"Industry 3.5" to Empower Intelligent Manufacturing and Empirical Studies in Taiwan

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Chen-Fu Chien is a Tsinghua Chair Professor and Micron Chair Professor in National Tsing Hua University, Taiwan. He received B.S. (Phi Tao Phi Hons.) with double majors in Industrial Engineering and Electrical Engineering from NTHU in 1990, M.S. in Industrial Engineering & Ph.D. in Decision Sciences and Operations Research from UW-Madison in 1994 and 1996, and PCMPCL Executive Training from Harvard Business School in 2007. From 2002 to 2003, he was a Fulbright Scholar with UC Berkeley.

Chen-Fu Chien is the Convener of Industrial Engineering and Management Program and Director of the Artificial Intelligence for Intelligent Manufacturing Systems (AIMS) Research Center, Ministry of Science and Technology (MOST), Director of AIMS Fellows Executive Program and NTHU-Taiwan Semiconductor Manufacturing Company (TSMC) Center for Manufacturing Excellence in NTHU. From 2005 to 2008, he had been on-leave as a Deputy Director in TSMC. He has received 10 US invention patents, published five books, over 170 journal papers, and 11 case studies in Harvard Business School. His book on Industry 3.5 (ISBN 978-986-398-380-4) is a bestselling book in Taiwan. He received National Quality Award, the Executive Yuan Award for Outstanding Science and Technology Contribution, Distinguished Research Awards from MOST, Distinguished University-Industry Collaborative Research Award from Ministry of Education, University Industrial Contribution Award from Ministry of Economic Affairs, Best Paper Awards of 2011 IEEE TASE and 2015 IEEE TSM. He is a Fellow of APIEMS, CIIE, and CSMOT.

Industry 3.5

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One Earth is not enough for everyone…
Inter- vs Intra-country Gaps

How many Earths do we need if the world's population lived like…

Country	Earths	Country	Earths
U.S.A.	5.0	France	2.8
Australia	4.1	Japan	2.8
South Korea	3.5	Italy	2.6
Russia	3.3	Spain	2.3
Germany	3.0	China	2.2
Switzerland	2.9	Brazil	1.8
U.K.	2.9	India	0.7

World 1.7

Source: Global Footprint Network National Footprint Accounts 2018

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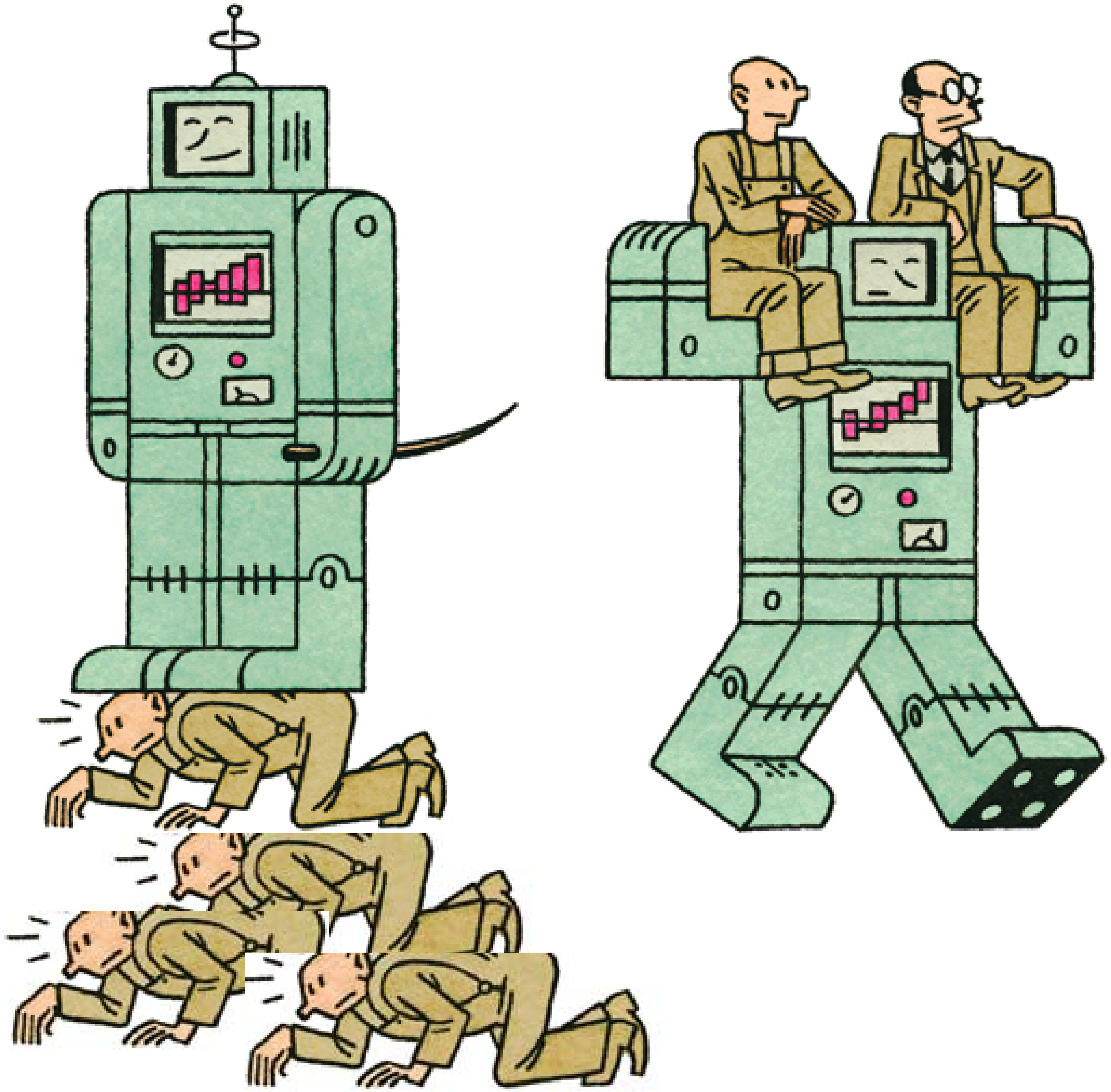
"Aincreasing" Gaps



MIT Technology Review

Business Impact

As Goldman Embraces Automation, Even the Masters of the Universe Are Threatened

Software that works on Wall Street is changing how business is done and who profits from it.

by Nanette Byrnes   Feb 7, 2017

At its height back in 2000, the U.S. cash equities trading desk at Goldman Sachs's New York headquarters employed 600 traders, buying and selling stock on the orders of the investment bank's large clients. Today there are just two equity traders left.

Automated trading programs have taken over the rest of the work, supported by 200 computer engineers. Marty Chavez, the company's deputy chief financial officer and former chief information officer, explained all this to attendees at a symposium on computing's impact on economic activity held by Harvard's Institute for Applied Computational Science last month.

Average compensation for staff in equities sales, trading, and research at the 12 largest global investment banks, of which Goldman is one, is $500,000 in salary and bonus, according to Coalition. Seventy-five percent of Wall Street compensation goes to these highly paid "front office" employees, says Amrit Shahani, head of research at Coalition.

For the highly paid who remain, there is a growing income spread that mirrors the broader economy, says Babson College professor Tom Davenport. "The pay of the average managing director at Goldman will probably get even bigger, as there are fewer lower-level people to share the profits with," he says.

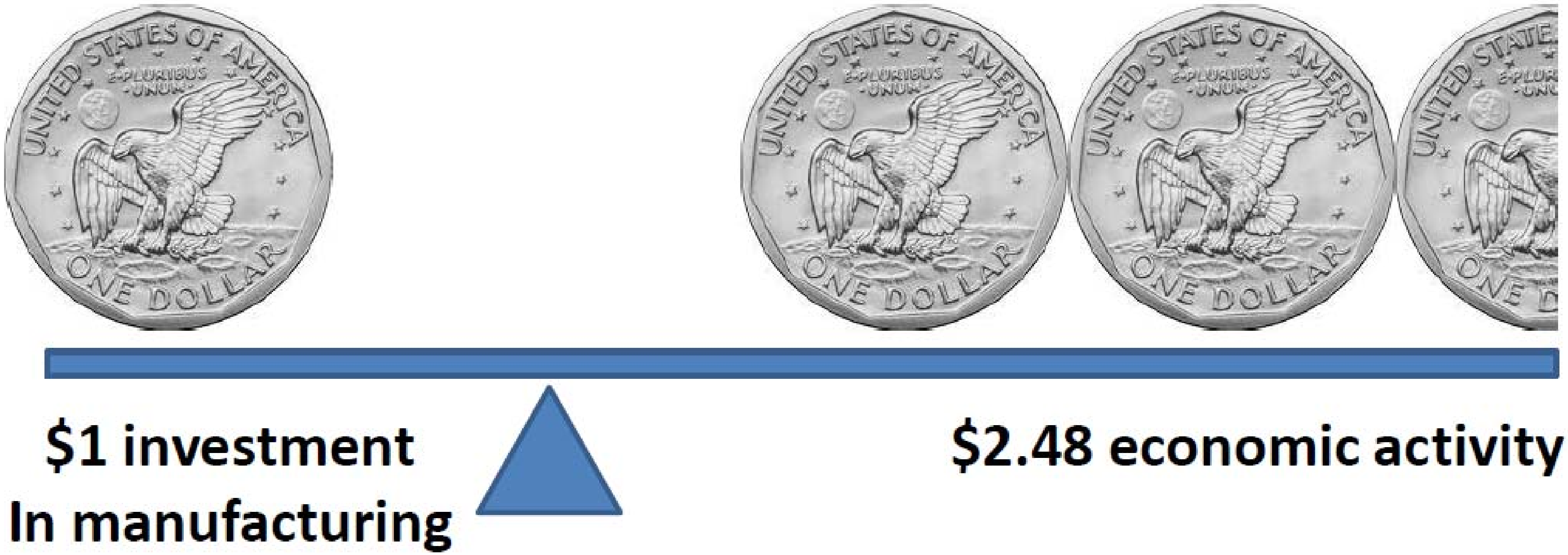
Return Manufacturing of Leading Nations

Industry 4.0

Made in China 2025

248% ROI (Return on Investment)

Advanced Manufacturing Partnership (AMP), creating high quality jobs and enhance USA global competitiveness.



Source: Professor Ben Wang of Gatech (2015)

Four Phases of "Industrial Revolution"

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1st: steam-powered mechanical manufacturing facilities

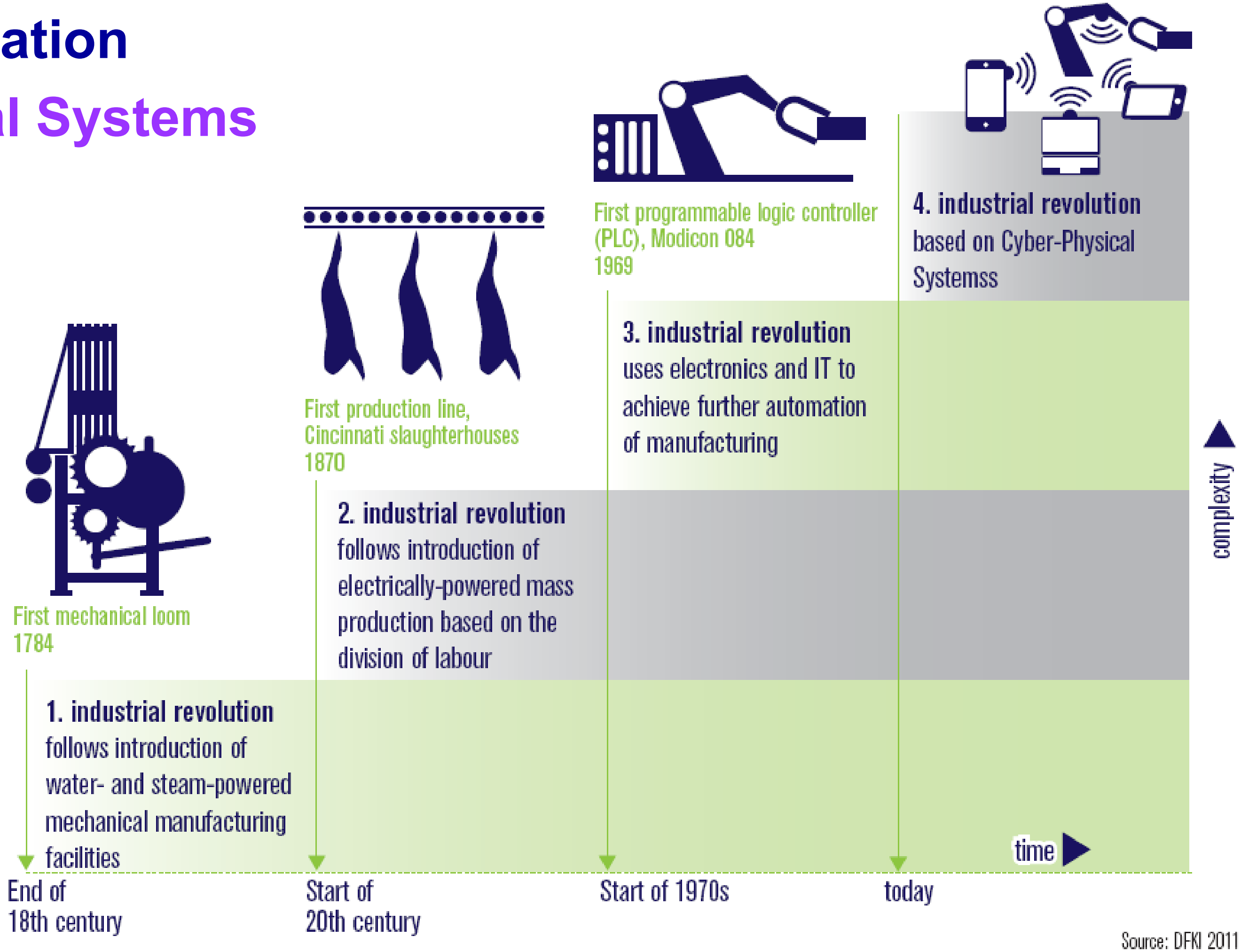
2nd: (start of 20th century)- electrically-powered mass production

3rd : IC and IT to achieve automation

4th : (today)- Cyber-Physical Systems

Enabling Technologies (0 -> 1)

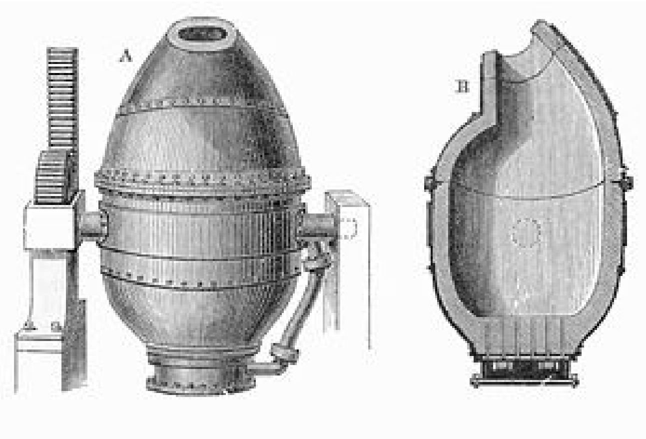
- Watt steam engine (James von Breda Watt)
- Transistor (1947/ Bardeen, Brattain, and Shockley, 1956 Nobel Prize)
- IC (Jack Kilby, 1958/ 2000 Nobel Prize)
- programmable logic controller (PLC) Modicon (modular digital controller) (Dick Morley 1968)



*Source: Federal Ministry of Education and Research (2013), "Securing the future of German manufacturing industry recommendation the strategic initiative INDUSTRIE 4.0 final report of the industrie 4.0 working group," *National Academy of Science and Engineering*.

