

The Application of the Complementarity Concept in the Management of IT Capital: Learning from Cases of CRM Systems

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Abstract

The intangible value of information technology (IT) has triggered researchers' and managers' interests in the knowledge-based economy. It has been increasingly emphasized that firms' IT capital is one of the key determinants of business competitiveness and sustainability. IT capital has usually been hidden in the structural capital as an indicator of either IT investment or the operational performance. There are a number of theoretical arguments about the infrastructural role of a firm's IT capital but limited understanding of how this kind of intellectual capital should be managed in a business environment in which complex resources interplay. Applying the complementarity concept, this study highlights the importance of the management of resource complementarity with IT capital in order to deliver sustainable competitiveness. Through multiple case studies of customer relationship management (CRM) systems management in five financial organizations, we analyze the value of customer relationship management systems in relation to the management of complementary resources, including process, structure, capability, and culture. The findings contribute to a better understanding of the management of IT capital and a better application of the complementarity of IT-related resources.

Keywords: IT capital, CRM systems, IT management, resource complementarity

互補觀念應用於IT資本管理—CRM系統個案分析

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摘要

在知識經濟的時代，資訊科技的無形價值引發學者及管理者的廣大興趣。企業IT資本成為企業競爭力、持續力的重要關鍵因素之一。IT資本通常隱藏在結構資本內，成為IT投資或營運績效的指標。目前有許多針對企業IT資本基礎結構角色的論點。但是我們針對在複雜環境、資源互相影響下，如何管理IT資本卻是甚少瞭解。本研究利用互補觀念，強調IT資本與其互補資源管理以達到企業持續競爭力的重要性。經由CRM系統的多重個案分析，我們瞭解CRM系統價值與互補資源（包含流程、結構、能力及文化）管理的關係。本研究的發現可以貢獻在IT資本管理及IT資本相關互補資源的應用。

關鍵字：IT資本、CRM、資訊管理、資源互補



1. INTRODUCTION

Information technology (IT) capital includes IT infrastructure, human IT resources, databases, systems, applications, and IT processes (Bharadwaj, 2000; Bontis, 1999; Piccoli and Ives, 2005). IT is considered one of the most important elements of businesses' intellectual capital for gaining or sustaining competitive advantage in today's rapidly changing environment. Enterprises are becoming more and more reliant upon information technologies such as knowledge, process, and communication technologies to improve their agility in the marketplace (Sambamurthy, 2003). Effective management of intellectual capital is the key to corporate success in this knowledge-intensive, rapidly changing environment (Bassi and Buren, 1999; Bontis, 2001; Johnson, 1999; Kannan and Aulbur, 2004; Oliver and Porta, 2005; Roos and Roos, 1997).

Although there are a number of theoretical arguments about the infrastructural role of IT capital (Bontis, 1999; Edvinsson and Malone, 1997; Johnson, 1999; Knight, 1999; Saint-Onge, 1996; Stewart, 1997; Sveiby, 1997; Roos and Roos, 1997), there is limited understanding of the management of IT capital in organizations in which complex, interrelated resources interplay. Furthermore, IT capital has usually been hidden in the measurement of overall structural capital (Bontis, 2004; Edvinsson and Malone 1997; Kannan and Aulbur, 2004) as either investments in information technologies or operational results of cost reduction or productivity improvement. The management function of turning the technology investment into business value is overlooked.

The management of information technology involves a wide range of resources, including technology, structure, culture, and capability, that need to be aligned and synchronized (Melville et al. 2004; Wade and Hulland, 2004). The IT-related resources has generally been seen as having supplemental roles, such as process reengineering for successful system application or organizational change management for effective system implementation (Amit and Schoemaker, 1993; April, 2002; Hughes and Morton, 2006). It is now understood that organizations that invest heavily in IT but lack suitable processes or structures may reap only a small amount of IT intellectual capital (Masoulas, 1998). For example, if a company invests in an enterprise resource planning (ERP) system but does not train employees to use the system, the result will be underutilization of the functionality of the ERP system. IT is complementary with organizational characteristics, technology, decision authority, and internal processes (Barua et al. 1996), and investment in IT and process reengineering cannot be successful if done separately. Low complementarities among resources can lead to negative results in IT management.

The primary objective of this study is to examine how the value of IT capital can be maximized through the management of related resources. Applying the complementarity

theories, this study highlights and elaborates on the importance of managing the complementarity of IT-related resources for creating and sustaining competitive advantage.

The paper is organized as follows. In the Section 2, we analyze literature on topics of IT capital, complementarity theories, and IT-related complementary resources. In Section 3, we describe our data and research methodology, and in Section 4 we present the results. Finally, we discuss our findings in Section 5 and draw conclusions from the study in section 6.

2. LITERATURE REVIEW

2.1 IT capital

IT capital is the structural capital of an organization. Through the implementation and application of the technologies the firm established IT capital by accumulating knowledge and embedding the knowledge within the routines of an organization (Bontis, 1999). The knowledge accumulated includes all technical, organizational and industrial knowledge (Patricia, 2004).

