電子設計自動化技術對台灣半導體產業價值網的影響

摘要

台灣半導體產業由於產業群聚效應促成產業的興盛，2005年台灣整體的半導體產業產值已達新台幣一兆一千億元以上，更創造科學園區十萬員工的產業族群，而由於整體半導體產業的基礎深厚，台灣半導體產業在全球半導體產業可說是具有舉足輕重的地位，有著從上而下完整的半導體產業供應鏈，相當具有產業發展的優勢。

電子設計自動化技術可說是IC產業的源頭，但是在EDA產業裡，（Electronic Design Automation 電子設計自動化; 以下簡稱EDA），只有少數全球性的EDA廠商將研發資源投注在台灣；國內半導體產業賴以設計晶片研發的EDA工具幾乎完全掌握在外商手裡，對台灣半導體產業的整體發展實屬不利。

本研究利用價值鏈理論，來分析半導體產業各業者之間的互動關係與重要的價值創新活動，並利用價值網理論發展出價值網的動態模型，藉由動態價值網中各個廠商間所提供的價值分析，來瞭解EDA產業與半導體產業間的互動行為與競合關係，並分析EDA技術創新對於半導體產業價值網的影響，同時本研究發現，晶圓代工公司正積極扮演在半導體產業價值網中價值整合者的角色。

本研究的貢獻在於經由分析EDA產業與技術，得知EDA技術對半導體產業價值網有顯著的影響，首先是對IC設計公司的創新研發能力、成本控制能力、進入市場時機、合作網路關係、保護智慧財產等關鍵因素的價值創新有顯著的正面影響。再者對晶圓製造公司的創新研發能力、創造市場價值、成本控制能力、進入市場時機、合作網路關係、提升顧客服務等關鍵因素的價值創新均有非常顯著的正面影響。由於本研究歸納出價值網的動態模型，後續研究者可以利用動態價值網的模型，來分析產業價值網的動態變化。

關鍵字：價值鏈、價值網、半導體產業、電子設計自動化。

The Impact of EDA Technology to Taiwan Semiconductor Industry Value Net

Abstract

The prosperity of Taiwan semiconductor industry is facilitated by the industry cluster effect. In 2005, the total Taiwan semiconductor industry's value had amounted to above 1.1 trillion NTD and IC industry creates one hundred thousand jobs opportunity in Science Park. Built on a structure that emphasizes horizontal division and vertical integration, the IC industry has delivered an economic miracle to Taiwan. Because Taiwan semiconductor industry has a well organized infrastructure and a complete supply chain, it plays an very important role in worldwide semiconductor industry with superiority.

Table A-1：Taiwan Semiconductor Industry Revenue

Unit：hundred million NTD

	2001	2002	2003	2004	2005	2005 Worldwide Ranking
IC Design	1,220	1,478	1,902	2,608	2,850	2
IC Manufacturing	3,025	3,785	4,701	6,239	5,874	4
Foundry	2,048	2,467	3,090	3,985	3,735	1
IC Packaging	771	948	1,176	1,566	1,780	1
IC Testing	253	318	409	577	675	1
Total IC Industry	5,269	6,529	8,189	10,990	11,179	4

Sources: IEK ITIS (2006/06)

We may say that EDA (Electronic Design Automation; hereafter refers as EDA) technology is the beginning of IC industry. But in EDA industry, only few global EDA companies deployed R&D resources in Taiwan. The EDA tools which Taiwan semiconductor companies rely on developing IC design are almost completely being grasped in foreign EDA companies. This situation is very disadvantageous to Taiwan IC industry. Therefore, Taiwan government proclaimed that developing EDA talents and products will be the first priority plan in "National SoC (System on Chip) Program". This Program hopes to integrate EDA software, and to

provide an outstanding design environment for the use of global systems design firms.

This research is focusing on three major question groups as following:

1. How is the interaction among semiconductor industry companies in Taiwan IC industry value chain? What are important value creation activities among enterprises in Taiwan IC industry?