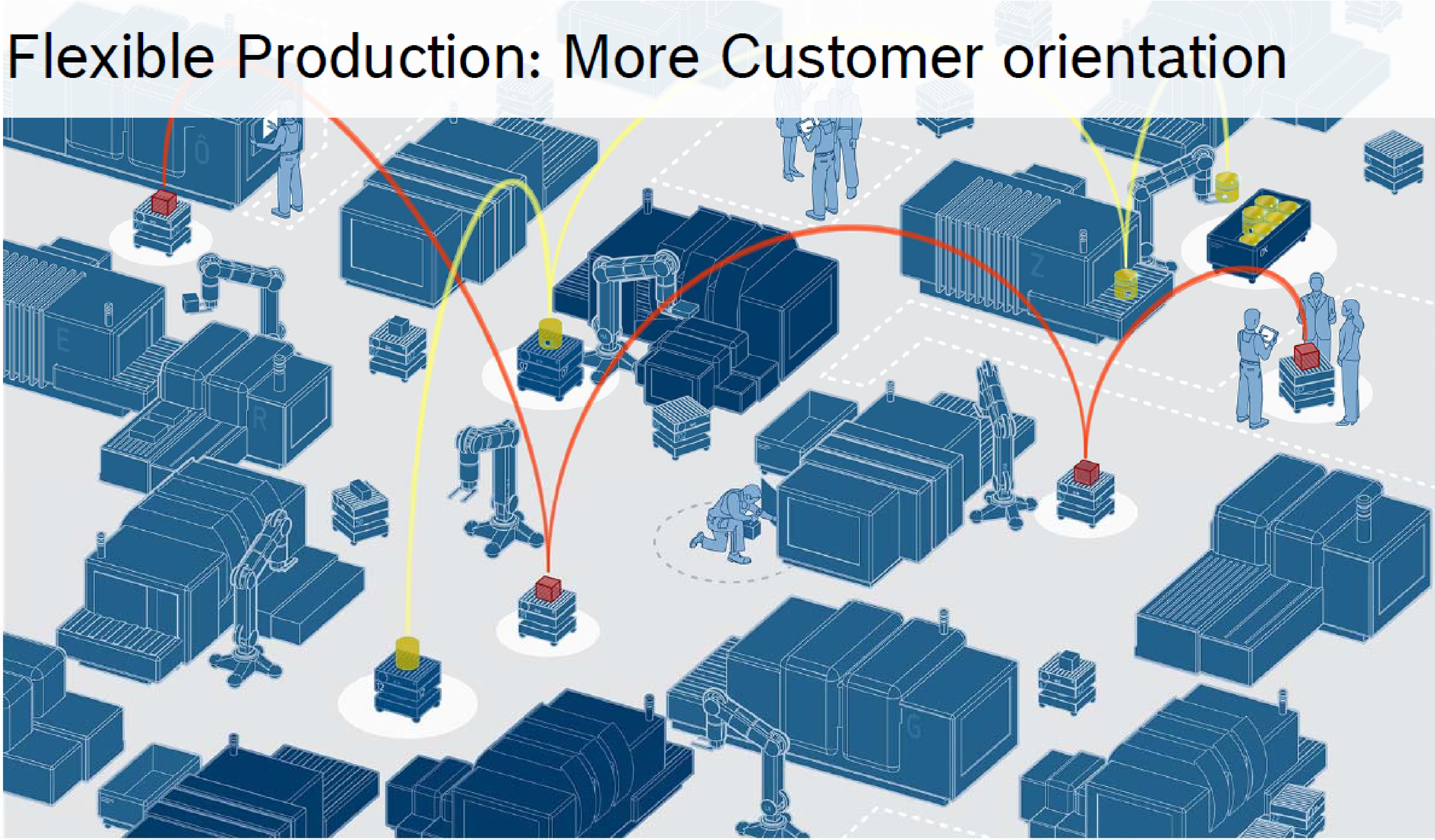
Industry 2.0 (1-> 10..0?)

The **Second Industrial Revolution**, also known as the **Technological Revolution**,[1] was a phase of the larger Industrial Revolution corresponding to the latter half of the 19th century, sometime between 1840/1870 until World War I. It is considered to have begun around the time of the introduction of Bessemer steel in the 1850s and culminated in early factory electrification, mass production and the production line. (Wikipedia)



Taylorism: Scientific Management (Industrial Engineering)

Flexible Production: More Customer orientation



... profitable production for lot size 1

Harvard Business Review

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TECHNOLOGY

The Death of Supply Chain Management

by Allan Lyall, Pierre Mercier, and Stefan Gstettner

JUNE 15, 2018

SUMMARY SAVE SHARE 0 COMMENT TEXT SIZE PRINT $8.95 BUY COPIES

Industry 3.5

Hybrid Strategy between Industry 3.0 and to-be Industry 4.0 via AI, Big Data Analytics, Computing & Digital Decision as disruptive innovations to empower smart production and Taiwan manufacturing (Chien, 2014).

DIGITIMES電子時報 觀點 2017年2月23日 星期四 15

簡禎富：工業3.5才是台灣製造的機遇和戰略

名人講堂

簡禎富

隨著物聯網(IoT)、大數據、機器人和人工智慧(AI)的發展，產業轉型升級的工業革命已經在進行中，越來越多工作機會因為自動化和智能化而消失，年輕人和弱勢族群更不容易找到好的工作。世界各國均提出自己的製造戰略，換言之，發展工業4.0提升製造的國際競爭力以搶救失業和經濟是德國的國家戰略。為了因應未來個人化、少量多樣的市場需求，工業4.0、大數據和虛實整合系統只是「工具目標」，聰明生產和彈性決策才是根本目標。台灣應該認真做SWOT分析，思考適合台灣的製造戰略。

Cover Story 封面故事

避免被上下夾殺

簡禎富建議：台灣應獨創工業3.5

做備料、產能規畫，求取最大利益。

「全世界的製造業，很多人都以為只要花錢買機台就可以做，可是台積電的例子告訴我們，它們的良率可以超出同業，靠的不是前段的設備與技術投資，後段的數據分析與預測運算，才是它們能夠一直保持領先的關鍵。」工研院產經中心分析師戴熒美說。市調機構研究分析師估算，台積電先進製程良率比對手至少高出十五個百分點。

簡禎富將決策分析的理論用到台積電實務上的消息傳出後，他的名號在科技業傳開。因此，當他重回清大教書，一家又一家的產業龍頭廠開始來敲門，從最上游的半導體產業延伸到下游硬體代工廠、LED、太陽能等，他替聯發科做過供應鏈管理分析，也替廣達做產品設計決策，現在就連傳統腳踏車業、鞋廠都上門來向他請益，拜託簡禎富幫忙抓問題。

美國、德國搶著做！台灣製造業不能等

「這些龍頭廠肩負產業發展的責任，它們都很清楚，大數據分析、智能化製造的重要性，這是它們一定要推進的趨勢。」簡禎富分析，因為這影響的不是台積電、聯發科、廣達、台達電任一家公司，而是整體台灣製造業的競爭力。

過去這幾年，美國政府積極喊出「再工業化(reindustrialization)」，要把高階製造搬回美國去，德國推動「工業四・〇」，將高度自動化與數據分析的技術導入德國工業，往「無人工廠」的目標發展，都是著眼於提升自家製造業的競爭力。

「美國、德國把製造業價值最高的這塊拿走，便宜勞力、大量生產的低階製造，又被中國搶走，台灣剩下什麼？」簡禎富認為，這是台灣所有製造業者不能迴避的課題。

運用過去管理經驗，先從部分自動化做起

「台灣過去總被稱為製造大國、軟體小國，如果不發展大數據，就如同我們把精良武器都賣到海外，但我們自己攻擊敵人的武器卻是弓箭與矛。所以，台灣製造業一定要升級，要用大數據的思惟來想事情，增加我們的產業競爭力。」工研院巨資中心主任余孝先說。

同樣的說法，也在對智慧工廠研究甚深的工研院機械所分析師黃仲宏口中聽到，「大數據絕對是開啟製造業在智慧化、自動化發展的一大關鍵。」

相較於歐美製造業都在升級，簡禎富從另外一種角度想，「我們不能停在工業三・〇，短期內又無法像美國、德國做到全自動化，可不可以用混合的方式，提出一個工業三・五？」簡禎富直言，台灣製造業仍未具備足夠能力，發展工業四・〇的全自動智慧化工廠，但我們可以利用過去的管理經驗與智慧，先從部分自動化做起，再搭配數據分析的力量，從根本上提升台灣製造業的競爭力，因為這一戰，台灣已沒有本錢再等下去了。

今周刊 2014, 11/24 / 86

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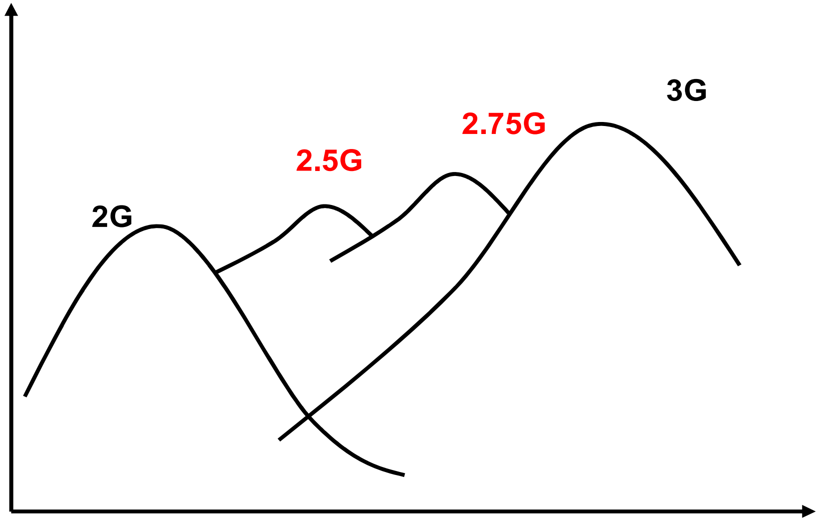

WILLY SHIH
CHEN-FU CHIEN 簡禎富
JYUN-CHENG WANG

Shanzhai! MediaTek and the "White Box" Handset Market

The term "Shanzhai Ji" discounts the huge economic value these handsets have created. The makers of these phones have created a classic "disruptive innovation" by addressing new markets with cost-effective solutions. If you look closely, you will find that many of these handset makers are quite innovative.

—Ming-Kai Tsai, Chairman and CEO of MediaTek

Ming-Kai Tsai looked back on 2009 with a great deal of satisfaction. His Hsinchu, Taiwan–based fabless semiconductor company had grown to become one of the top-three global suppliers of wireless chipsets, the essential electronic "brains" for mobile telephone handsets. In the second quarter of the year, the company had shipped 80 million chipsets, and the outlook for the third quarter was for 100 million, likely topping 350 million for the full year. In a global wireless handset market estimated to total 1.2 billion to 1.4 billion units,[1] this was quite an accomplishment.

Industry 3.5

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Industry 3.5 in 200mm fabs

IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING 1

A Novel Route Selection and Resource Allocation Approach to Improve the Efficiency of Manual Material Handling System in 200-mm Wafer Fabs for Industry 3.5

Chen-Fu Chien, *Member, IEEE*, Che-Wei Chou, and Hui-Chun Yu

***Abstract*—Motivated by realistic needs to enhance the productivity for 200-mm wafer fabs, this paper aims to propose a novel approach for manual material handling system (MMHS) to mimic functionalities of the automated material handling system in the advanced fabs without intensive capital investment to deliver the wafer lots manually and systematically. In particular, a mathematical model is developed to optimize the routing plan with two objectives that minimize the total traveling distance in all routes or minimize the number of manpower needed in all routes. Furthermore, a route planning approach is proposed to utilize the routes that reduce the technician traveling distance and transportation time for implementation. Also, a manpower loading index was developed for evaluating the number of needed technicians in the proposed MMHS. To estimate the validity of the proposed MMHS, we developed a simulation environment based on empirical data with different transportation requirement scenarios for comparison. The results have shown practical viability of the proposed approach.**

***Note to Practitioners*—As advanced manufacturing strategies such as Industry 4.0 are proposed for smart production, 200-mm wafer fabs cannot be equipped with fully automation facilities such as the automated material handling system to enhance overall productivity. To address the needs in real settings, a disruptive innovation manual material handling system was developed, on the basis of existing 200-mm fab facility, to organize the technicians to mimic the setting of a virtual material handling system manually to enhance productivity. Indeed, the developed solution has been implemented in this case company, in which the results have validated the proposed approach that can be a hybrid between the existing Industry 3.0 and to-be Industry 4.0.**

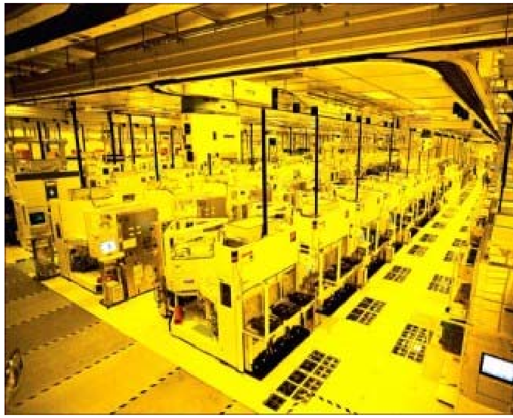
***Index Terms*—Fab economics, Industry 3.5, manpower allocation, manual material handling system (MMHS), productivity, route planning.**

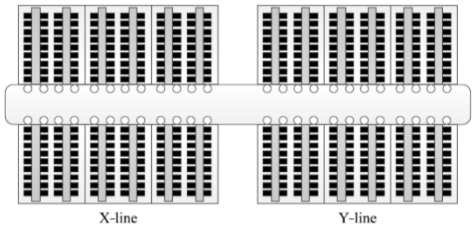
I. Introduction

SEMICONDUCTOR fabrication facilities (fabs) are the most capital-intensive and complex manufacturing plants that consists of lengthy re-entrant processes including cleaning, oxidation, deposition, metallization, lithography, etching, ion implantation, photoresist strip, inspection, and measurement [1]. The wafers pass through approximately several hundred processing steps for wafer fabrication, in which operational efficiency and productivity enhancement via maximizing the throughput and yield, while minimizing cycle time, are critical for maintaining competitive advantages [2], [3].

Automation in modern fabs enables efficient material handling between resources to reduce cycle time and manufacturing cost [4]. In particular, the advanced 300-mm fabs rely on automated material handling system (AMHS) to manage the wafer transportation in fabs [5], [6]. Furthermore, Germany has proposed a manufacturing strategy, Industry 4.0 [7], for smart factory via cyber-physical systems and decentralized decisions within a smart and networked platform. However, most existing 200-mm fabs that find it difficult or cost effective to install AMHS employ technicians maneuvering the trolleys for moving the wafer lots [8].