The scope of IT capital has been described by many researchers (Bharadwaj, 2000; Bontis, 1999; Edvinsson and Malone, 1997; Piccoli and Ives, 2005; Roos, et al. 1998; Sveiby, 1997) as including hardware, software, infrastructure, technologies, methodologies, human IT resources, patents, concepts, models, administrative systems, processes, databases, systems, documentation, and tools to enable companies to operate and enhance the efficiency of manufacturing or service delivery and facilitate information sharing.

An understanding of the indicators of this kind of technology capital could influence business strategy, process design, and ultimately the sustainability of competitive advantage (Kannan and Aulbur, 2004). Indicators of IT capital have usually been hidden in the measurement of the overall organizational intellectual capital as either IT investment or the efficiency and quality of the production or service. IT capital investment may be reflected in the IT expense (Edvinsson and Malone, 1997; Van Buren, 1999; Wall, 2005), management information system (MIS) investment (Sveiby, 1997), IT investment over turnover (Roos et al. 1998), or investment in computer equipment (Patricia, 2002). In contrast, the efficiency and quality of the production or service delivery are usually reflected in productivity enhancement, inventory reduction (Melville, Kraemer and Gurbaxani, 2004), cycle time reduction (Roos et al. 1998; Van Buren, 1999), system efficiency, and quality (Van Buren, 1999; Patricia, 2002; Johnson, 1999). See Appendix 1 for a summary of indicators of the value of IT capital.

Information technologies are applied by firms to capture opportunities for creating maximum value by using knowledge to effectively develop new products and services for customers (Kim and Davidson, 2004). However, in a changing business environment the effectiveness of the management of IT capital depends upon the type of IT, management practices, origination structure, partners, customers, and so on (Melville et al. 2004). IT

resources such as infrastructure, business applications, technical skills, and managerial skills need to align with non-IT physical resources and organizational resources such as structure, policies, rules, practices, and culture to establish synergy—the ability of resources to work together—and increase performance (Melville, 2004; Wade and Hulland, 2004). The complementary resources can be valuable components of IT-dependent strategic initiatives to create customer value (Piccoli and Ives, 2005). Applying the theories of complementarity, we discuss the concept and its application in the management of IT capital.

2.2 Complementarity Concept

The complementarity concept, which originated in the economics writing of Edgeworth (1881), holds that that increasing one element will increase the advantage of increasing its complementary elements. Organizational studies considered resource complementarity critical to business sustainability and found that doing more of any one of the activities will increase the marginal returns to doing more of other activities (Milgrom and Roberts, 1995). Complementary assets are resources or capabilities that permit companies to earn benefits associated with strategy, technology, or innovation and to accelerate their profiting from innovation (Teece, 1986). The complementary assets are critical to the management of intellectual capital because knowledge assets are intermediate goods and need to be packed into products or services to provided value (Teece, 2000).

In today's continuously changing business environment, complementary assets are complex combinations of resources, including technology, people, and business processes, that transform inputs into outputs (April, 2002). The combined value of a company's resources and capabilities under complementarity may be higher than the cost of developing each asset individually (Amit and Schoemaker, 1993). Resource complementarity plays an important role in explaining innovations and sustainable competitive advantages (Stieglitz and Heine, 2007; Teece, 1986). Complementarity enhances synergy among the complementary activities (Stieglitz and Heine, 2007; Choi, 2008) to create value (Davern and Kauffman, 2000; Zhu, 2004), leads to higher long-term firm performance (Harrison et al. 2001), and plays a significant role in the internal appropriation of innovation rents (Stieglitz and Heine, 2007; Rothaermel, 2000). It can be seen as the capability of an organization to manage the dynamic resources such as company strategy, structure, people, technology, and the external socioeconomic and technical environments (Hughes and Morton, 2006).

A distinctive synergy of complementary assets integration can enable the company to gain sustainable competitive advantages (Harrison et al., 2001). The investment in complementary assets is not only physical capital but also human and organizational processes to build consistent operations (Hughes and Morton, 2006). It has been noted that only when leveraged with complementary business processes, human resources and capabilities can IT resources and

capabilities lead to better organizational performance (Teo and Ranganathan, 2003).

Today, companies adjust internal processes, structures, and culture to obtain value from technology (Hughes and Morton, 2006). A thorough understanding of the effect of the management of complementary resources for developing IT capital would provide a useful perspective for getting the maximum value from IT capital.

3. RESEARCH METHOD

To understand the measurement of IT capital, we chose a multiple case study approach. The case study approach is appropriate for providing insights and answers to “how” and “why” questions (Yin, 1994). We selected multiple cases from the financial services industry, all of which had implemented CRM systems, as the subjects for study with regard to building, managing, and testing the management of resource complementarity with IT capital. With investment in CRM technologies and systems, enterprises expect that processes can create long-term value. However, many firms have reported failure of the investment in CRM systems due to technology or organizational issues. CRM systems seem to be a significant form of intellectual capital that requires proper investment in both technology and the capability to manage the complex context.