2. What is the roadmap of EDA technology? How is the EDA industry developing?

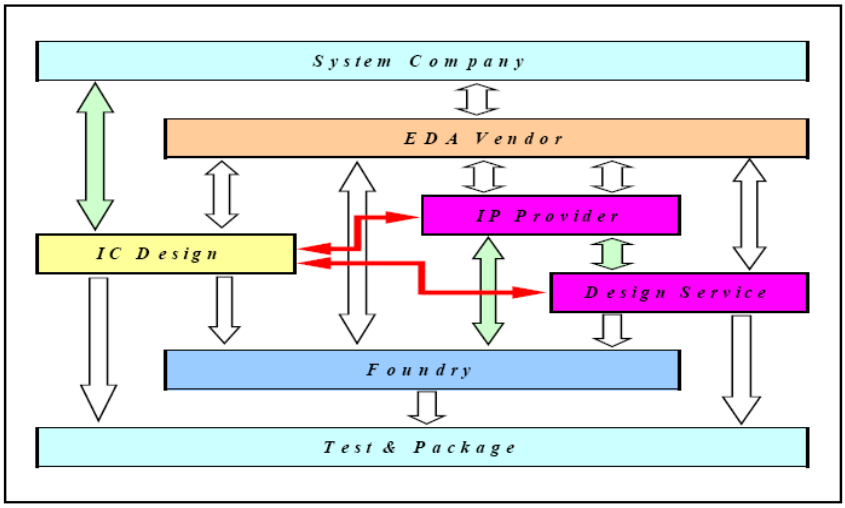
3. What is the influence of EDA technology regarding to the semiconductor industry value net? What are the interactions and relations between EDA industry and Taiwan semiconductor industry? What is the impact of EDA technology to the value creations of Taiwan semiconductor industry dynamic value net?

First, this research uses Value Chain Theory to analyze the interaction and value creation activities among Taiwan semiconductor industry companies. Secondly, this research develops a “Dynamic Value Net Model” from Value Net Theory then to analyze Taiwan semiconductor industry. Third, this research analyzes the affiliation between each players in Taiwan IC industry dynamic value net and the interaction and co-opetition relationship between EDA vendors and semiconductor companies. Moreover, this research analyzes the influence of EDA technology innovation regarding Taiwan IC industry value net.

There are four major findings in this research as below:

1. EDA Play an Important Role in IC Industry

This research points out that EDA technology plays a very important role in IC industry, as it shows in Figure A-1. EDA is a necessary technology for IC design and PCB industry. The EDA software industry is located the most upstream position in IC design industry and IC manufacturing industry value chain. Through EDA technology, we may reduce the IC design cycle time and raise IC manufacturing yield rate which can enhance IC industry competitive advantage.



Sources: IEK (2005)

Figure A-1: EDA Role in IC Industry

2. The Co-opetition Relationship in Taiwan IC Industry Value Net

This research analyzes the IC industry co-opertition relationship in Taiwan IC industry value net. This research figures out the existing complicate co-opertition relationship including "customer-supplier" relations, "complementor" relations, "competition" relations between each players in Taiwan IC industry value net as Table A-2 shows.

Table A-2 The Co-opetition Relationship in Taiwan IC Industry Value Net

Value Net Co-opetition	EDA	IC Manufacturing (Foundry)	IC Design	IDM	SIP	IC Design Service
EDA	Industry Internal Co-opetition	Customer-Supplier、Complementor、Competition	Customer-Supplier、Complementor	Customer-Supplier	Customer-Supplier、Complementor、Competition	Customer-Supplier、Competition
IC Manufacturing (Foundry)	Customer-Supplier、Complementor、Competition	Industry Internal Co-opetition	Customer-Supplier、Complementor	Competition	Complementor、Competition	Customer-Supplier、Complementor
IC Design	Customer-Supplier、Complementor	Customer-Supplier、Complementor	Industry Internal Co-opetition	Customer-Supplier、Competition	Customer-Supplier、Complementor	Customer-Supplier、Complementor
IDM	Customer-Supplier	Competition	Customer-Supplier、Competition	Industry Internal Co-opetition	Customer-Supplier、Complementor	Customer-Supplier、Complementor、Competition
SIP	Customer-Supplier、Complementor、Competition	Complementor、Competition	Customer-Supplier、Complementor	Customer-Supplier、Complementor	Industry Internal Co-opetition	Customer-Supplier
IC Design Service	Customer-Supplier、Competition	Customer-Supplier、Complementor	Customer-Supplier、Complementor	Customer-Supplier、Complementor、Competition	Customer-Supplier	Industry Internal Co-opetition