Motivated by realistic needs to empower 200-mm wafer fabs, this paper aims to propose a disruptive innovation via manual material handling system (MMHS) that mimics the AMHS functionalities by technicians and reduces the trolley accidents effectively. However, since the technicians may decide by themselves the wafer lots and the corresponding transportation route, some lots may be delayed causing cycle time increase, while serious trolley accidents happen causing





Kevin Plank: "Time for disruptive innovation for labor-intensive shoe making that is dominated by Asian countries…"

Under Armor Lighthouse is groundbreaking new design and manufacturing hub to push the boundaries of what's possible via pioneering the best practices, efficiencies, and methods that will help us make products faster and better…

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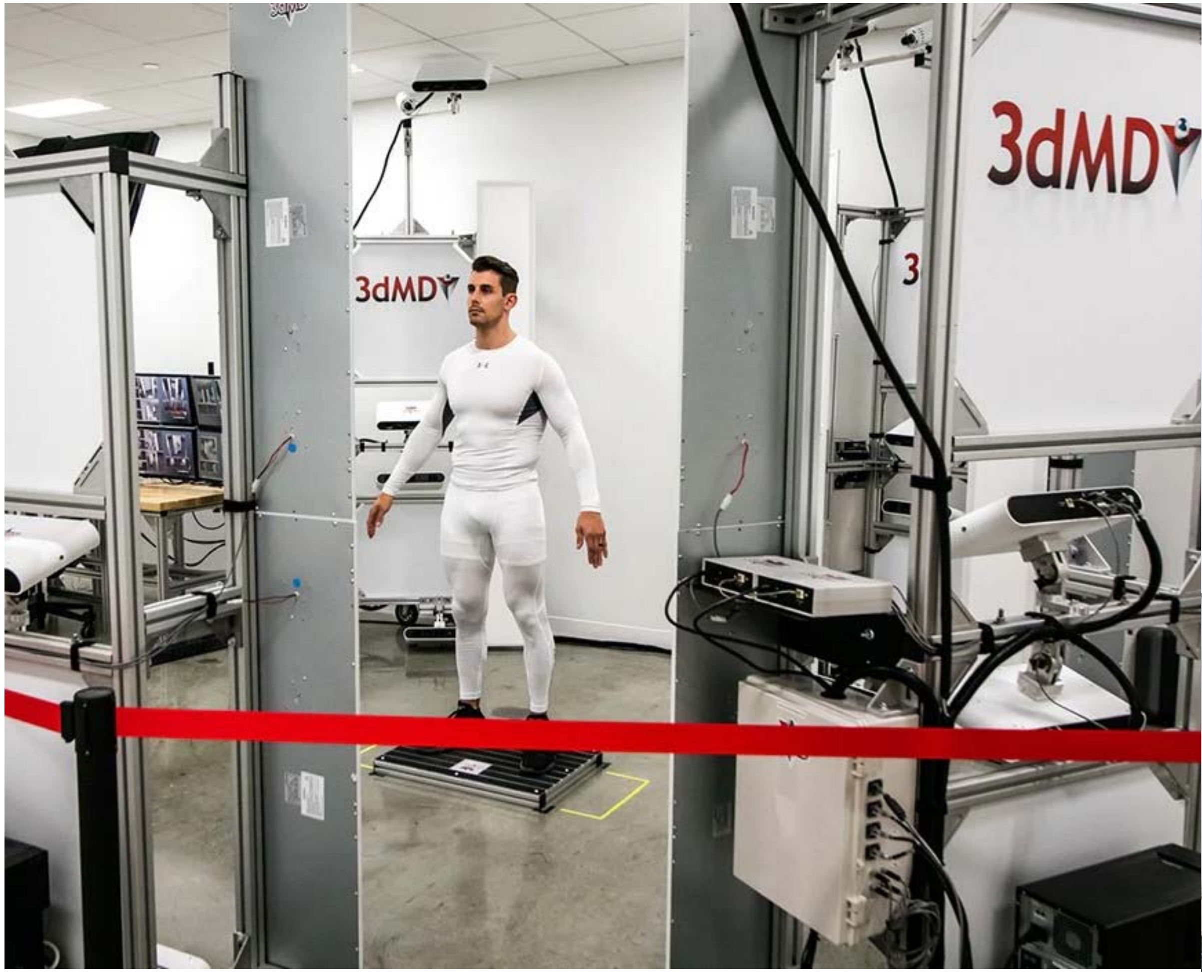
UA LIGHTHOUSE

MANUFACTURING & DESIGN LEADERSHIP CENTER



3D PRINTING &
RAPID PROTOTYPING

3D DESIGN &
BODY SCANNING

Robot for shoe making via EMS such as Flex (Flextronics)

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Not easy to replace human :)

Flex and Nike terminate business relationship

Flex and Nike has mutually agreed to wind-down the footwear manufacturing operations in Guadalajara by the end of the year.

"Regarding NIKE, we have worked hard with NIKE to make our footwear operation in Mexico technically and commercially successful. In recent weeks, however, it became clear that we are unable to reach a commercial and viable solution with NIKE and have mutually agreed to wind down our NIKE footwear manufacturing operation in Guadalajara by December 31, 2018. We are finalizing the terms and details of the wind-down and we are striving to retain many of our affected employees and to repurpose our facility", states Christopher E. Collier, CFO at Flex Ltd. in an analyst call.

In connection with the closing of the operation, the EMS-provider recognised USD 30 million of exit costs primarily related to its estimated impairment of fixed assets. Additional costs as the wind-down is completed may be incurred.

"I would say that we are disappointed where we sit right now. I think as we step back, NIKE was extremely unique in differentiating and I think that it was an important feature that we went after and we are just being very thoughtful at this stage in terms of where we sit. And since we can't get to a commercial agreement where our shareholders can have a sustainable return, we decided to exit", Collier continues.

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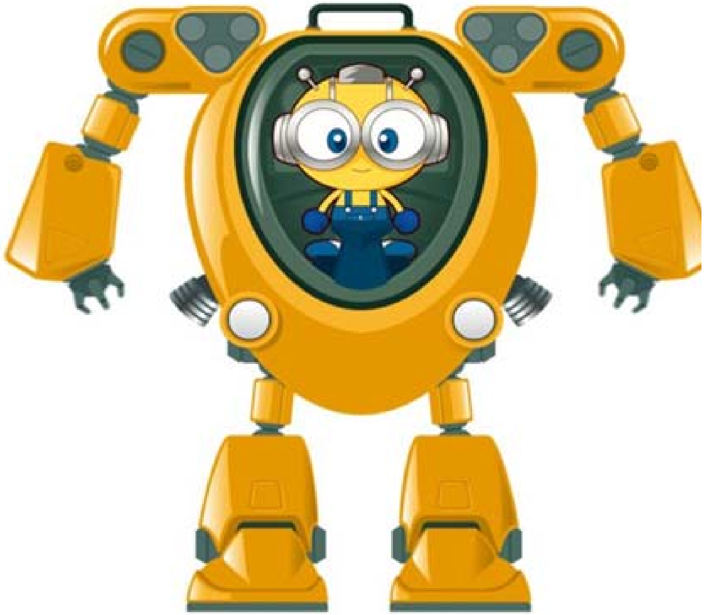
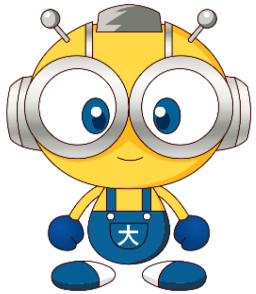
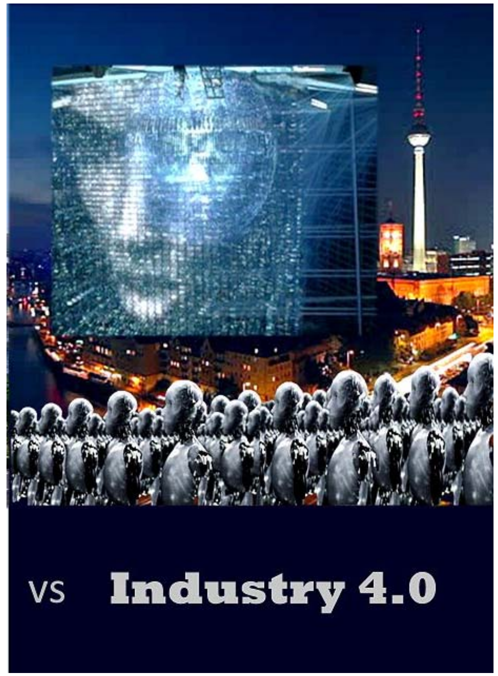
Industry 3.5 aims to empower human being as "Iron Man"

WPG Holdings is the world No.1 Semiconductor Distributor and the largest electronics distributor

?







Industry 3.5 "Iron Man"	Industry 4.0 "I, Robot"
Human-System Collaborations Decentralized DSS & disruptive innovations	Cyber-Physical System Closed platform led by big company with constant charge
Human empowered by AI	**human replaced by robots and AI**

Digital Transformation：
Industry 3.5 as alternantive strategy

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大聯大控股執行長 葉福海

面對新變革 一起共享共好 把市場做大

大數據、物聯網的出現，使得運作近百年的商業流程，將在5年內全面「顛倒」，過往大量製造銷售、壓低成本、搶佔市占率的紅海手段已面臨考驗。在面臨變革的重要時刻，大聯大領頭，邀請產業建立共識、攜手打群架，建築智慧供應鏈平台的生態圈，一起贏市場，把市場做大。

撰文者 商周數位 | 2017-09-07 | 瀏覽數：2049

讚 94 分享

清華講座教授 簡禎富

善用台灣優勢 鋼鐵人迎戰機械人

工業4.0驅動各國製造戰略競合，台灣製造業如何乘勢而起？清華講座教授簡禎富提醒，台灣必須升級轉型，但無法一步到位，工業3.5的混合策略是先當鋼鐵人，善用台灣人的管理智慧和產業利基，並整合新科技的應用，搶先卡位。

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讚 216 分享

Industry 3.5 is better for Emerging Countries

Industry 3.5
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產業動態

台灣工業3.5　更適合新南向國家

菲律賓國家研究委員會年會　台灣學者首次受邀演講

台北訊

科技部人工智慧製造系統研究中心(AIMS)主任、科技部工業工程與管理學門召集人、國立清華大學清華講座教授暨美光講座教授簡禎富，日前(11日)應邀於菲律賓國家研究委員會(NRCP)年會演講「工業3.5混合戰略以優化新興國家人力資本」，為首次在菲律賓科技會議暨國科會年會中演講的台灣教授。

本屆NRCP大會由菲律賓科技部長Fortunato de la Pena主持，共計超過1,300多位學者與會。會議主軸為「人性化第四次工業革命」，特邀簡禎富講座教授於「工程與產業研究群」分享所提出的「工業3.5」策略。

簡禎富教授認為：新興國家工業基礎並不足以一步到位地推動工業4.0，同時也需要解決更多就業和貧富差距等社會問題，因此必須發展適合自己產業結構和核心能力的製造戰略。「工業3.5」作為工業3.0和工業4.0之間的混合策略，藉助人工智慧和大數據等破壞性創新技術，發展本土智慧製造解決方案。

簡教授並介紹AIMS的研究成果和台灣產業實證案例，與菲律賓目前發展工業4.0面臨的挑戰與實際需求不謀而合，受到熱烈迴響和深入討論交流。簡禎富教授並以他撰寫的台積電、聯發科、創意電子、晶元光電等哈佛商學個案的典範企業為例，說明台灣製造軟實力和工業3.5，更能當作菲律賓產業升級參考，以擴大台灣在東南亞國家的影響力。

會後菲律賓NRCP理事長Ramon A. Razal院士並邀請各研究群組主席，與簡禎富教授進行圓桌會議，討論國際合作和人才培育等議題。簡禎富表示：「台灣應把握新興國家面對工業4.0的產業升級壓力和挑戰，讓工業3.5成為台灣製造的品牌，成立國家隊整合相關企業和台商，發展更符合新興國家需求的工業3.5解決方案，讓台灣製造軟實力在東南亞國家發揮更大的影響力」。

▲菲律賓科技部長Fortunato de la Pena(左)與簡禎富教授(右)同席並聆聽演講。

Harvard Business Review
哈佛商業評論 全球繁體中文版

迎向工業 4.0 挑戰

如何先打造出「工業3.5」的能力？

簡禎富（國立清華大學工業工程與工程管理系講座教授）

工業4.0智慧製造時代來臨！工業4.0的生產方式以物聯網、大數據、雲端系統、互聯網+、智慧機械等新型科技為基礎，以數據匯流串接產業價值鏈每一個環節，強調跨域虛實整合，打破生產與服務疆界和公司界線，正在重新解構價值鏈並形塑全球製造分工。

另一方面，愈來愈多工作機會已因無人化而消失，年輕人和弱勢族群更不容易找到好的工作，更加大貧富差距。製造業帶動經濟發展、創造就業的重要性，遠超過國內生產總額（GDP）表面數字，各國政府為了救經濟、救失業，無不積極推動國家製造戰略，以拿回先進製造，並爭奪第四次工業革命的主宰地位。然而，台灣如何在先進國家重回製造和新興國家替代的上下夾擊間，發展適合自身產業結構和核心能耐的製造戰略？台灣廠商如何在產業升級重構過程中，規畫適合的數位轉型和智慧製造策略？

國立清華大學工業工程與工程管理系講座教授簡禎富主張，「如果企業不能馬上跨入工業4.0，不妨先做「工業3.5」！」大多數公司只是工業4.0軟硬體系統的使用者，而相關系統架構仍在演化中，當務之急，還是先發展能讓智慧製造系統發揮效能的大數據分析和彈性決策能力。也就是說，「工業3.5」是工業3.0和工業4.0之間的混合策略，企業可以先站在既有的基礎之上，盤點自身擁有的資源和長短處，建立自身專屬的數位轉型策略和智慧製造技術藍圖，一面強化自身的數位能力，拉開與新興國家的差距，另一方面先進入工業4.0之前的過渡階段，先從市場上收割部分產業升級的好處。厚植實力後，再進入工業4.0，成功機率就會大幅提升。

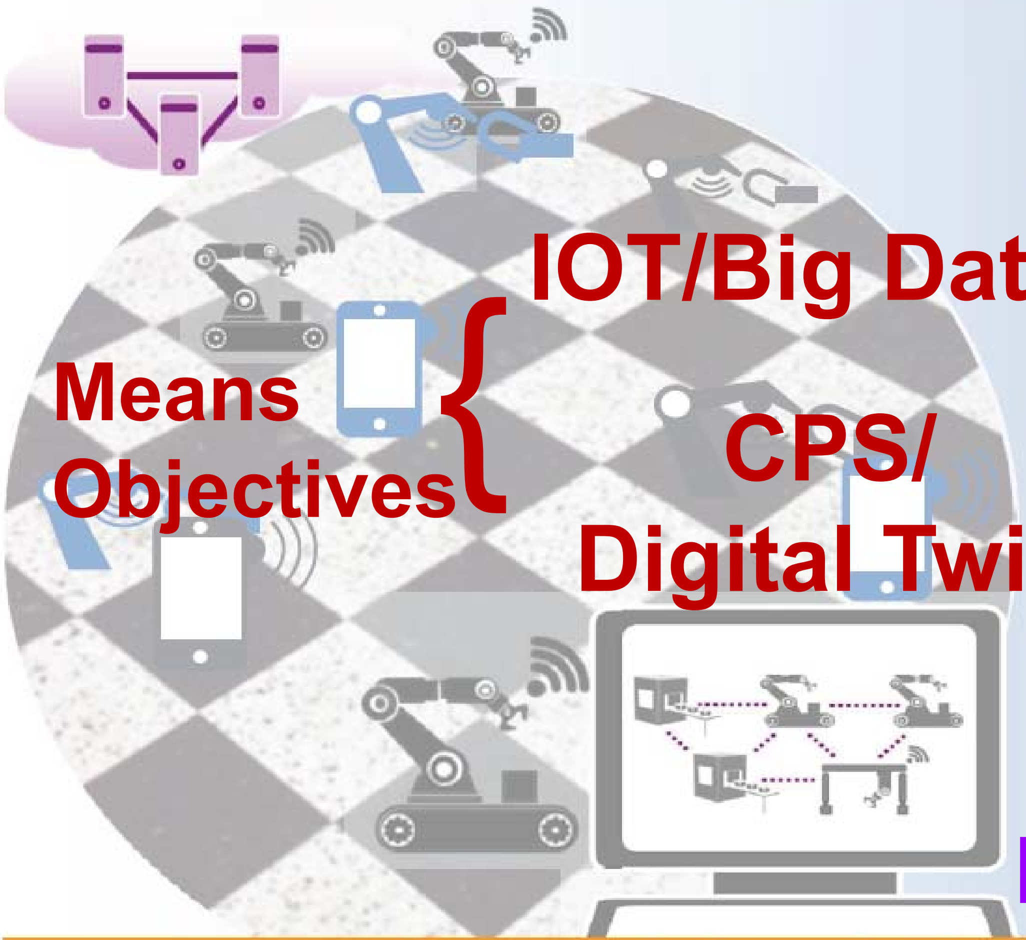
他並提出「工業3.5概念架構圖」，作為製造業者盤點自身資源和決策情境、

工業 4.0 與工業 3.0 的差異

	工業 3.0	工業 4.0
商業模式	供應鏈水平分工的上下游廠商協同合作，商業模式以 B2B（business to business）與 B2C（business to consumer）為主	價值鏈垂直整合的製造平台，商業模式以 C2M（customer to manufacturer）為主
生產模式	價值主張是提升生產力和規模報酬。品牌商（行銷部門）推估消費者需求開發產品下單生產，製造商（生產部門）根據市場需求預測來規畫產能和批量生產，完成後以滿足客戶訂單的需求，或設法賣給更多消費者來提升產能利用率。	價值主張是彈性決策和聰明生產。製造商（生產部門）直接根據各個消費者需求才生產，提高產品和服務價值，提升虛實整合製造平台的綜合效能。

