet the user characteristics and requirements to each user (i.e., personalized services).

Table 2. Normalized correlation of users and categories

Categories / Users	U_1	U_2	……	U_T	……
G_1	$W_1[U_1]$	$W_1[U_2]$	……	$W_1[U_T]$	……
……	……	……	……	……	……
G_k	$W_k[U_1]$	$W_k[U_2]$	……	$W_k[U_T]$	……
……	……	……	……	……	……

3.4 PDA User Busy Level Determination (UBD) Module

In UBD module, the total busy time and variance of free time of specified user are analyzed. The higher total busy

time means that the specified user has less time to browse the documents provided by the knowledge center. Similarly, if the free time is allocated at different periods, the specified user has less flexibility to take advantage of the provided documents. That is, for a busier user (with a higher busy time and a less flexibility time), only documents of higher correlation with the specified user are provided to the user at the synchronization process.

In UBD module, the schedule time of specified user (U_T) can be extracted via DP module. After that, total busy time ($T[U_T]$) and variance of free time $\delta[U_T]$ of specified user (U_T) can be respectively computed in UBD module via Equation (6) and Equation (7). Based on the results, the rank value ($R\{T[U_T]\}$) of total busy time of specified user among all users can be derived according to descending busy time. Similarly, the rank values ($R\{\delta[U_T]\}$) of variance free time also can be determined according to ascending variance free time among all users. The derived ranking values (i.e., $R\{T[U_T]\}$ and $R\{\delta[U_T]\}$) of specified user (U_T) are respectively multiplied with corresponding weighting values (W_T and W_δ) via Equation (8) for regarding as the busy scale ($B[U_T]$) of specified user.

Therefore, a mapping table for user category (or occupancy scale) determination ($R\{B[U_i]\}$) can be established (as shown in Table 3) via ranking busy scale $B[U_i]$. In this table, the users with smaller ranks are regarded as busier users with less time to browse the imported documents in their PDA.

$$T[U_T] = \sum_{all\ i} E_i[U_T] \text{ where } E_i[U_T] \text{ denote the ith busy time} \quad (6)$$

$$\delta[U_T] = \frac{\sum_{all\ i}(EI_i[U_T] - Ave(EI[U_T]))^2}{n(EI[U_T]) - 1}, \text{ where } Ave(EI[U_T]) = \frac{\sum_{all\ i} EI_i[U_T]}{n(EI[U_T])} \quad (7)$$

$EI_i[U_T]$ denote free time between the (i - 1)th and ith busy period

$$B[U_T] = R\{T[U_T]\} * W_T + R\{\delta[U_T]\} * W_\delta \text{ where } W_T + W_\delta = 1 \quad (8)$$

Table 3. Busy mapping table

Users / Ranks	U_1	U_2	…	U_T	…
$B[U_i]$	$R\{B[U_1]\}$	$R\{B[U_2]\}$	…	$R\{B[U_T]\}$	

As a whole, in the UBD module, the user occupancy scales can be determined based on their daily schedule. According to the occupancy scale, the knowledge center can automatically provide appropriate volume of knowledge to the PDA users to prevent knowledge overloading.

4. PERSONAL BUSINESS INFORMATION MANAGEMENT (PBIM) PLATFORM

In order to demonstrate feasibility of the modules proposed in previous section, a Web-based personal business information management (PBIM) platform is developed in this research. Under the PBIM platform, the project history and personal daily records could be maintained and the user authorities are properly managed. Also, the business suggestions including critical/potential customers and personalized knowledge documents can be accurately provided to the TSP staff.

The information that is systematically processed by the PBIM platform includes the user data (e.g., the user profiles), project history (e.g., the project data and customer profiles), PDA user daily records (e.g., notes and daily schedule) and business promotion suggestions (e.g., critical/potential customers and personalized business information). Based on the user login information, the PBIM platform recognizes the user category (e.g., common user, salesman or system administrator) and provides the corresponding functions to the user. Under the PBIM platform, the common user can provide and access all project history including project data (Figure 3) and customer profiles to increase the data volume for business analysis and to improve the reasoning performance of CCI and PCI modules. Also, the common user can import knowledge documents and training materials to increase the volume of personalized business information for salesmen.