3.1 CRM systems and complementary resources

CRM technology applications combine (1) front-edge functions (e.g., sales, marketing, and customer service) and (2) back-edge functions (e.g., financial, operations, logistics, and human resources) with companies' customer touch points (Fickel, 1999). Enabled by CRM information and technologies, companies are able to understand customer demands and behavior and leverage that knowledge to increase customer acquisition, satisfaction, loyalty, profitability, and retention (Feinberg and Kadam, 2002). CRM technologies include operational systems of call center systems, sales automation software, and market automation applications, and they also include analytical systems for data acquisition, warehousing, and mining. These technologies are the essential tools for firms to automate customer service operations (Karimi, Somers, and Gupta, 2001), coordinate service functions (Chattopadhyay, 2001), restructure business processes (Chen and Popvich, 2003) and present the same view to customers (Chan, 2005). The benefits of CRM include efficient call centers, opportunities for cross-selling and up-selling, superior customer service, information about customers' preferences and habits, and the ability to integrate customer and supplier relationships (Chen and Popvich, 2003).

As mentioned in the previous section, when IT resources and other resources exist in the firm, the latter are called complementary resources (Barney, 1991). These complementary resources are resources that either supply mutual needs or offset mutual lacks in the

implementation of the CRM system. The basis step in implementing CRM is to integrate resources to deliver customer value (Tan et al. 2002). Complementary resources of CRM system include: processes, capabilities, structure, and culture.

Processes. Processes are the critical part of CRM. Processes are the combination of actions and activities to provide a product or service. CRM is a continuous effort involving customer feedback and perspective to redesign core business processes. In order to become customer-centric, companies need to build cross-function processes to satisfy customers (Chen and Popovich, 2003). The processes at the customer relationship initiation stage involve customer evaluation, acquisition, and referral, and at the customer relationship maintenance stage they involve customer retention, up-selling/cross-selling, and recovery. The effectiveness and efficiency of a CRM system depends upon establishment of a close relationship between front-edge activities and back-edge operations, including strategic planning, product development, marketing and sales processes, and financial processes.

Structure. Structure consists of regulatory mechanisms that refer to identifiable, bounded sets of methodically interrelated factors or principles with an intended purpose (Hoogervorst et al. 2004). They represent the embedded system of management in an organization (Hoogervorst et al., 2004). Structure is the arrangement of accountabilities and responsibilities that defines the positions and relationships among members of a firm (Saint-Onge, 1996). In this research, we define structure as the defined functions, accountabilities, measurement criteria, and reward mechanism of an organization.

Culture. Culture represents characteristics of an organization such as shared beliefs, values, attitudes, and behavior. Culture is the total of individual opinions, values, shared mindsets, and the rules of the firm (Saint-Onge, 1996), and as such it can influence the implementation and use of information technology (Leidner and Kayworth, 2006). CRM is an enterprise-wide business model that must be built around the customer, and in order to benefit from CRM implementation companies need to change from a product-focused culture to one that is customer-centric (Chen and Popovich, 2003).

The aligned CRM culture can be divided into the team level and individual culture. Customer orientation at the team level can be classified into three levels of customer-focused actions (Homburg and Pflesser, 2000): (1) market intelligence generation refers to customer interaction, customer information gathering, and review of environment change; (2) market intelligence dissemination refers to cross-departmental data sharing, formal and informal organization-wide communication, and customer information circulation; and (3) market intelligence responsiveness is reflected in decisions on price and product change, business plans, and customer responsiveness. Customer orientation at the individual level is represented by employee empowerment, which involves encouraging employees to be more proactive and self-sufficient in assisting the organization in achieving its goals (Herrenkohl, Judson, and Heffner, 1999).

Capability. Capability is the ability to accomplish CRM-related activities and to make CRM function properly. The implementation process, organizational culture, and management skills are major determinants of how efficiently resources are converted into organizational performance (Weill, 1989). In this study, capability represents management capability. The CRM process contains three fundamental steps (Tan et al. 2002): (1) understanding customers completely, (2) aligning organizational capabilities to deliver what customers perceive as heightened value, and (3) facilitating the immediacy of information availability both inside and outside the organization. There are five determinants of a successful CRM process (Plakoyiannaki and Tzokas, 2002): (1) learning and market-orientation capabilities; (2) integration capabilities; (3) analytical capabilities; (4) operational capabilities; and (5) direction capabilities. We summarize the complementary assets of a CRM system in Table 1.

Table 1 : Complementary Assets of a CRM System

Resources	Descriptions
Processes	The combination of actions and activities to provide a product or service
Structure	Defined functions, accountability, measurement criteria, and reward mechanism of the organization
Capability	The ability to accomplish CRM-related activities to make CRM function properly
Culture	Characteristics of an organizationsuch as shared beliefs, values, attitudes, and behavior.

3.2 Case selection and data analysis

Firms in the finance industry have a wide variety of customers, and they have taken an early lead in CRM implementation. We selected five consumer banking cases ranked between the top and the bottom in the industry by credit card volume, which is one of the key indicators of market performance. Table 2 presents a summary of CRM systems and data collection of the five cases.