Industry 4.0: Algorithmicized "production chess" within cyber-physical systems

SIEMENS



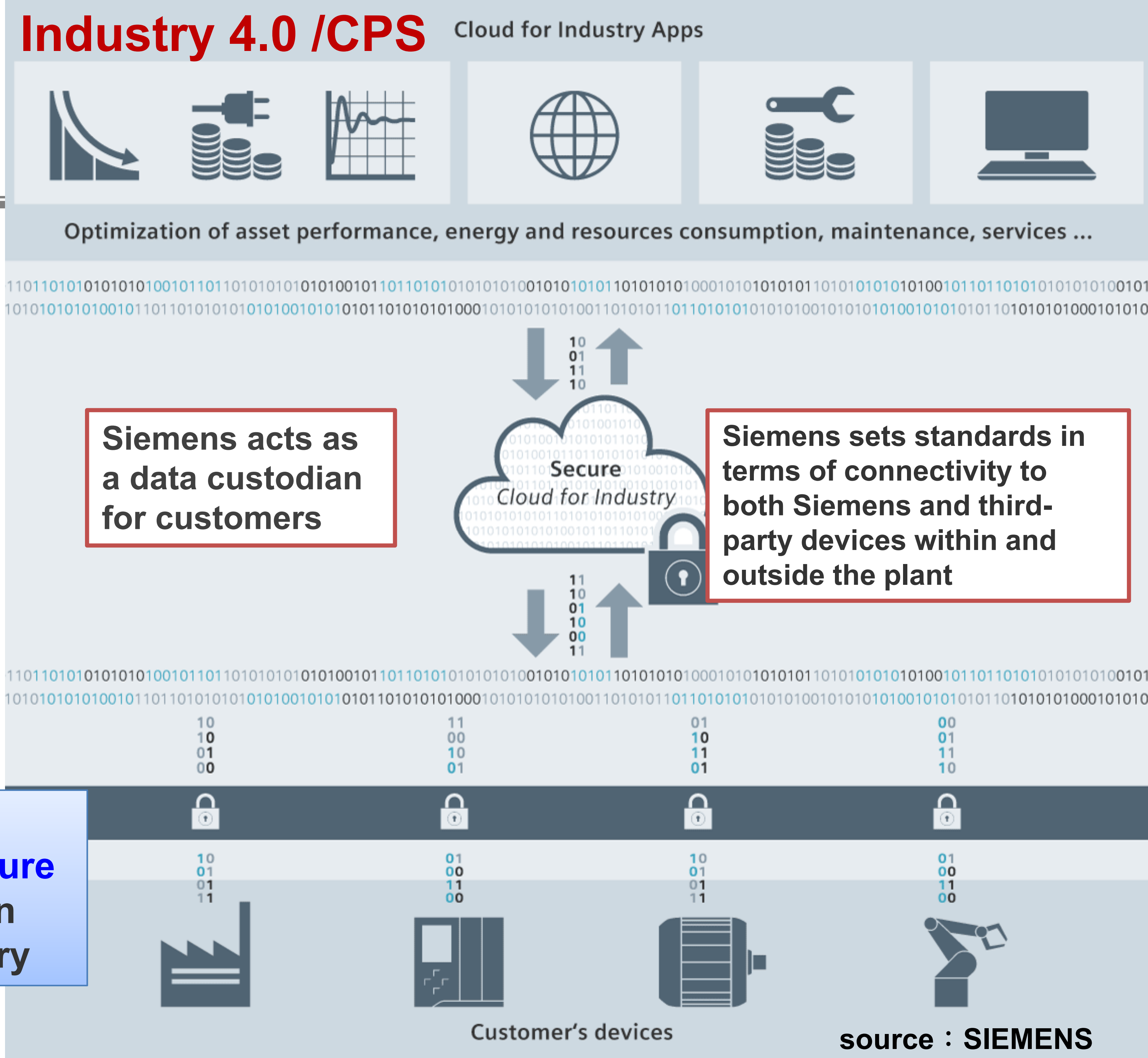
Vision for Industry 4.0

- The **product** to be manufactured **contains all necessary information** on its production requirements
- **Self-organization of integrated production installations** considering the entire value chain
- **Flexible decision on production process** on the basis of the current situation

Fundamental Objectives

Decentral cyber-physical systems (CPS) interact via embedded internet-based technologies

Industry 4.0 /CPS



Siemens acts as a data custodian for customers

Siemens sets standards in terms of connectivity to both Siemens and third-party devices within and outside the plant

Value Chain Restructuring

- Profit shifts to hidden modules with high barriers

A powerful, secure, and reliable cloud infrastructure enabling Easy integration into the Cloud for Industry

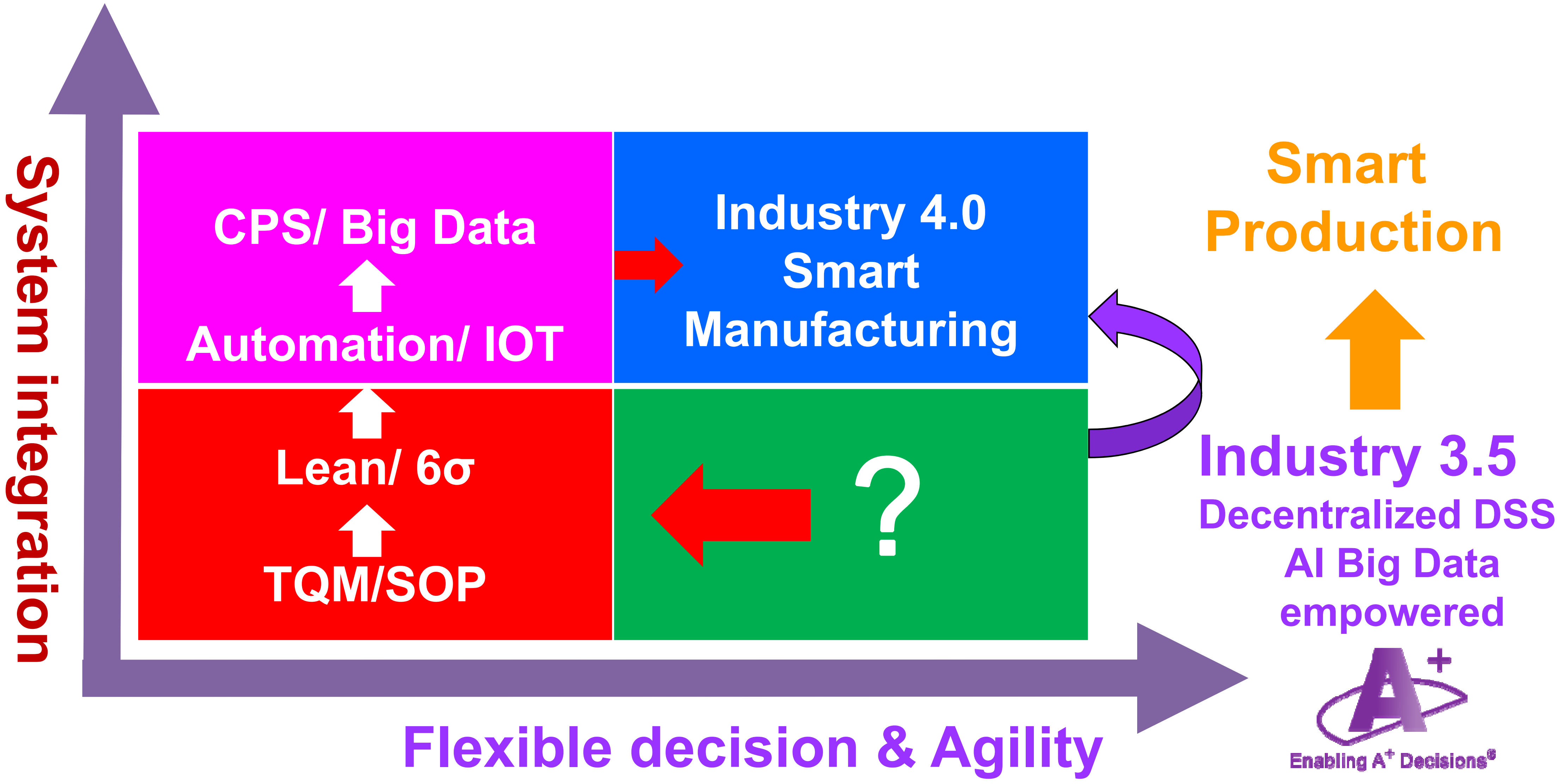
source：SIEMENS

SAP “indirect access” charge

- Indirect access is a term used to define the situation where a SAP customer is liable for additional license fees when third party applications access data held in SAP.
- If a customer fails to purchase licenses for users accessing a SAP system indirectly through a third party or custom interface, such as software-as-a-service (SaaS) application. For example, a third-party or custom mobile app for tracking goods and updating SAP records accordingly would be deemed indirect access.
- February 2017: SAP wins court case against Diageo that is ordered to pay £54,503,578 in licensing fees after its sales staff were running Salesforce applications on top of SAP data.
- SAP seeks $600 million in compensation for unlicensed use from the Belgian brewing giant Anheuser-Busch InBev that was also settled in June 2017
- May 2017: SAP responds to Diageo indirect licensing case with "modern pricing" approach/ October 2017: SAP launches Licensing Transparency Centre
- ….

Source: https://www.computerworlduk.com/it-vendors/sap-indirect-access-explained-3671760/

Flexible decisions for mass-personalization (profitable lot size=1) is fundamental objective



PDCCCR Framework for integrated corporate digital decision

C.-F. Chien et al. / Int. J. Production Economics 128 (2010) 496–509

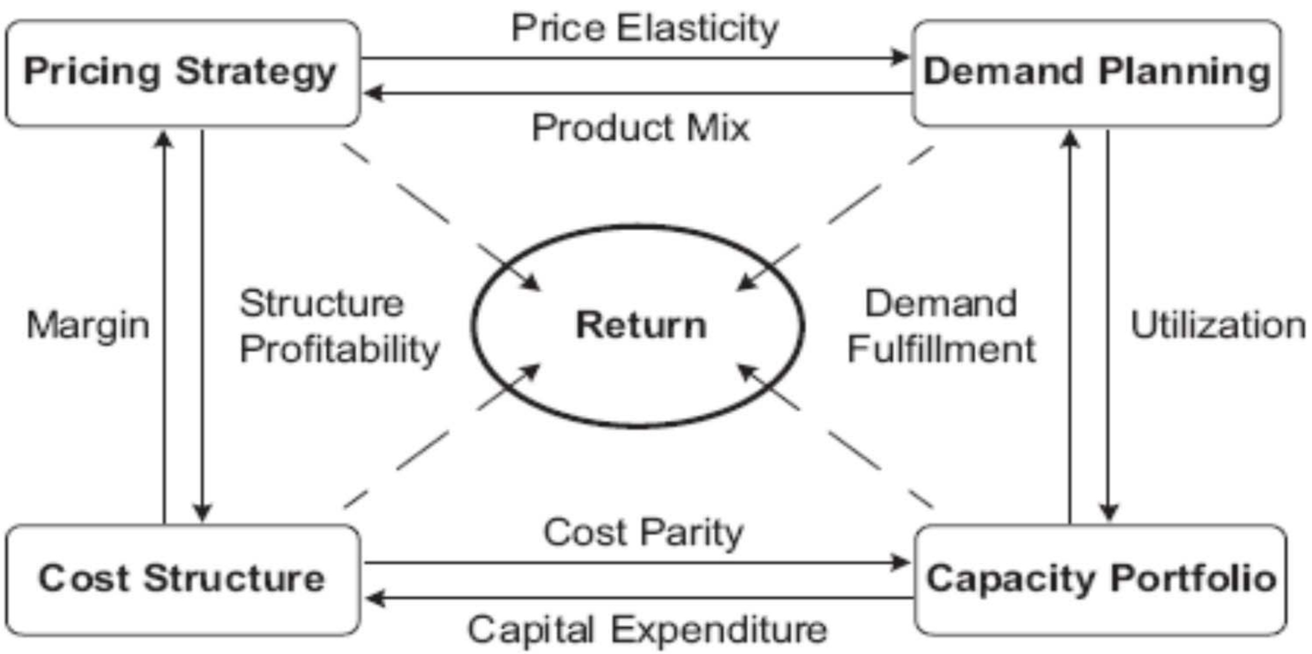
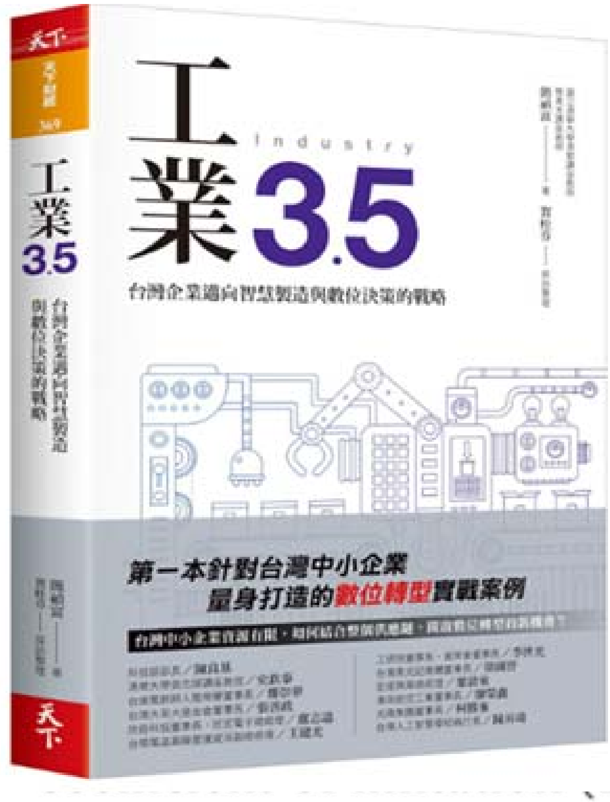


Fig. 1. Conceptual Framework of PDCCCR.