3. Taiwan IC industry Dynamic Value Net Model Analysis

This research analyzes the interactions among EDA vendors, IC design companies and Foundries in Taiwan semiconductor industry value net through dynamic value net model analysis. This research discovers that Foundries are acting as value integrators in Taiwan IC industry value net aggressively. There are four major value creation activities in the value net:

(1) e-Service.
(2) Provide "IC design reference flow", including DFM (Design for Manufacturing) support.
(3) Build EDA alliance to provide design support.
(4) CyberShuttle.

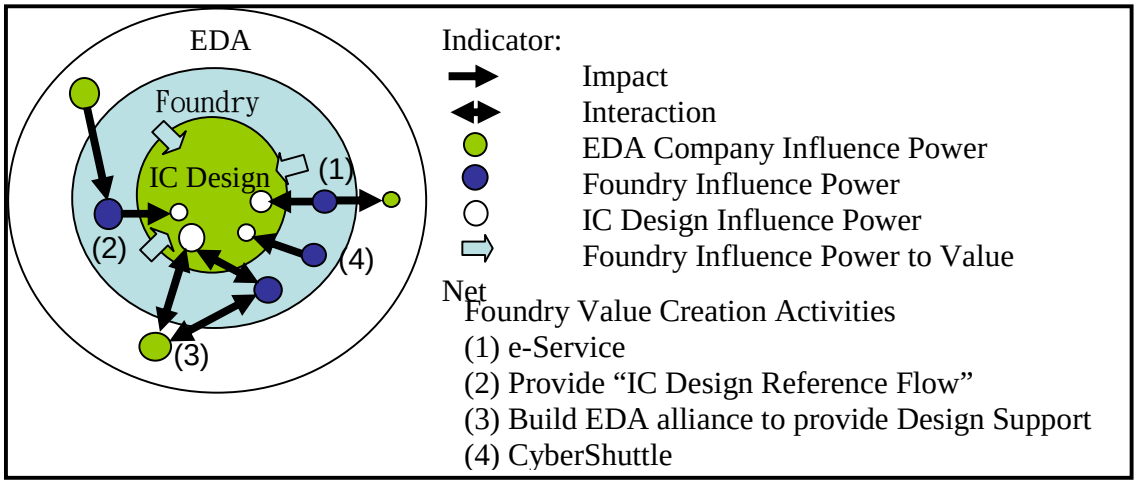


Figure A-2 Taiwan IC industry Dynamic Value Net Model Analysis

4. Impact of EDA Technology to Taiwan IC Industry Value Net

The contribution of this research is acknowledging that EDA technology has positive influence to semiconductor industry value net by analyzing EDA industry and technology. First, to the IC design companies, EDA technology has positive influence to R&D capability, cost control capability, active market entrance capability, cooperation network relationship and intellectual property protection. Furthermore, to Foundries, EDA technology has positive influence to R&D capability, market value creation, cost control capability, active market entrance capability, cooperation network relationship and

customer service value. Because this research induces the dynamic value net model, the following researchers may use the model to analyze the dynamic change in any industry value net if applicable.

Table A-3 Impact of EDA Technology to Taiwan IC Industry Value Net

Major Influence Factor	IC Design Tools Technology Influence	DFM Tools Technology Influence
R&D Capability	Very Important	Very Important
Market Value Creation	Less Important	Important
Cost Control Capability	Important	Very Important
Active Market Entrance Capability	Important	Very Important
Cooperation Network Relationship	Important	Important
Customer Service Value	Irrelevant	Important
Reduce Operation Risk	Less Important	Less Important
Intellectual Property Protection	Important	Less Important

This research suggests that Taiwan IC industry should establish an outstanding design environment and services for global systems design firms, especially EDA software. These measures enable Taiwan to maintain its semiconductor manufacturing lead and grow the crucial design and design service business.

Key words: value chain, value net, semiconductor industry, EDA.