Table 2 : Description of Cases Studied and data collection

Case	CRM Processes	Years of CRM Use	People Interviewed	Interviewees	Interview Time
A	Customer service	2	4	Executive officer, senior business managers	4 h, 40 min
B	Customer service	15	5	Business managers and division head	7 h, 50 min
C	Customer service, marketing and sales	5	5	Vice president, business managers	8 h. 20 min
D	Customer service, marketing and sales	6	5	Business managers	6 h. 50 min
E	Customer service, marketing and sales	15	3	Vice president, business managers	5 h, 40 min

Multiple interviewees from all five cases were contacted for data collection. The case study conducted between March and September in 2007. The major interviewees were users and managers of CRM systems who know the operation and effects of CRM well. Three to five business managers were interviewed for each case, and every interview took more than an hour. Based on the literature review and verification by industry experts, this research develops detailed descriptive points of resource complementarity with CRM systems. The list of detailed points contains 40 statements (listed in Table 3), to which managers indicated the extent of their agreement of the stated status of their resource complementarity with CRM systems. In order to obtain an objective comparison of the value of the resource complementarity across the multiple cases, two industry experts were interviewed. Data collected from the five selected cases and the industry experts were consolidated again with the objective of building a consistent viewpoint.

Table 3 : Descriptive statements of complementary resources of a CRM System

<i>Processes</i> (consolidated from Chen and Popvich, 2003)
Effective formal system to identify to identify potential customers
Effective system to interact with lost customers
Effective, systematic process/approach to rebuild customer relationship
Effective system to track customer information to set up customer segmentation
A number of customer loyalty or retention programs to build long-term customer relationship
Percentage of customized services or products
Effective procedures for cross-selling and up-selling to valuable customers
Effective process/program for customer referral
Effective product design process to involve cross-departmental cooperation
Effective billing/receipt process to provide customer bill information
Effective customer service process to solve customers' problems or requests systematically
<i>Structure</i> (consolidated from Hoogervorst et al. 2004)
Employees are organized around customer groups and processes
The design of organizational structure assure customers of complete services
Employees are responsible for quality of customer relationship
Employees' job descriptions include customer relationship management activities
Performance measures are related to customers' needs and satisfaction
Employees are rewarded for engaging in CRM activities and customer-oriented behaviors
<i>Capability</i> (consolidated from Plakoyiannaki and Tzokas, 2002)
Managers are active in understanding customer behavior changes
Managers attentively listen to customers' responses to improve company performance
Managers are able to generate insights from customer information
Managers are capable of aligning functional areas with business strategies
Managers encourage interdepartmental collaboration, integration, and information sharing
CRM users are able to acquire and transform information to help customers
Managers can translate customer information or demand into services or products
Managers can lead the team with a customer-centric value orientation

<i>Culture</i> (consolidated from Kohli et al. 1993)
Team level Company contacts customers frequently to understand customer demand Company discovers industry change quickly Company regularly reviews effects on customers of environment changes A number of interdepartmental meetings each month to discuss market trends and development Average response time when something important happens to customers or market Average time to pass customer satisfaction information to all business units When one unit finds important competitor information, average time to alert other departments Company regularly reviews product development schedule Average response time when a competitor launches an intensive campaign to gain customers Company coordinate activities of different departments well Average time to implement a new product or service plan Average time to modify product or service to meet customer demand Individual level Employees are open minded, creative, and active in serving customers Employees are authorized to make decisions about customer problems

4. CASE ANALYSIS

We analyze the complementary assets of CRM systems of five cases in the finance industry. The study results are summarized in Table 4. Managers' perceptions of the resource complementarity of each resource item are consolidated and reported here as low, medium, or high complementarity. The performance ranking and market growth for 2006 are reported in the bottom columns of Table 4. The following section describes the resource management of the CRM systems in each firm. Detailed descriptions of resource complementarity are presented in Table 5.

Table 4 : The Level of Managers' Perspective

	Company A	Company B	Company C	Company D	Company E
Technology investment	Operational and analytical	Operational and analytical	Operational and analytical	Operational and analytical	Operational and analytical
Processes	Low	Medium	Medium	High	High
Structure	Low	Low	Medium	Medium	High
Capability	Low	Medium	Medium	Medium	High
Culture	Low	Low	Medium	High	High
Performance * Ranking (2006)	10	8	5	3	1
Customer Growth (2006)*	L	L	H	H	H

* Based on data from Taiwan Financial Supervisory Commission.

Company A

Company A is a public financial institution with an organizational structure of multiple layers and controls. The institution has more than 1,200 branches across the nation under three geographical business centers. Decisions are made centrally, with functional departments (production, sales, marketing, finance, etc.) focusing on separate operational objectives. To keep up with competitors and to fully utilize their budget, Company A has purchased a variety of CRM systems, including call center implementation, sales automation applications, data warehousing, data mining, and advanced reporting software. However, the major application of the CRM systems in Company A seems to be in customer services.

A call center has been in place for sixteen years and is managed by the Department of Service at the company's headquarters. The call center is designed to manage customer inquiries, reply to complaints, and conduct some cross-selling campaigns. Because customer satisfaction is the key measurement of the CRM processes, employees pay more attention to customer complaints and respond passively but quickly to customer inquiries.