參考文獻：簡禎富，《工業3.5》，天下雜誌出版，2019。

TSMC Way

Harvard Business Review

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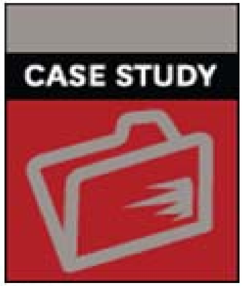
CASE (FIELD)

The TSMC Way: Meeting Customer Needs at Taiwan Semiconductor Manufacturing Co.

by Willy Shih, 簡禎富, Chintay Shih, Jack Chang
Source: Harvard Business School
23 pages. Publication date: Aug 13, 2009. Prod. #: 610003-PDF-ENG



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When L.C. Tu receives an emergency order, he is confronted with a range of production scheduling choices, each of which has unique costs and trade-offs. The case was designed to help students understand job-shop style production and the impact of disruptions and reactive scheduling. Students use two of Taiwan Semiconductor Manufacturing Company's mainstream processes as a vehicle for analysis. The case describes a real situation in which upper management accepts an emergency order. By working through the impact on the production system, students should develop a feel for how shifting demand in a large factory that is structured as a job shop alters the demands on, and utilization rates of expensive capital equipment in a complex way. As bottlenecks shift, students can explore several alternatives, each with different costs and trade-offs. Students may also reflect on the true cost of providing the extraordinary service, and whether management properly takes the impact on operations into account when it makes customer commitments.

To maximize their effectiveness, color cases should be printed in color.

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約有 837,000 項結果 (搜尋時間：0.32 秒) **837,000 findings**

The TSMC Way: Meeting Customer Needs at Taiwan ... - Prezi
https://prezi.com/.../the-tsmc-way-meeting-customer-needs-at-taiwan-se... ▾ 翻譯這個網頁
2013年10月15日 - The TSMC Way: Meeting Customer Needs at Taiwan Semiconductor Manufacturing Co. Group 6. Questions 7-9. Q7. Does this suggest that ...

Google Toyota way **Toyota Way: Industry 2.0+**

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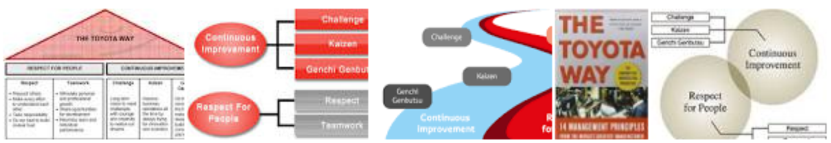
約有 21,300,000 項結果 (搜尋時間：0.51 秒) **21,300,000 findings**

[PPT] Toyota Way 豐田模式
bm.nsysu.edu.tw/tutorial/kuo/rm/toyotaWay.ppt ▾
Toyota Way 豐田模式. 郭倉義. 中山企管. kuo@bm.nsysu.edu.tw. www.books.com.tw. 為何導入『豐田生產系統』. Just-in-time; 自働化Jidoka. 大野耐一的兩大支柱.

The Toyota Way - Wikipedia
https://en.wikipedia.org/wiki/The_Toyota_Way ▾ 翻譯這個網頁
The Toyota Way is a set of principles and behaviors that underlie the Toyota Motor Corporation's managerial approach and production system. Toyota first ...

「Toyota way」的圖片搜尋結果 檢舉圖片

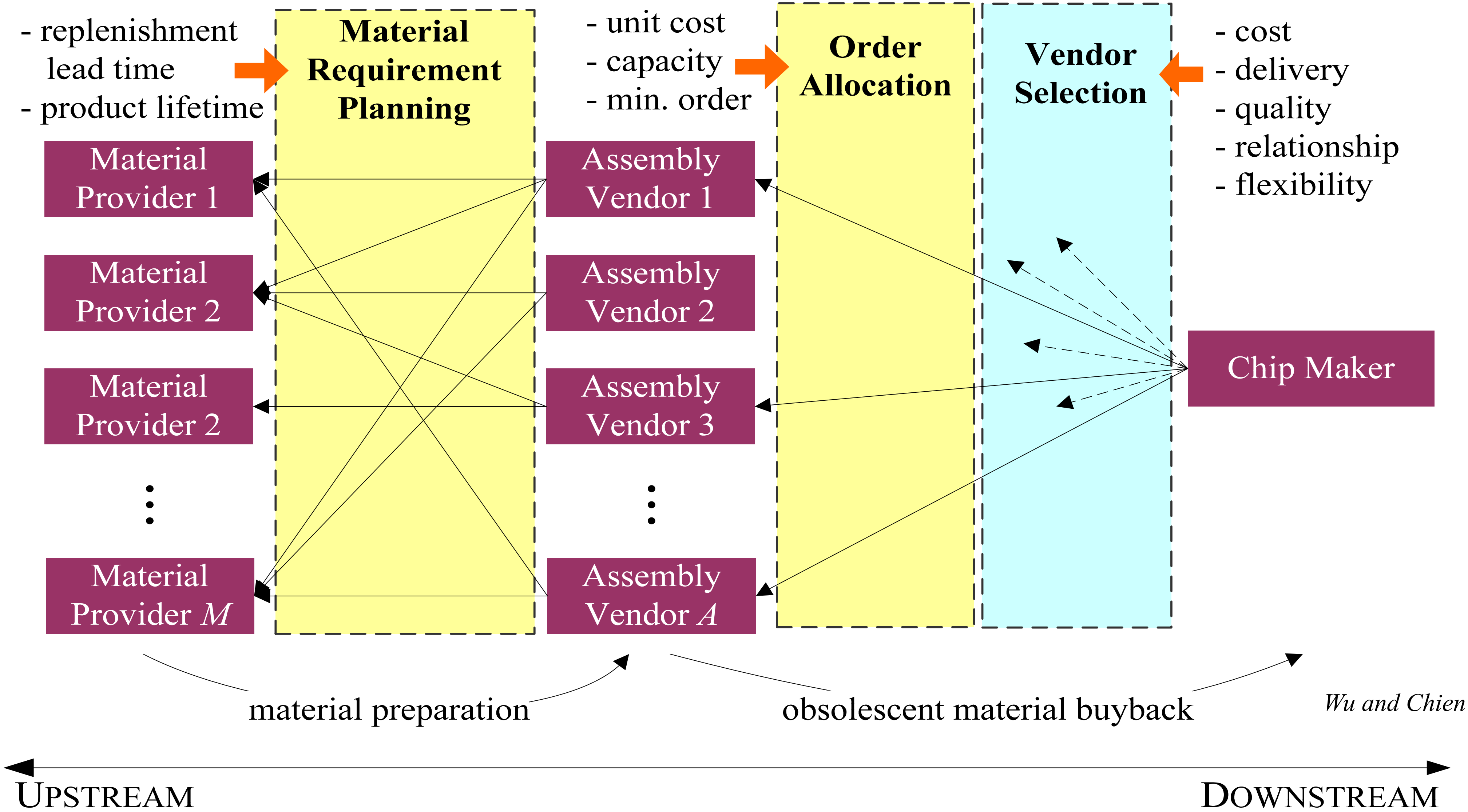


更多符合「Toyota way」的圖片

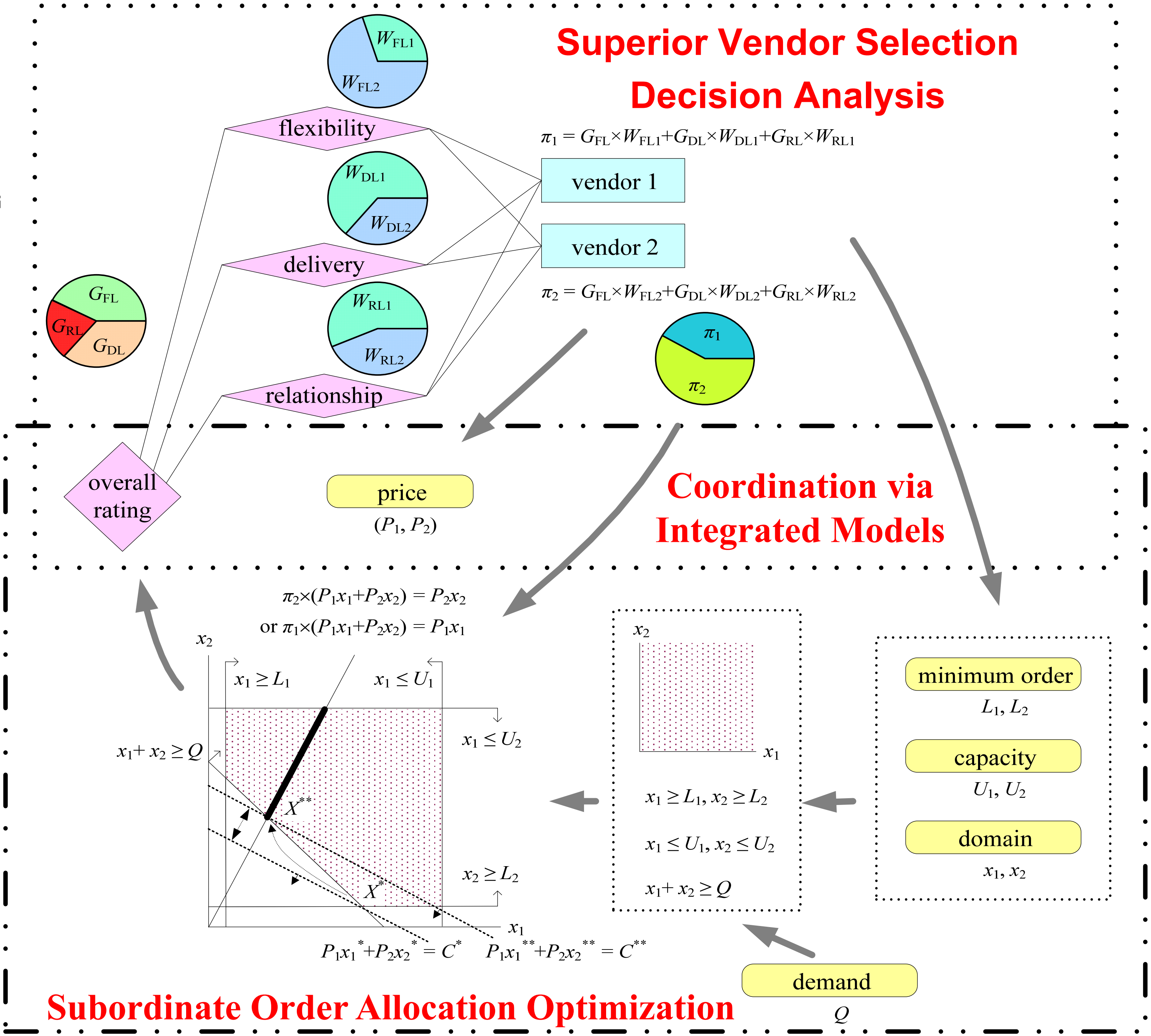
New paradigm of Taiwan Industry3.5!!!

12 Harvard Case Studies by Chen-Fu Chien 簡禎富

PDCCCR for optimizing outsourcing and order allocation decisions



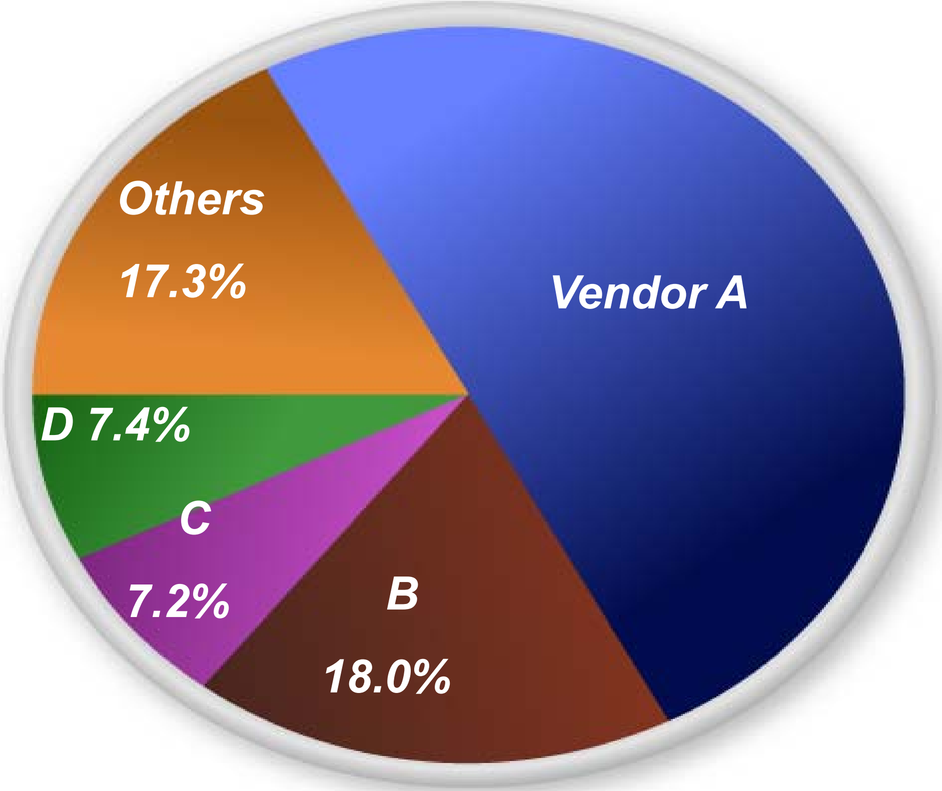
Wu and Chien (2008)



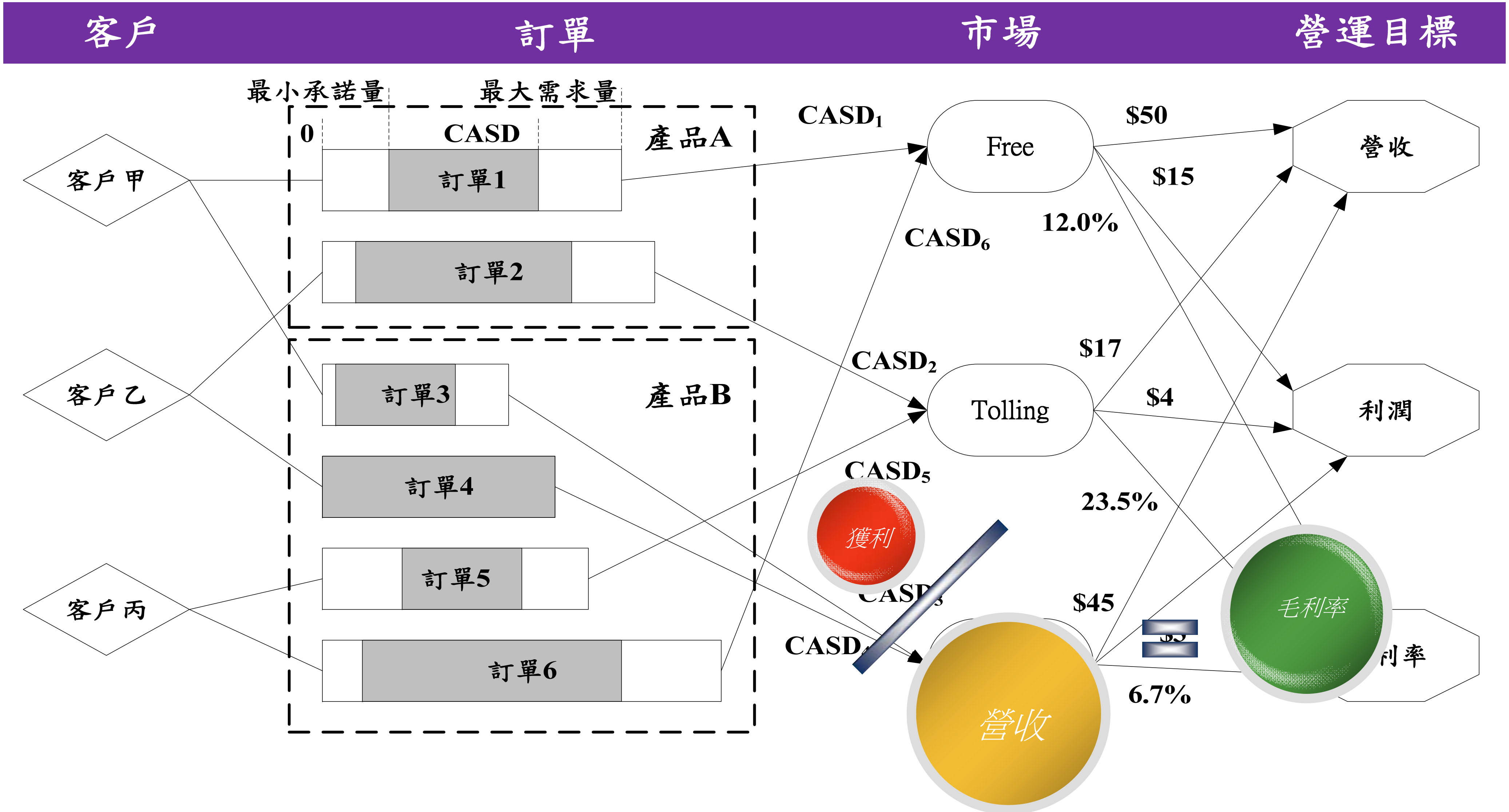
Wu, J.-Z. and Chien, C.-F. (2008)

