論文摘要

　　台灣半導體產業協會（2005）對台灣主要 IC 公司營運狀況所做的調查統計結果所發表「台灣半導體產業對國家的貢獻」研究報告顯示：IC 產業無論在產值、營運附加價值、創匯收入、投資、政府投資獲利、所帶動的週邊效益…等，都有穩定到持續成長之表現，為台灣深具競爭力之產業。在先進半導體製造技術進步之下，「智慧工廠自動化」技術成為半導體製造廠商的核心能力的重要部分。根據資策會市場情報中心的 1998 年分析研究，「智慧工廠自動化」系統技術創新屬於「系統整合」類型的軟體創新。

　　本研究主要採用文獻探討以及個案訪談作為主要的研究方法，先藉由文獻探討建立起論文整體之架構以及相關理論之說明定義所需探討之研究變項，之後再透過台灣半導體製造標竿企業的六個系統整合專案訪談加以實證。本研究以研究「系統整合專案類型」、「技術知識特質」、與「組織架構特質」對「系統整合創新平台」的關聯，來探討台灣半導體智慧工廠系統整合軟體開發的管理作為，說明所觀察現象的具體意義，以及背後的思考邏輯。而可得到以下初步之研究結論：

一、系統整合專案類型與技術知識特質

1.　不同的系統整合專案類型，有不同的技術知識特質。製程發展攸關類型專案，技術知識的多元性較高。資訊系統改造類型專案，技術知識的內隱性較低、多元性較低、標準化程度較高、路徑相依程度較高。

2.　製程發展攸關專案在不同階段可能因應技術開發標的不同，會有不同的技術知識特質。早期發展階段將現有的作業流程「自動化」，所以技術知識內隱性為較低。在後期發展階段以採用新技術使系統「智慧化」，所以技術知識內隱性為較高。

二、技術知識特質與系統整合的創新平台

3. 系統整合專案的技術知識的內隱程度差異，使外部知識的來源有所差異。系統整合專案的技術知識的內隱程度愈低，外部知識的來源愈傾向專業廠商。系統整合專案的技術知識的內隱程度愈高，外部知識的來源愈傾向大學等研究機構。

4. 系統整合專案的技術知識的多元程度愈高，使用者參與程度愈傾向「共同開發」。多元程度愈低，使用者參與程度愈傾向「交付模式或是隔牆交易」。

三、組織結構特質與系統整合的創新平台

5. 台灣半導體製造業隨著組織正式化的程度提高，傾向將跨部門的整合溝通活動，予以正式的組織化。這些組織的成員也是來自各個知識領域。

6. 在台灣半導體製造企業內的正式組織與臨時性的專案組織之間，選擇「虛擬組織」結構以吸收、創造、積蓄、與擴散重要的跨部門技術知識。

四、其他發現

7. 整合跨部門知識領域來創造出新的知識，進而由新知識來創造出新的軟體系統。

8. 製程發展攸關類型系統整合專案之技術知識內隱程度愈低，使用者需求定義書對於專案的成功就愈重要。反之，技術知識內隱程度愈高，使用者需求定義書對於專案的成功就愈不相關。

關鍵字：半導體製造、系統整合、智慧工廠自動化、技術知識特質、組織結構特質、創新平台

Abstract

Taiwan Semiconductor Industry Association (2005) delivered a report "The national contribution of Taiwan semiconductor industry", which claimed that IC industry is very critical to Taiwan economic growth and a very competitive industry in the world. In 2004, Taiwan was the first in IC foundry industry with more than 70% market share, the second large cluster of IC design houses with market share 28.2%, and the third in the DRAM industry in the word.

In recent years, "Intelligent Fab Automation" technology has become the crucial component of the core competence of nanotechnology IC manufacturing. Based on the software classification of 1998 Institute for Information Industry, "Intelligent fab automation" is one kind of "System Integration" computer software innovation. It includes the advanced Manufacturing Execution System (MES), Advanced Process Control (APC), Advanced Material Handling System (AMHS), equipment automation systems, Engineering Data Analysis (EDA), and etc. "Intelligent fab automation" builds up the proprietary manufacturing capability.

This thesis attempts to take an exploratory study of the relationship between characteristics of system integration project, characteristics of technological knowledge, characteristics of organization structure, and innovation platform on the benchmark semiconductor company in Taiwan. This thesis adopts reference and case study as the main research approach. It sets up the thesis whole structure by reference and relevant theories to define the factors. Afterward, to demonstrate the thesis structure by interview six system

integration software projects of that company. There are primary figures found in the thesis：

1. The relationship between characteristics of system integration projects and characteristics of technological knowledge

   a) Different kinds of system integration projects have different characteristics of technological knowledge. The manufacturing-process relevant system development projects associate with high degree of technology diversity. The IT system reengineering projects associate with low degree of technology diversity and manufacturing technology advance.

   b) The manufacturing-process relevant system development project consists of different development stages that have different technology development targets. In the early stage, the development target is procedure automation with codified technology knowledge. In the later stage, it turns to intelligent system with tacit technology knowledge.

2. The relationship between characteristics of technological knowledge and innovation platform

   a) Different kinds of system integration projects have different types of project organizations. The IT system reengineering projects tend to adopt the "Function Team" to operate, but the manufacturing-process relevant projects tend to adopt a team type between the "Heavyweight Team" and the "Lightweight Team".

   b) The IT system reengineering projects are not different from the manufacturing-process relevant projects in their joint problem

resolution ways. They both tend to adopt "Experiments and Prototypes". Projects with higher degree of tacit technology knowledge tend more to adopt prototypes and experiments to resolve problems jointly.

c) System integration project with codified technology knowledge tend to collaborate with professional software house. However, those projects with tacit technology knowledge tend to collaborate with research institutes, such as university labs.

d) Projects with higher technology diversity require more the end-user management and IT management to conduct the project vision together, and project team will consists of more different kinds of skills. Project manager tends to hire a manager with T-type or A-type management skills.

e) Degree of technology diversity determines degree of user engagement in development. Projects with high degree of technology diversity tend to engage user in the joint development mode. Projects with low degree of technology diversity tend to engage user in the "Offering Mode".

f) All project teams tend to share knowledge internally through the "project meeting" regularly.

g) If there is no sound industry standard, Taiwan semiconductor manufacturing company tends to define its own internal standard in order to reduce development cost.

3. The relationship between characteristics of organization structure and

innovation platform

    a) High degree of organization formalization associates with the effort to formalize the communication and coordination activities across organizations.

    b) High-Tech manufacturing company tends to establish the virtualized organization before a formalized organization to absorb, create, accumulate, and diffuse cross-function technology knowledge.

    c) High degree of organization formalization associates with "structural" intenal knowledge sharing sessions.

4. Others

    a) New technology knowledge development leads to new system development.

    b) URD (User Requirement Definition) document becomes less important for the new system development projects, which associate with tacit technology knowledge. So does for project success.

There are primary recommendations for managers in the relevant high-tech manufacturing industries:

    a) Understand that characteristics of technology determine technology innovation behaviors.

    b) Develop the manufacturing-process relevant technogies in the step-by-step approach - "procedure standardization", "procedure

automation", and "intelligent system".

c) Encourage prototyping and experiements.

d) Practively develop leaders with diversed skills.

e) Follow or build the internal technology standards.

f) Establish the dedicated organization to absorb, create, accumulate, and diffuse cross-function technology knowledge.

g) Choose the software development model carefully.