Although customer information has been collected and passed to related departments, there are seldom any initiatives in response to noted changes in customer behavior. Product review and development is done solely by the product department, with no involvement of front-line employees or utilization of customer information. Managers clearly understand the purpose of CRM, but they seldom spend much time in CRM-related meetings.

Company B

Company B is a private financial institution. In addition to call center technology, a data warehouse system, managed by the IT department has been in operation for three years. The call center has been in place for five years and is managed by the credit card department. The main work of the call center is to serve customers, and operations are well managed and linked well with the front-end systems.

Due to a rigid decision process, company B could not modify their products or services to meet customer demand as quickly as its competitors. If company B needed to modify products or services to meet customer demand, it took more than one week for employee to discuss with related departments and reported to managers at different levels. Moreover, the sales, marketing, and product development departments work together closely but overlook changes in consumer demands. Since the performance measures are mainly concerned with functional efficiency, employees focus on accomplishing their own tasks and are not encouraged to share information and communicate with others.

Company C

Company C is a private financial institution that established a customer relationship develop department three years ago to integrate the CRM activities of all subsidiaries. Data warehousing capability has also been in place for three years, including data mining and in-house query systems. Each business unit manages its call center separately.

The goals of the CRM committee are to increase cross-department communication, to facilitate CRM execution, and to improve the cross-selling rate.

The empowered customer relationship development department is able to quickly modify services or products to fulfill requests of changing customers. Every week, Company C distributes customer information throughout the firm and conducts cross-departmental meetings to discuss issues and plan CRM strategies. The committee has developed customer behavior analysis models to plan campaigns and to launch new products. Employees are measured on customer satisfaction and customer value. The company scored 30–40% on customer-related indexes on the balanced scorecard.

Company D

Company D is a privately owned financial institution. It has had data warehousing for five years and has used data mining tools for three years. The call center was implemented eight years ago and is managed by the operations department. The company also has a CRM committee responsible for CRM process implementation and for the analytical CRM systems. Customer data are carefully classified and segmented, and the cross-departmental CRM committee accelerates communication and discussion about customer information. The mission of the CRM committee is to respond to competitors and market changes and to modify products and services to meet customer demands. Employees are active and creative in proposing and designing changes. The CRM systems have significant effects on processes in marketing and sales, R&D, and new product development and fulfillment to increase quality and efficiency. The company scored 40% on the customer-related indexes on the balanced scorecard. Top management fully supported CRM implementation and directly manages conflicts among business units and product lines and allocates resources well to increase customer satisfaction and revenue.

Company E

Company E is a leading financial institution, and it has had a call center for 15 years, operated by the credit card department. Data warehousing capability has been in place for eight years, and a data mining system has been operational for five years, both managed by business units. Company E conducted business process reengineering (BPR) five years ago,

and the major changes were customer data integration, customer-focused process redesign, and structure reorganization. Company E has a complete process for modifying products or services to respond to changing customer needs, market trends, and competitor threats. There are many customer-related Key Performance Indexes (KPIs) to continuously track customer behavior and link it to employee performance. The company sees the purpose of CRM implementation as being that of making employees more customer-oriented. R&D and new product department processes are customer-centric and fulfill customer needs and address market trends.

Employees of different value chains are trained to use data query tools to analyze customer information and they are authorized to design the events with informal but fluent interdepartmental meetings. They are active in serving customers and respond to customers' questions and complains quickly. Managers understand the key elements of the implementation of CRM. Because of decentralization, Company E can pass customer information, competitor development information, and market trend data to all business units rapidly.

The complementary assets of the CRM systems in the five cases in the finance industry are summarized in Table 5.



Table 5 : Summary of complementary assets of CRM systems in 5 cases

	Company A	Company B	Company C	Company D	Company E
CRM technology investment	Call center, data mining, data warehousing, query system	Call center, data mining, data warehousing, query system	Call center, data mining, data warehousing, query system	Call center, data mining, data warehousing, business intelligence tools	Call center, data mining, data warehousing and business intelligence tools
Processes	Functional processes disconnected with other functions. Few customized services or products.	Sales, marketing and product development department work closely in planning new products and promotion events Rigid decision process, waste time to modify product or service to meet customer demand.	Functional CRM processes with cross-functional committee for product development, marketing strategy, and planning. Customer behavior analysis models to plan campaigns.	Functional CRM processes, cross-functional work. System to identify potential customers, R&D, marketing and sales, new product development processes to increase productivity.	Customer-focused process with operations integrated. Business process reengineering (BPR) project to integrate customer data, redesign process. Complete modifying product or service process to satisfy customers.
Structure	Bureaucratic structure with multiple layers of controls. Performance measures are on customer satisfaction. Employees pay more attention to customer complaints and response passively.	Reactive to market changes. Employees are not encouraged to share and communicate across departments. Performance measures are on functional efficiency.	Performance measures are related to customers' needs and value. Employees focus on customer complaints and response to customer problems.	Employees are organized around customer groups. Performance measures are around 40% customer-related indexes.	Customer centered structure. Customer-related KPIs and link to employee performance. Continuously tracking customer changes.
Capability	Managers react to customer changes passively. Managers clearly understood the purpose of CRM, but did not spend much time for CRM-related meetings.	Managers are reactive to customer changes. Managers are incapable of utilizing customer information for better services.	Managers can translate customer information or demand into services or products. Managers are active in understanding customer behavior changes.	Managers are active to understand customer behavior change. Managers fully supported CRM implementation, managed conflicts and allocated resources well	Managers can lead the cross-departmental team with customer-centric value proposition. Managers understand the key elements of the implementation of CRM.
Culture	Very little inter-department communication and collaboration. Information was collected and passed to related departments but seldom noted changes in customer movements.	Low employee empowerment. Lack of team work and cross communication. Employees just accomplish their own tasks.	Quickly pass customer information around, many interdepartmental meetings. Employees are authorized to make decisions of customer problems.	Quick response to customer changes Employees are active and creative to propose and design new products, services and campaign.	Employees are authorized to make decisions of product and services. Active to serve customers, pass customer information, and market trend around quickly. Fluent interdepartmental meetings.
Performance Ranking*	10	8	5	3	1