(Wu and Chien 2008)

Vendor	Target Ratio	Proposed Model Cost	Proposed Model Alignment Difference	Heu Cost	
v	π_v	C_{1v}	$\lvert \pi_v \sum C_{1v} - C_{1v} \rvert / \sum C_{1v}$	C_{2v}	
A	37.60%	85,931	1.20%	87,102	
B	33.44%	74,532	0.22%	77,293	
C	12.99%	24,995	1.70%	22,258	
D	10.71%	23,114	0.27%	22,378	
E	2.84%	5,925	0.16%	6,632	
F	1.28%	3,240	0.18%	3,590	
G	1.14%	3,717	0.54%	2,705	
Total	100.00%	221,454	4.28%	221,958	
$TVP_m = \sum \pi_v \times C_{mv}$		63,208		64,150	62,717



Smart Production



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財務報表 (by cash)

Input Data

- 訂單資訊
- 成品價格
- 製程產出分佈
- 製程成本
- 晶片成本
- 晶片期初存貨
- 產品期初存貨
- 存貨賣出信心度
- 瓦數轉換表
- 其它

Run

- 執行

Out Data

- 財務報表(by cash)
- 財務報表(by unit)
- 各期訂單滿足情況
- 各期晶片購買及投產量
- 各期製程投產量
- 各期製程產出明細
- 各期產品庫存狀況
- 各期晶片庫存狀況

TIME	0	1	2	3	sum
Total cost	$ 5,454,992.21	$ 9,555,487.53	$ 8,939,502.55	$ 7,853,375.35	
Chip purchase cost	$ 4,415,340.71	$ 6,450,506.83	$ 6,049,234.37	$ 5,449,601.73	$ 17,949,342.93
Production cost	$ 1,039,651.50	$ 2,168,946.57	$ 1,954,225.42	$ 1,467,727.76	$ 5,590,899.75
Chip inventory cost	$ -	$ 4.97	$ 0.95	$ 0.95	
Product inventory cost	$ -	$ 29.16	$ 41.81	$ 44.92	
Fixed cost	$ -	$ 936,000.00	$ 936,000.00	$ 936,000.00	$ 2,808,000.00
存貨價值	$ -	$ -	$ -	$ 2,160,606.13	$ 2,160,606.13

Total Cost	$ 31,803,234.89

IEEE

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Chen-Fu Chien

For the paper entitled "An Algorithm of Multi-subpopulation Parameters with Hybrid Estimation of Distribution for Semiconductor Scheduling with Constrained Waiting Time" published in the IEEE Transactions on Semiconductor Manufacturing Volume 28, Number 3, August, 2015

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An Integrated Approach for IC Design R&D Portfolio Decision and Project Scheduling and a Case Study

Chen-Fu Chien, *Member, IEEE*, and Nhat-To Huynh

***Abstract*—Research and development (R&D) projects are crucial for semiconductor companies to maintain growth, profitability, and competitiveness. Integrated circuit (IC) design is capital intensive and continuously migrates to new technologies to meet various market demands. Moreover, the scheduling of selected R&D projects that enables technology roadmap involving complicated interrelationships, while competing for similar resources. Focusing on realistic needs, this paper aims to propose an integrated approach for selecting IC design projects for R&D portfolios and scheduling the selected projects simultaneously. In particular, a hybrid autotuning multiobjective genetic algorithm was developed to solve large sized problem instances. An empirical study was conducted at a leading IC design service company in Taiwan to test the validity of the proposed approach. The proposed algorithm was compared with conventional approaches for both convergence and diversity. The results have shown the practical viability of this approach in efficiently and effectively generating near-optimal portfolio alternatives for portfolio selection. The approach also enables the scheduling of the selected projects to achieve R&D portfolio objectives. The developed solution was fully implemented and adopted by the company.**

***Index Terms*—IC design, portfolio decision, project management, scheduling, R&D portfolio, genetic algorithm.**

impact organizational productivity and profitability [3], [4]. In particular, the semiconductor industry is capital intensive and continuously migrates to new technologies that require intensive capital investments for various R&D projects [5], [6]. Semiconductor industry is characterized by shorter product life cycles, longer production lead times, and intensive research of inter-related products since semiconductor companies strive to maintain their competitiveness and market power through their R&D portfolios and intellectual properties. The decision maker has to determine the new projects that should be funded, the resources that are needed for the selected projects in the R&D portfolio, and the sequential order and priority for completing the selected projects.

A project portfolio is a set of projects that share resources during a given period. Complementarity, incompatibility, or synergy may occur when sharing the costs and benefits derived from completing more than one project concurrently [1], [7]. Project portfolio selection (PPS) is extremely complex when project interactions and preference information are considered simultaneously [8]. Most of the existing studies have selected R&D projects by evaluating individual projects and

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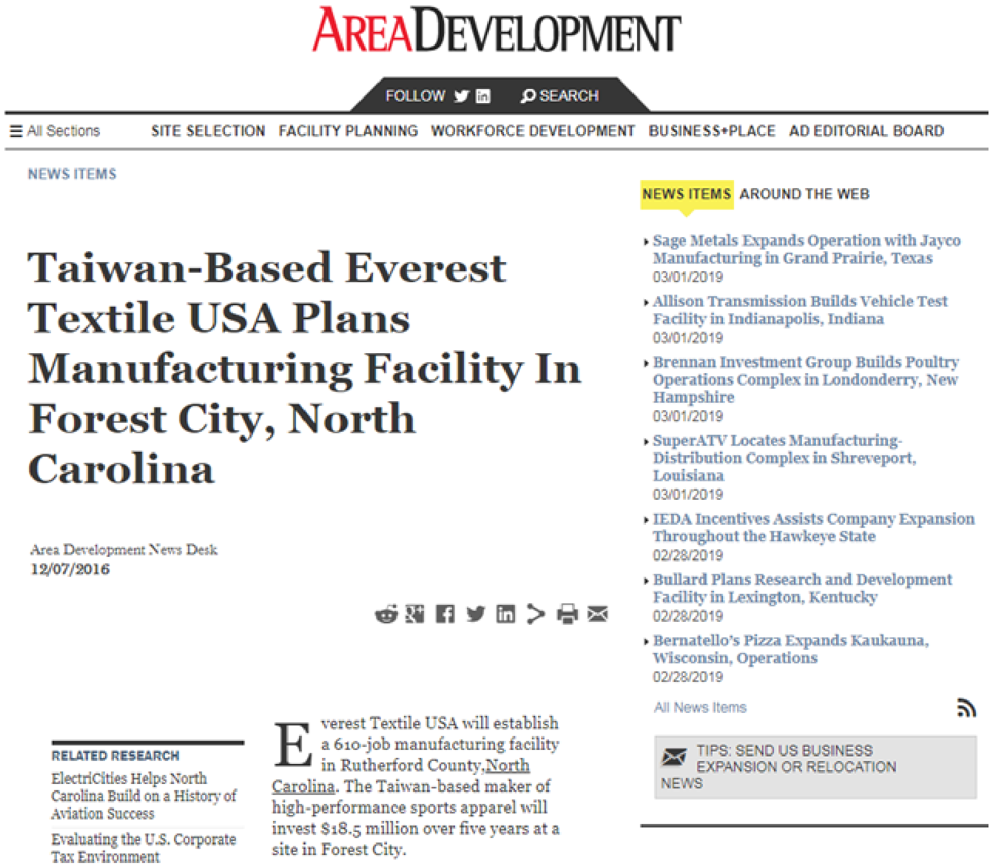

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Taiwan-Based Everest Textile USA Plans Manufacturing Facility In Forest City, North Carolina

Area Development News Desk
12/07/2016

Everest Textile USA will establish a 610-job manufacturing facility in Rutherford County, North Carolina. The Taiwan-based maker of high-performance sports apparel will invest $18.5 million over five years at a site in Forest City.

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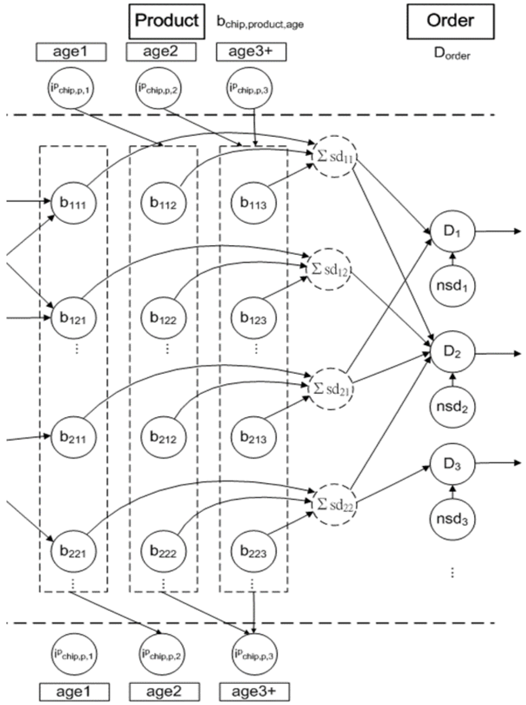

Industry 3.5

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Smart Fab of Industry 3.5

Industry 3.5
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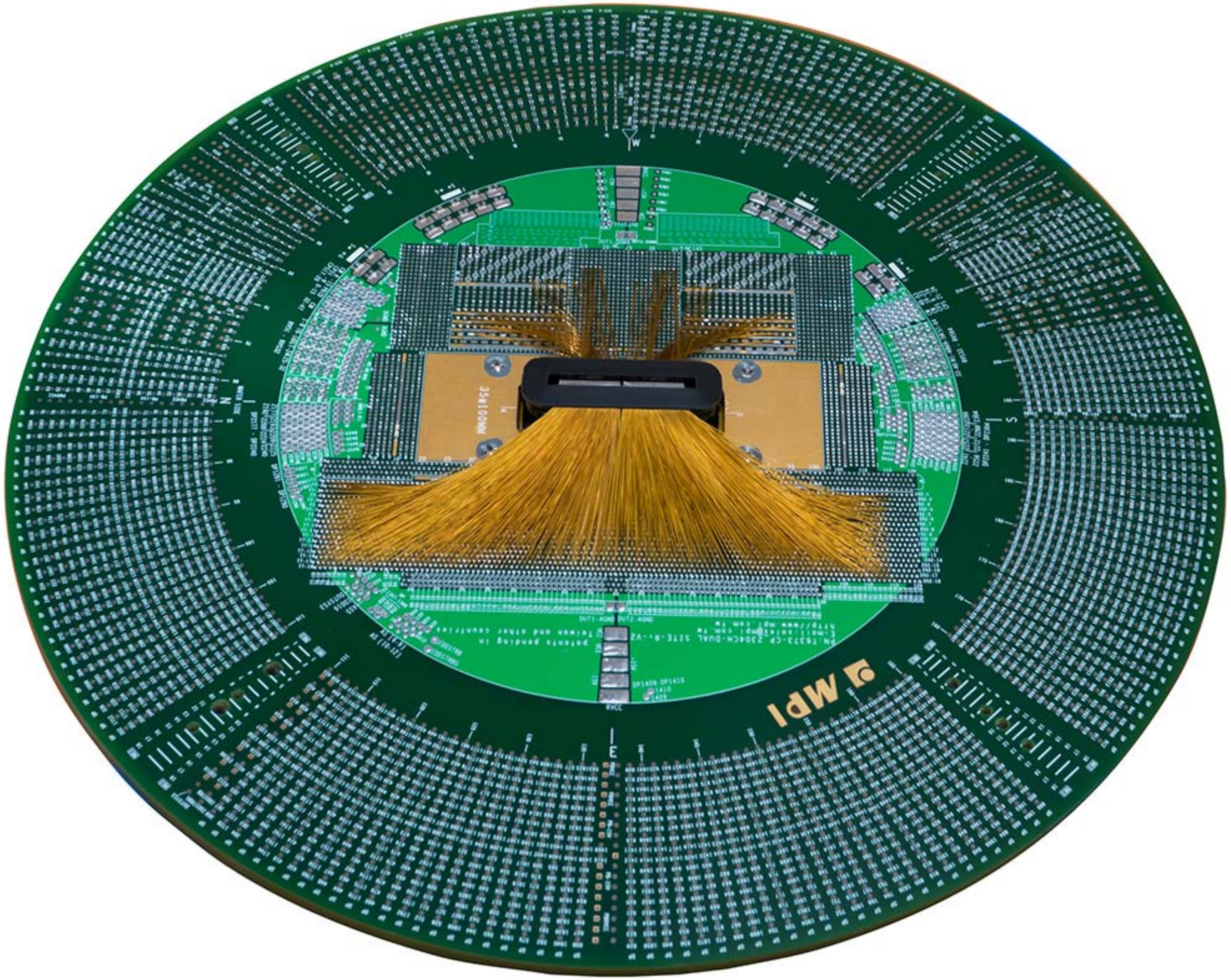
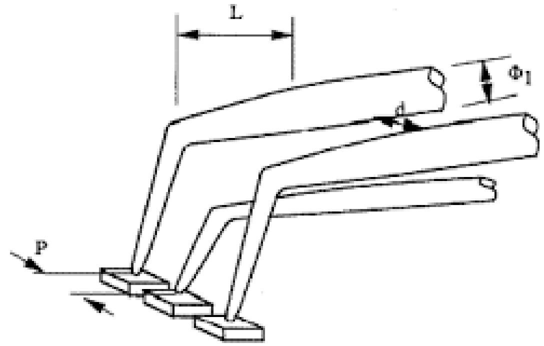
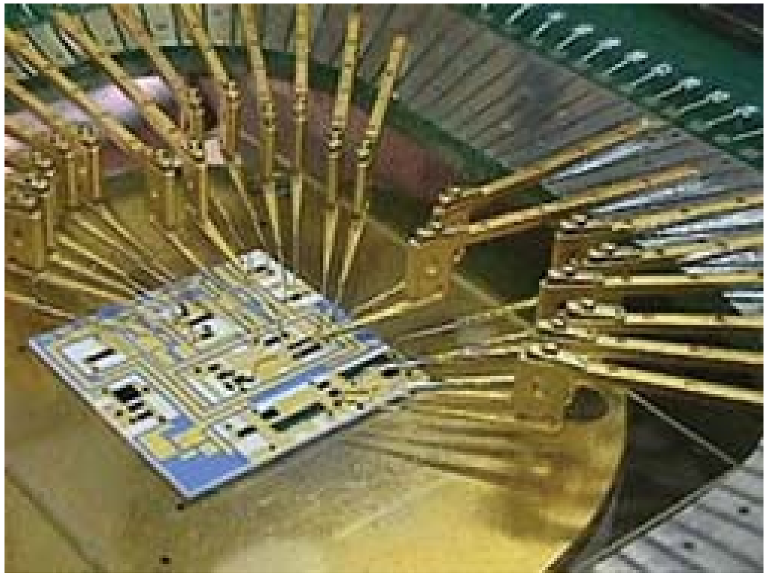
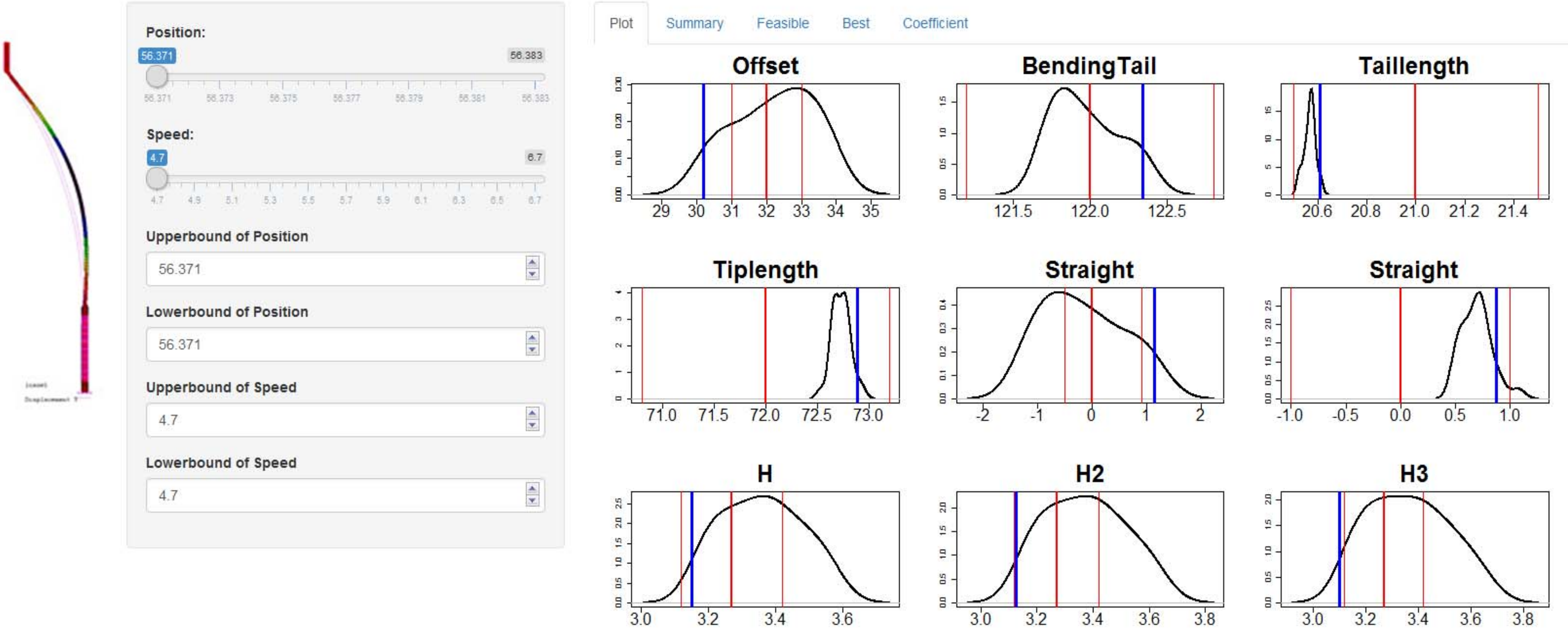
Circuit Probe (CP) test for wafer to identify "Known Good Dies"