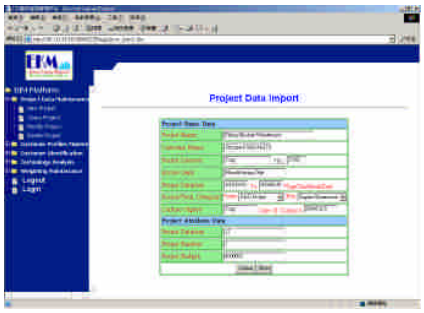

Fig. 3. Project data maintenance

For the salesman, in addition to importing and accessing project history, the salesmen also can derive the critical and potential customer suggestions (Figure 4) under the PBIM platform. Furthermore, the salesman also can generate distinct customer searching suggestions by setting different attribute weighting values (Figure 5) or feature weighting value based on their experience.

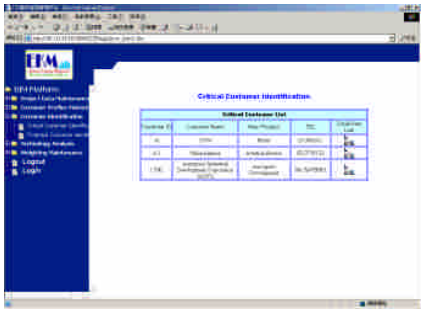

Fig. 4. Results of critical customer identification

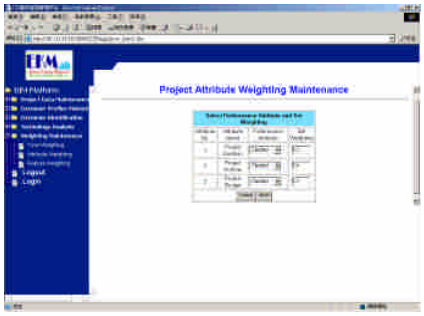

Fig. 5. Maintenance of project attribute weighting

Besides, the salesmen with PDA (PDA users) can update the latest domain knowledge (i.e. personalized business information) onto their PDAs (Figure 6) and the daily records can be synchronized to PBIM platform for exploring the user profiles (i.e., UCD and UBD modules). That is, the PBIM platform provides PDA user with the personal profile analysis and provision functions. With the personalized services, the members can efficiently acquire the latest news meeting salesmen interests. Finally, the system administrator can flexibly manage the user authority via the user administration function.

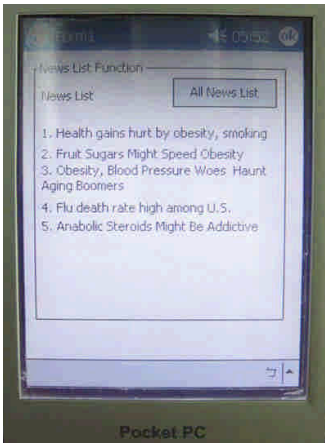

Fig. 6. Personalized business information displayed via PDA

5. CONCLUSIONS

Concerning the operation characteristics of the TSPs, this paper develops a personal business information management model with CCI, PCI, UCD and UBD modules for TSPs to identify the potential customers and provide personalized knowledge. Based on performance of the previous projects, the existing customers are classified into critical and non-critical customers via the 80-20 principle in the CCI module. After classifying the existing customers into critical and non-critical customers, the PCI module can filter out the key features and the corresponding confidence intervals to identify the potential customers. In addition, in order to increase the efficiency of business promotion. This research develops a PDA user mining model (i.e., UCD and UBD modules) on the basis of the user information (i.e., notes and daily schedule) stored in the fundamental PDA functions. Furthermore, according to the user profile, a mobile knowledge management center is established to silently provide knowledge that meets user demands and availability during the PDA synchronization process. A non-profit R&D center is used to validate feasibility of the proposed modules. This paper presents a feasible approach for the TSPs to analyze the project history and to explore user profile for provision of the personalized business promotion suggestions.

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