* Based on data from Taiwan Financial Supervisory Commission.

5. DISCUSSION

The five cases studied in the finance industry provide evidence that companies with high resource complementarities develop synergy and are more competitive than those who have less resource complementarity. The investments in CRM systems of the five cases are about the same; they all have invested in CRM technologies that include a call center, CRM software, data mining, data warehousing, and query systems. However, the capability of leveraging complementary resources (processes, capability, structure, and culture) with CRM systems seems to be the critical factor in determining performance. Company E, with higher resource complementarity, has outperformed the rest and has maintained a leading role in the market for a long time, whereas company A, with low resource complementarity, has underperformed in the market.

For several decades, researchers and practitioners have debated the productivity paradox with regard to investment in IT (Stratopoulos and Dehning, 2000; Pinsonneault, 1998; Lin and Shao, 2006). High investment in IT does not automatically bring relevant return on business and technical performance (Stratopoulos and Dehning, 2000; Pinsonneault, 1998; Lin and Shao, 2006). Many organizational factors (Hughes and Morton, 2006; Melville, 2004; Wade and Hulland, 2004) can affect the relationship between investment in IT and the company's capability to deliver the promised results. Conversion effectiveness (Weill, 1989) and business alignment (Brockway, 1996; Jerry, 2003) have been particularly highlighted as factors affecting the return on IT investment. Conversion effectiveness consists of the resource allocation processes that enable a company to convert IT investment into valuable outputs. Processes, culture, and the skills of managers are the essential determinants of the effectiveness of IT exploitation (Weill, 1989). The finding of this study has further elaborated on business initiatives related to managing conversion effectiveness and alignment of resources with information technology. We have provided examples and guidelines (Table 4) about how organizations can improve the IT management capability, with related resources being aligned and coordinated to achieve the company's goals.

Investment in information technology is one of the key measurements of IT capital, assuming that the investment can deliver expected results under proper management of the organizational resources. Business efficiency and effectiveness are other indicators of IT capital, assuming that the favorable results can be replicated in the same contextual environment. This study proposes another indicator, which is that the capability of managing complementary resources for the IT investment can reflect the value of IT capabilities for business adaptation and innovation in the long term.

A firm's intellectual capital consists of human capital, customer capital, relational capital, structural capital, and so on. These need to be aligned with each other (Edvinsson and Malone, 1997; Hussi, 2002; Saint-Onge, 1996).

6. CONCLUSION

IT capital is one of the key determinants of business competitiveness and sustainability. This study applies the complementarity concept to explain the importance of the management of resource complementarity with IT capital for delivering sustainable competitiveness. Through multiple case studies of CRM systems management in five finance organizations, we analyze the value of the customer relationship management systems in relation to the management of complementary resources, including process, structure, capability, and culture. The findings contribute to a better understanding of the management of IT capital and a better application of the complementarity of IT-related resources.

Theoretically, this study has arranged the elements of complementary assets of a CRM system. Our study indicates that only companies with a good capability to leverage complementary resources can create sustainable competitive advantage. In order to build sustainable competitiveness, firms need to pay more attention to understanding IT-related resources and the management of their complementarity. This study provides a useful summary of practical activities of the management of complementary resources of IT capital (Table 4). In future research, we suggest the testing of items of complementary assets of IT capital in different industries and with different information technologies. Complementarity appears to be an important concept of IT management, and the related research is still in its infancy. Theoretical validation and empirical testing are necessary.