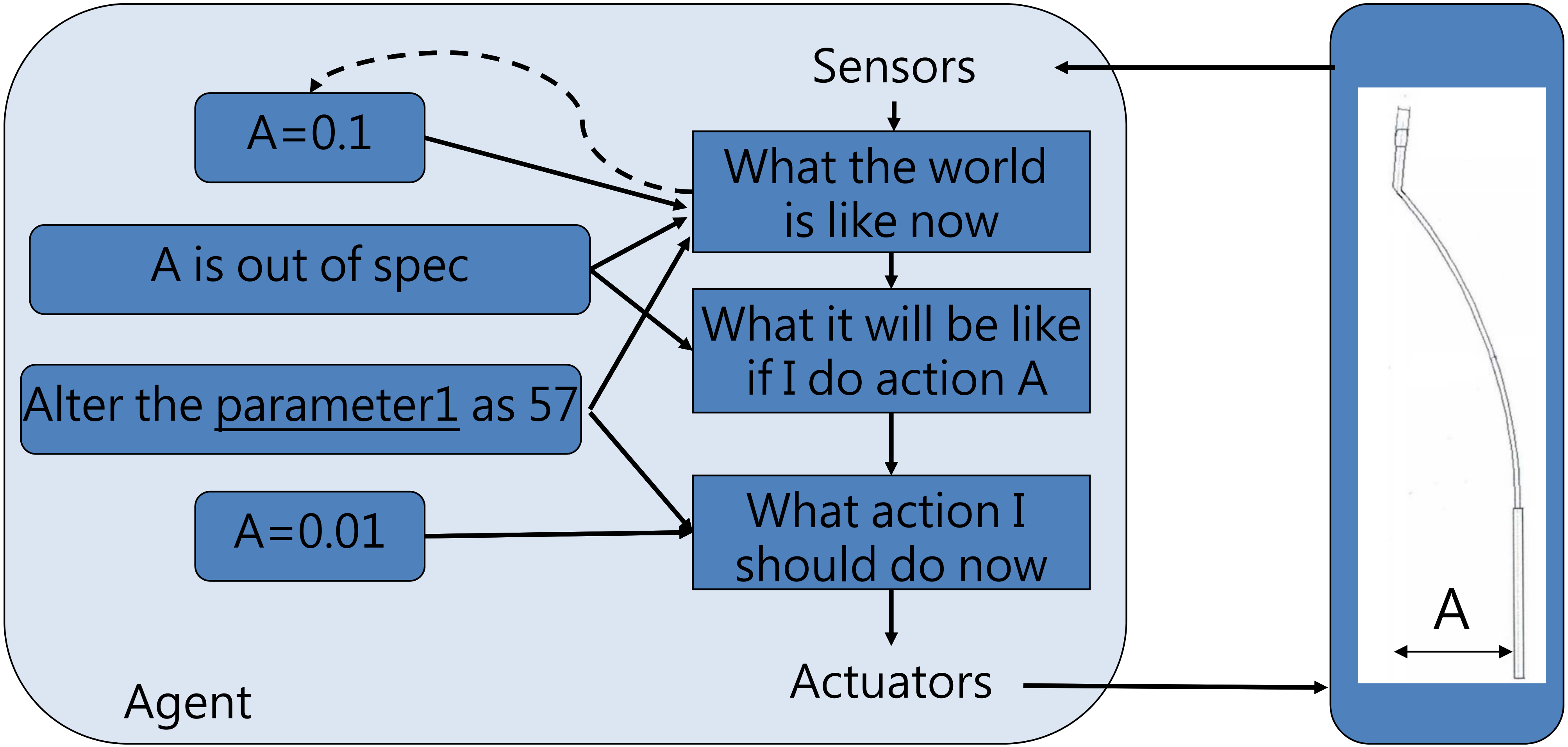


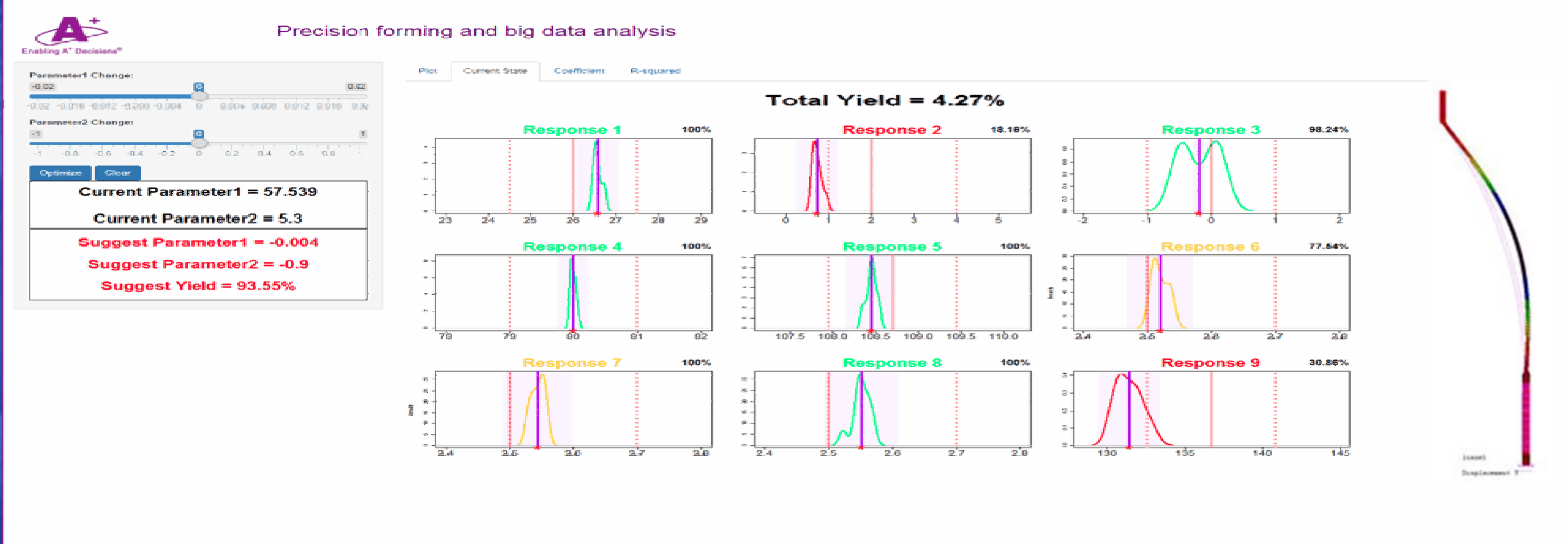
Optimizing multi-variate analytics



Intelligent Agents to Empower Engineers

A model-based, goal-based "intelligent agents" can perceive environment and take actions to maximize its chance of success at some goal.




Precision forming and big data analysis
Enabling A+ Decisions
Parameter1 Change:
Parameter2 Change:
Optimize
Clear
Current Parameter1 = 57.539
Current Parameter2 = 5.3
Suggest Parameter1 = -0.004
Suggest Parameter2 = -0.9
Suggest Yield = 93.55%
Plot
Current State
Coefficient
R-squared
Total Yield = 4.27%
Response 1
100%
Response 2
18.18%
Response 3
98.24%
Response 4
100%
Response 5
100%
Response 6
77.54%
Response 7
100%
Response 8
100%
Response 9
30.86%


1994
Chain-logic Intl. Corp. (CLIC) Established
1995
MPI Corporation Founded
2000
Headquarters Operation Started (FAB 1, Chupei)
2001
Granted UL ISO 9001 Quality System Certification
2001
Photonics Automation Division Established
2003
MPI on Taiwan OTC
2005
Luzhu Branch Office Established (Kaohsiung)
2012
FAB 2, Chupei Operation
2014
Advanced Semiconductor Test (AST) Division Established
2014
Xinpu Plant Operation
2015
Thermal Test Division Established


Probe Card Technologies


Photonics Automation


Advanced Semiconductor Test


Thermal Test

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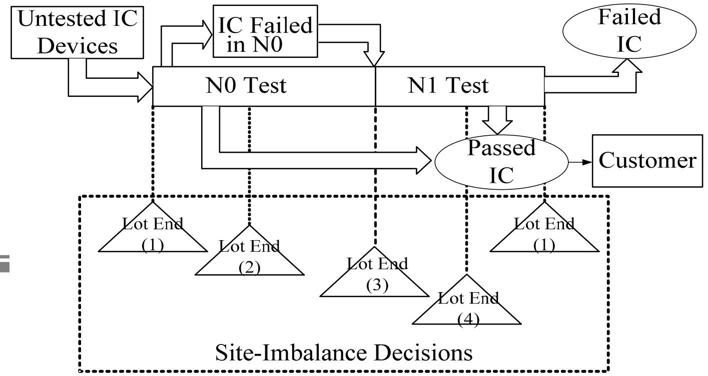
Labor-intensive Visual Inspection



704 IEEE TRANSACTIONS ON SEMICONDUCTOR MANUFACTURING, VOL. 16, NO. 4, NOVEMBER 2003

Analyzing Repair Decisions in the Site Imbalance Problem of Semiconductor Test Machines

Chen-Fu Chien, *Member, IEEE*, and Jei-Zheng Wu

Abstract—Test machines can test multiple IC devices simultaneously. When testing the same group of devices, unusual deviations in yield rates of specific sites from the other sites (i.e., site imbalance) imply a fault in the corresponding sites and the machine. This study develops a decision analysis framework for maximizing profit and customer satisfaction under uncertain conditions. The proposed framework can provide the on-site operators specific decision rules to help decide whether they should continue the test, close specific sites, or shut the machine down to repair it. A numerical example is used for illustration.

Index Terms—Decision analysis, decision support system, final testing, machine repair, site imbalance.