REFERENCES

1. Amit, R. and Schoemaker, P. J. H. "Strategic assets and organizational rent", *Strategic Management Journal* (14:1), 1993, pp. 33-46.
2. April, K. A. "Guidelines for developing a k-strategy", *Journal of Knowledge Management* (6:5), 2002, pp.445-456.
3. Barney, J. "Firm resources and sustained competitive advantage", *Journal of Management Information Systems* (17:1), 1991, pp. 99-120.
4. Barua, A., Sophie Lee, C. H., and Whinston, A. B. "The calculus of Reengineering", *Information Systems Research* (7:4), 1996, pp. 409-428.
5. Bassi, L. J. and Buren, M. E. V. "Valuing investments in intellectual capital", *International Journal of Technology Management* (18:5/6/7/8), 1999, pp. 414-432.
6. Bharadwaj, A. S. "A resource-based perspective on information technology capability and firm performance: an empirical investigation", *MIS quarterly* (24:1), 2000, pp. 169-196.
7. Bontis, N. "Managing Organizational Knowledge by Diagnosing Intellectual Capital: Framing and advancing the state of the field", *International Journal of Technology*

- Management* (18:5/6/7/8), 1999, pp. 433-462.
8. Bontis, N. "Assessing Knowledge Assets: A review of the models used to measure intellectual capital", *International Journal of Management Reviews* (3:1), 2001, pp. 41-60.
 9. Bontis, N. "Intellectual capital in Egyptian software firms" *The learning organization* (11:4/5), 2004, pp. 332-346.
 10. Brockway, D.W. "Knowledge technologies and business alignment", *Information Management & Computer Security* (4:1), 1996, pp. 45-46.
 11. Chan, J. O. "Toward a Unified View of Customer Relationship Management", *Journal of American Academy of Business* (6:1), 2005, pp. 32-38.
 12. Chattopadhyay, S. P. "Relationship marketing in an enterprise resource planning environment", *Marketing Intelligence and Planning* (19:2), 2001, pp. 136-139.
 13. Chen, I. J. and Popovich, K. "Understanding customer relationship management (CRM): People, process and technology", *Business Process Management Journal* (9:5), 2003, pp. 672-688.
 14. Choi, B., Ponn, S. K., Davis, J. G. "Effects of knowledge management strategy on organizational performance: A complementarity theory-based approach", *Omega* (36:2), 2008, pp. 235-251.
 15. Davern, M. J. and Kauffman, R. J. "Discovering Potential and Realizing Value from Information Technology Investments", *Journal of Management Information Systems* (16:4), 2000, pp.121-143.
 16. Edgeworth, F.Y. *Mathematical Psychics*, Kegan Paul, London, 1881.
 17. Edvinsson, L., and Malone, M. S. *Intellectual Capital: Realizing Your Company's True Values by Finding its Hidden Brainpower*, HarperCollins, New York, 1997.
 18. Feinberg, R. and Kadam, R. "e-CRM web service attributes as determinants of customer satisfaction with retail Web sites." *International Journal of Service Industry Management* (16:5), 2002, pp. 432-451.
 19. Fickel, L. "Know your customer", *CIO Magazine* (12:21), 1999, pp. 62-72.
 20. Harrison, J. S., Hitt, M. A., Hoskisson, R. E. and Ireland, R. D. "Resource complementarity in business combinations: Extending the logic to organizational alliances", *Journal of Management* (27: 6), 2001, pp. 679-690.
 21. Herrenkohl, R. C., Judson, G. T. and Heffner, J. A. "Defining and measuring employee empowerment", *The journal of Applied Behavioral Science* (35:3), 1999, pp. 373-389.
 22. Homburg, C and Pflesser, C. "A multiple-layer model of market-oriented organizational culture: Measurement issues and performance outcome", *Journal of Marketing Research* (37:4), 2000, pp. 449-462.
 23. Hoogervorst, J., Flier, H. V. D, and Koopman, P. "Implicit communication in organizations: The impact of culture, structure and management practices on employee behaviour", *Journal of Management Psychology* (19:3), 2004, pp. 288-311.

24. Hughes, A. and Norton, M. S. S. "The transforming power of Complementary assets", *MIT Sloan Management* (47:4), 2006, pp. 50-58.
25. Hussi, T. and Ahonen, G. "Managing intangible assets: a question of integration and delicate balance", *Journal of Intellectual Capital* (3:3), 2002, pp. 277-286.
26. Jerry, L. "Accessing IT/Business alignment", *Information Systems Management* (20:4), 2003, pp. 9-15.
27. Johnson, W. H. A. "An integrative taxonomy of intellectual capital: Measuring the stock and flow of intellectual capital components in the firm" *International Journal of Technology Management* (18:5/6/7/8), 1999, pp. 562-575.
28. Knight, D. J. "Performance measures for increasing intellectual capital", *Strategy and Leadership* (27:2), 1999, pp. 22-25.
29. Kannan, G., and Aulbur, W. G. "Intellectual Capital Measurement Effectiveness" *Journal of Intellectual Capital* (5:3), 2004, pp. 389-413.
30. Kaplan, R. and Norton, D. *Strategic Maps: Converting Intangible Assets into Tangible Outcomes*, Boston, MA, Harvard Business School Press, 2004.
31. Karimi, J., Somers, T. M., and Gupta, Y. P. "Impact of information technology management practices on customer service" *Journal of Management Information Systems* (17:4), 2001, pp. 125-158.
32. Kim, C. S and Davidson, L. F. "The effects of it expenditures on banks' business performance: using a balanced scorecard approach", *Managerial Finance* (30:6), 2004, pp. 28-45.
33. Kohli, A. K., Jaworski, B. J., and Kumar, A. "MARKOR: A measure of market orientation", *Journal of Marketing Research* (30:4), 1993, pp. 467-477.
34. Leidner, D. E. and Kayworth, T. "Review: a review of culture in information systems research: toward a theory of information technology culture conflict", *MIS Quarterly* (30:2), 2006, pp. 357-399.
35. Lin, W. T. and Shao, B. M. "The business value of information technology and inputs substitution: The productivity paradox revisited", *Decision Support Systems* (42:2), 2006, pp. 493-507.
36. Masoulas, V. "Organizational requirements definition for intellectual capital management", *International Journal of Technology Management* (16: 1/2/3), 1998, pp.126-143.
37. Milgrom, P. and Roberts, J. "Complementarities and fit: strategy, structure, and organization" *Journal of Accounting and Economics* (19:2/3), 1995, pp.179-208.
38. Melville, N., Kraemer, K., Gurbaxani, V. "Review: Information technology and organizational performance: an integrative model of it business value", *MIS Quarterly* (28:2), 2004, pp. 283-322.
39. Oliver, J. L. H. and Porta, J. I. D. "How to measure IC in clusters: empirical evidence", *Journal of Intellectual Capital* (7:3), 2005, pp. 354-380.

40. Patricia Ordonez de Pablos. "Evidence of intellectual capital measurement from Asia, Europe, and the Middle East", *Journal of Intellectual Capital* (3:3), 2002, pp. 287-302.
41. Patricia Ordonez de Pablos. "Measuring and reporting structural capital: lessons from European learning firms", *Journal of Intellectual Capital* (5:4), 2004, pp. 629-647.
42. Piccoli, G. and Ives, B. "Review: IT-dependent strategic initiatives and sustained competitive advantage: a review and synthesis of the literature", *MIS Quarterly* (29:4), 2005, pp. 747-776.
43. Pinsonneault, A. "Information technology and the nature of managerial work: From the productivity paradox to the Icarus paradox", *MIS Quarterly* (22:3), 1998, pp. 287-311.
44. Plakoyiannaki, E. and Tzokas, N. "Customer relationship management: A capabilities portfolio perspective." *Journal of Database Management* (9:3), 2002, pp. 228-337.
45. Roos, G., and Roos, J. "Measuring your company's intellectual performance" *Long Range Planning* (30:3), 1997, pp. 413-426.
46. Roos, J. R. G., Edvinsson, L and Nicola Carlo Dragonetti. *Intellectual Capital: Navigating in the New Business Landscape*, New York University Press, 1998.
47. Rothaermel, F. T. "Technological discontinuities and the nature of competition", *Technology Analysis and Strategic Management* (12:2), 2000, pp. 149-160
48. Sambamurthy, V. "Shaping agility through digital options: reconceptualizing the role of information technology in contemporary firms", *MIS quarterly* (27:2), 2003, pp. 237-263.
49. Saint-Onge, H. "Tacit Knowledge: the key to the strategic alignment of intellectual capital", *Strategy & Leadership* (24:2), 1996, pp. 10-13.
50. Stewart, T. A. *Intellectual Capital: The New Wealth of Organizations*, Currency Doubleday, New York, 1997
51. Stieglitz, N. and Heine, K. "Innovations and the role of complementarities in a strategic theory of the firm", *Strategic Management Journal* (28:1), 2007, pp. 1-15.
52. Stratopoulos, T. and Dehning, B. "Does successful investment in information technology solve the productivity paradox", *Information and Management* (38:2), 2000, pp. 103-117.
53. Sveiby, K. E. *The New Organizational Wealth: Managing and Measuring Knowledge-based Assets*, Berrett-Koehler, San Francisco, 1997.
54. Tan, X, Yen, D.C, and Fang, X. "Internet integrated customer relationship management: A key success factor for companies in the e-commerce arena", *The journal of Computer Information Systems* (42:3), 2002, pp. 77-86.
55. Teece, D. J. "Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy" *Research Policy* (15:6), 1986, pp. 285-305.
56. Teece, D. J. *Managing Intellectual Capital: Organizational, Strategic, and Policy Dimensions*, Oxford University Press Inc., New York, 2000.
57. Teo, T.S.H and Ranganathan, C. "Leveraging IT resources and capabilities at the housing and development board", *Strategic Information Systems* (12:3), 2003, pp. 229-249.

58. Van Buren, M. E. "A yardstick for knowledge management", *Training and Development* (53:5), 1999, pp. 71-78.
59. Wall, A. "The measurement and management of intellectual capital in the public sector: taking the lead or waiting for direction?" *Public Management Review* (7:2), 2005, pp. 289-303.
60. Yin, R. K. *Case Study Research: Design and Methods*, Sage publications, Beverly Hills, CA, USA, 1994.
61. Zhu, K. "Complementarity of IT infrastructure and e-commerce capability", *Journal of Management Information Systems* (21:1), 2004, pp. 167-202.
62. Wade, M. and Hulland, J. "Review: The resource-based view and information systems research: Review, extension and suggestions for future research", *MIS Quarterly* (28:1), 2004, pp. 107-142.
63. Weill, P. "Managing investment in information technology: Mini case examples and implications", *MIS quarterly* (13:1), 1989, pp.3-17.