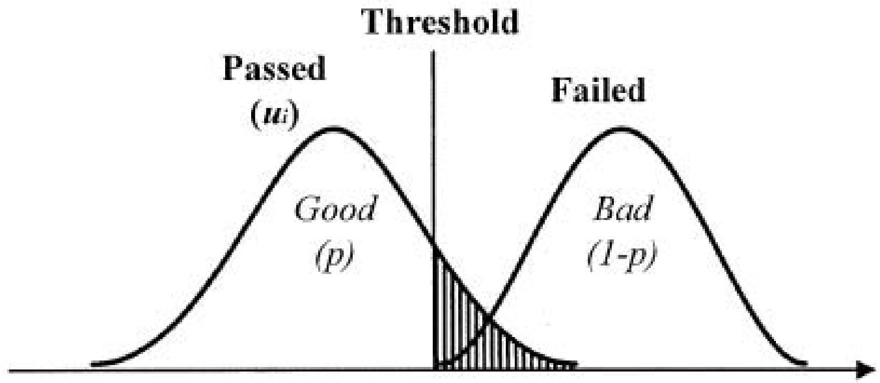
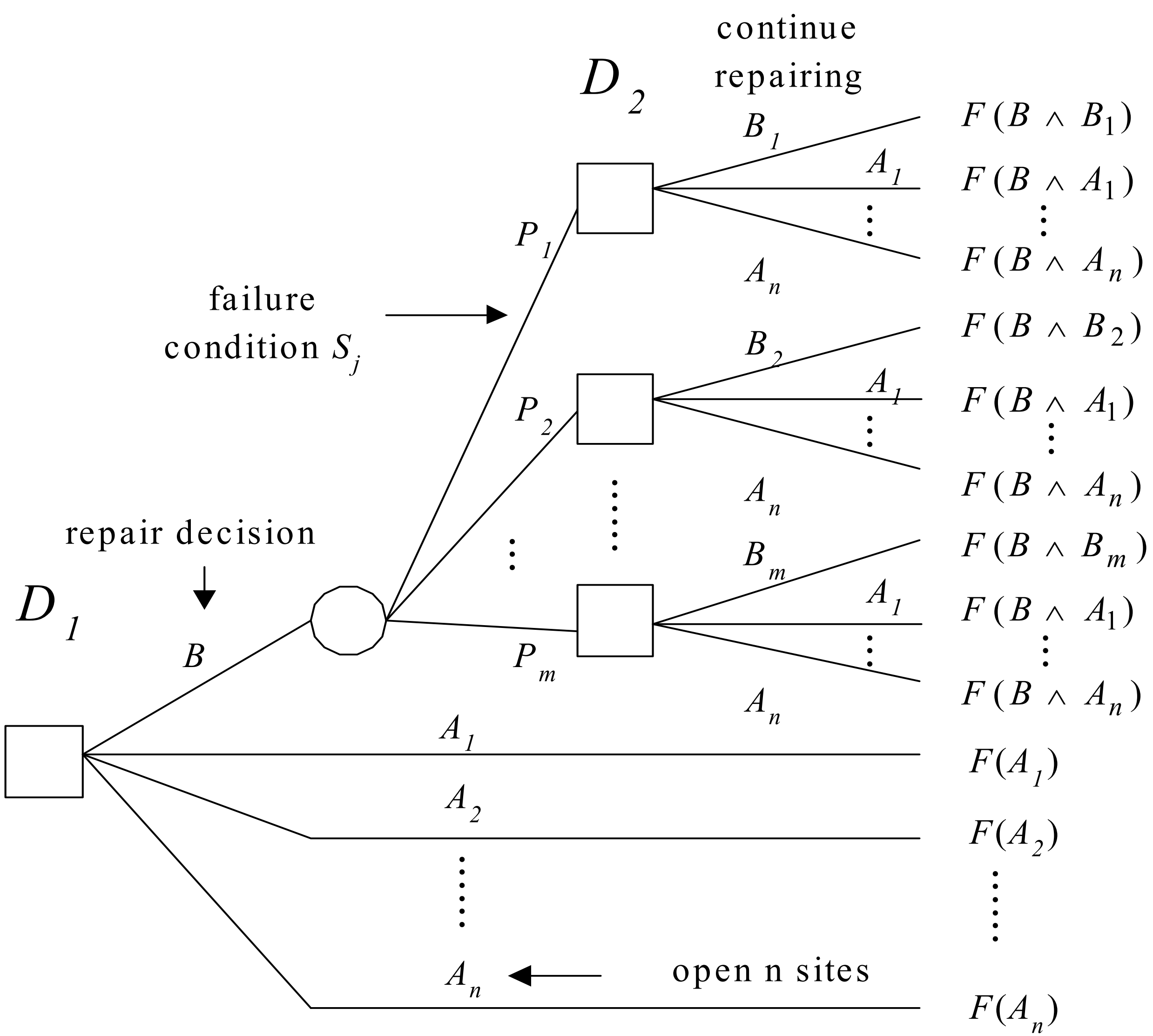
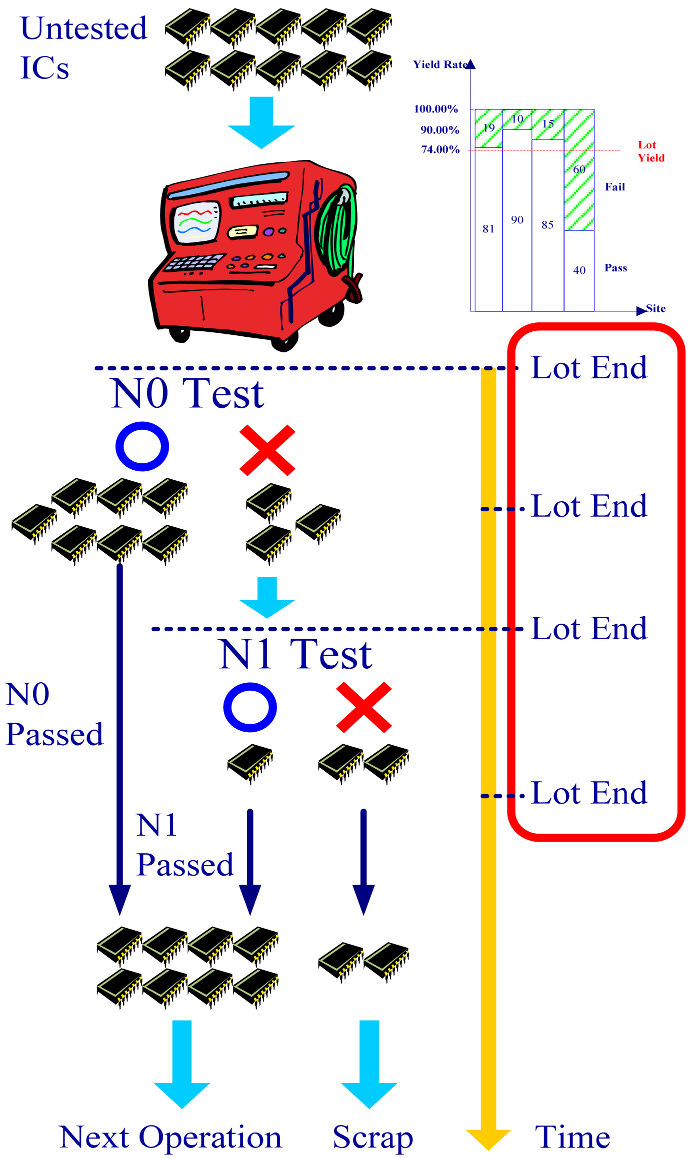


Fig. 1. Dichotomous testing results in the ith site.

Dynamic Decision for Overall Effectiveness (Chien & Wu, 2003)



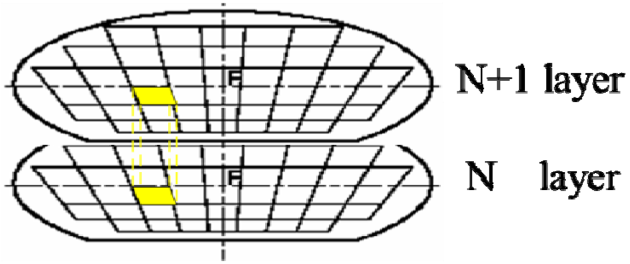


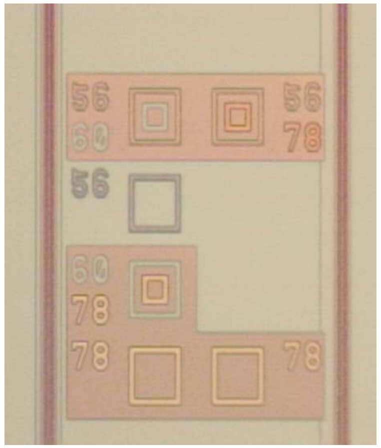
IEEETSM 2003. Reduce 50% cycle time with fairly low yield loss. ROC Invention Patent.

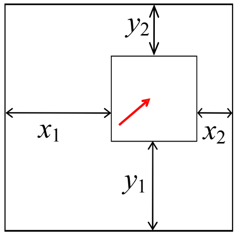
IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING, VOL. 11, NO. 2, APRIL 2014

Overlay Error Compensation Using Advanced Process Control With Dynamically Adjusted Proportional-Integral R2R Controller

Chen-Fu Chien, *Member, IEEE*, Ying-Jen Chen, Chia-Yu Hsu, and Hung-Kai Wang







Abstract—As semiconductor manufacturing reaching nanotechnology, to obtain high resolution and alignment accuracy via minimizing overlay errors within the tolerance is crucial. To address the needs of changing production and process conditions, this study aims to propose a novel dynamically adjusted proportional-integral (DAPI) run-to-run (R2R) controller to adapt equipment parameters to enhance the overlay control performance. This study evaluates the performance of controllers via the variation of each overlay factor and the variation of maximum overlay errors in real settings. To validate the effectiveness of the proposed approach, an empirical study was conducted in a leading semiconductor company in Taiwan and the results showed practical viability of the proposed DAPI controller to reduce overlay errors effectively than conventional exponentially weighted moving average controller used in this company.

Note to Practitioners—Although various APC/R2R control approaches have been proposed for specific conditions, little research has been done to deal with unknown changing production/process conditions in the real setting of semiconductor fabrication. Focusing on a realistic problem, this study is the first to develop dynamically adjusted proportional-integral R2R controller by considering future disturbance prediction to effectively reduce overlay errors. The proposed DAPI controller has only one key parameters needed to be determined like exponentially weighted moving average (EWMA) controllers. The proposed approach was validated in a leading semiconductor company in Taiwan and has been implemented on line.

Index Terms—Advanced process control (APC), manufacturing intelligence, overlay errors, proportional-integral controller, run-to-run (R2R) control, yield enhancement.

thus achieved unparalleled growth in past few decades. Thus, process control and excursion detection become increasingly difficult. However, most existing studies focus on defect diagnosis for yield enhancement [2]–[5]. To meet the demands of shrinking feature sizes and the reduced linewidth of integrated circuits (ICs), lithography has become increasingly critical for wafer fabrication [6], [7]. In particular, wafer fabrication contains multilayer wiring in which the patterned layers must overlay each other to within the tolerance to function properly. Overlay errors are the displacement of the present exposure layers relative to preceding layers [8], [9]. To enhance the process yield and to satisfy customers' need, overlay errors must be controlled within a tight tolerance.

Modern semiconductor fabrication facilities (fabs) adopted a variety of advanced process control (APC) and run-to-run (R2R) control methodologies for yield enhancement. Moyne *et al.* [10] defined R2R control as "a form of discrete process and machine control in which the product recipe with respect to a particular machine process is modified *ex-situ*, i.e., between machine runs, to minimize process drift, shift, and variability." Sachs *et al.* [11] and Ingolfsson and Sachs [12] pioneered the application of R2R controller in semiconductor fabrication processes. Conventionally, the exponentially weighted moving average (EWMA)-based controller is widely used to compensate for process shift and noise such as epitaxial growth [8], silicon epitaxy [13], chemical mechanical polishing (CMP) [14], and metal sputter deposition [15]. However, the

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DALab Proprietary

Novel Overlay Error Models
(US Invention Patents)

- **Overlay error model for stepper (Chien et al., 2003)**

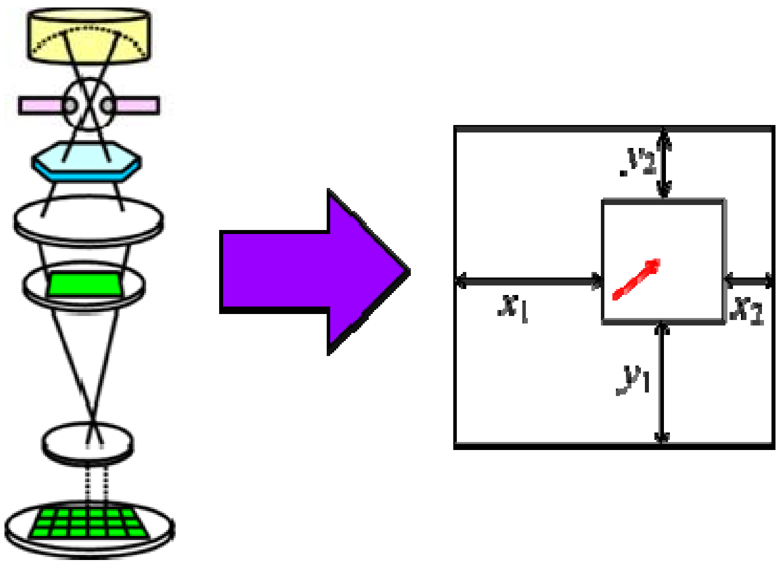
$$O_{x+X} = T_{x+X} + S_X X - (N_{or} + \theta_w)Y + M'_x x - R_x y + \varepsilon_{x+X}$$

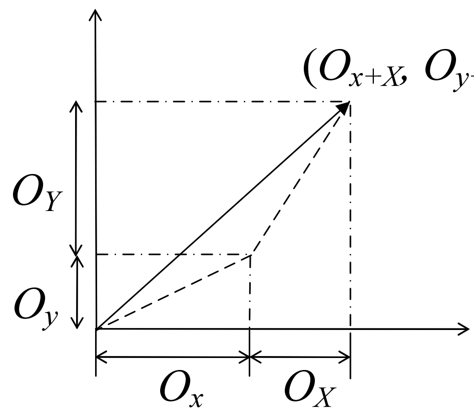
$$O_{y+Y} = T_{y+Y} + S_Y Y - (\theta_w - N_{or})X + M'_y y - R_y x + \varepsilon_{y+Y}$$

- **Overlay error model for scanner (Chien and Hsu, 2011)**

$$O_{x+X} = T_{x+X} + S_X X - (\theta_w + N_{or})Y + (M_i + M_a)x - (\theta_r + \theta_a)y + \varepsilon_{x+X}$$

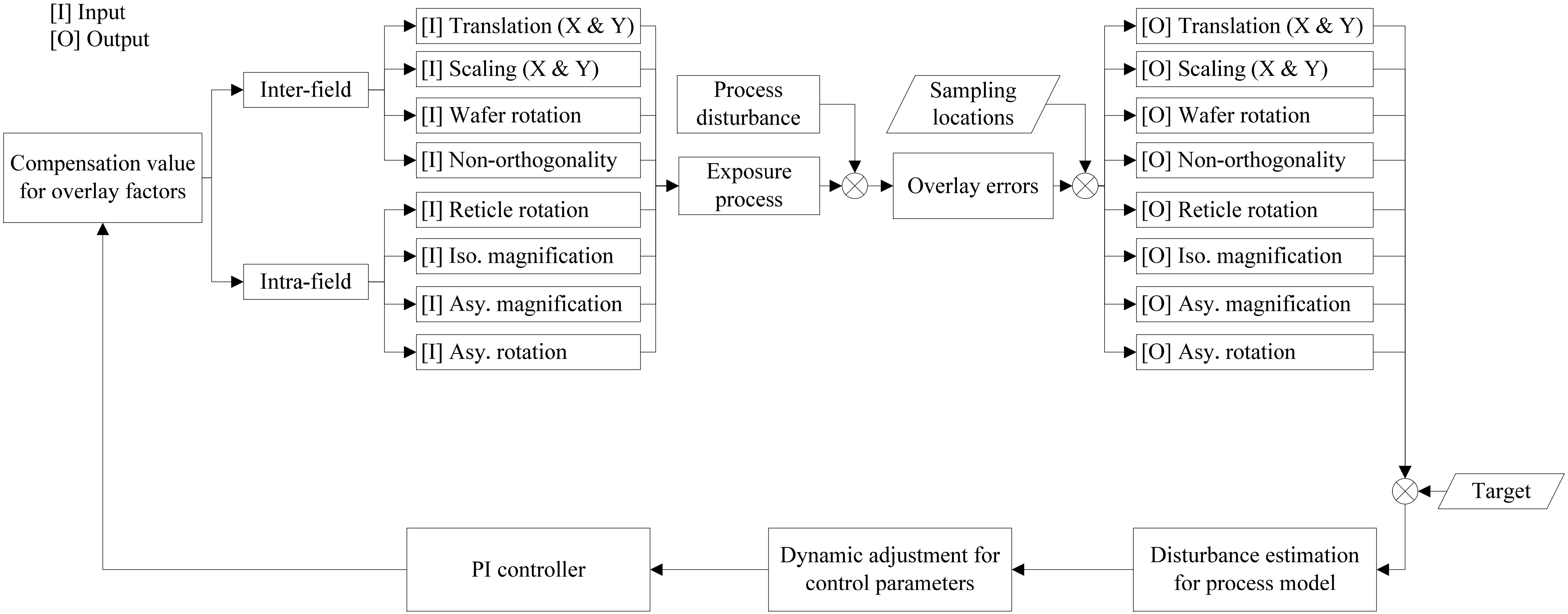
$$O_{y+Y} = T_{y+Y} + S_Y Y + \theta_w X + (M_i - M_a)y + (\theta_r - \theta_a)x + \varepsilon_{y+Y}$$





APC/AEC
R2R control for overlay error compensation

- **Step1. Overlay process modeling for R2R control**
- **Step2. DAPI controller design**
- **Step3. Performance monitoring and evaluation**



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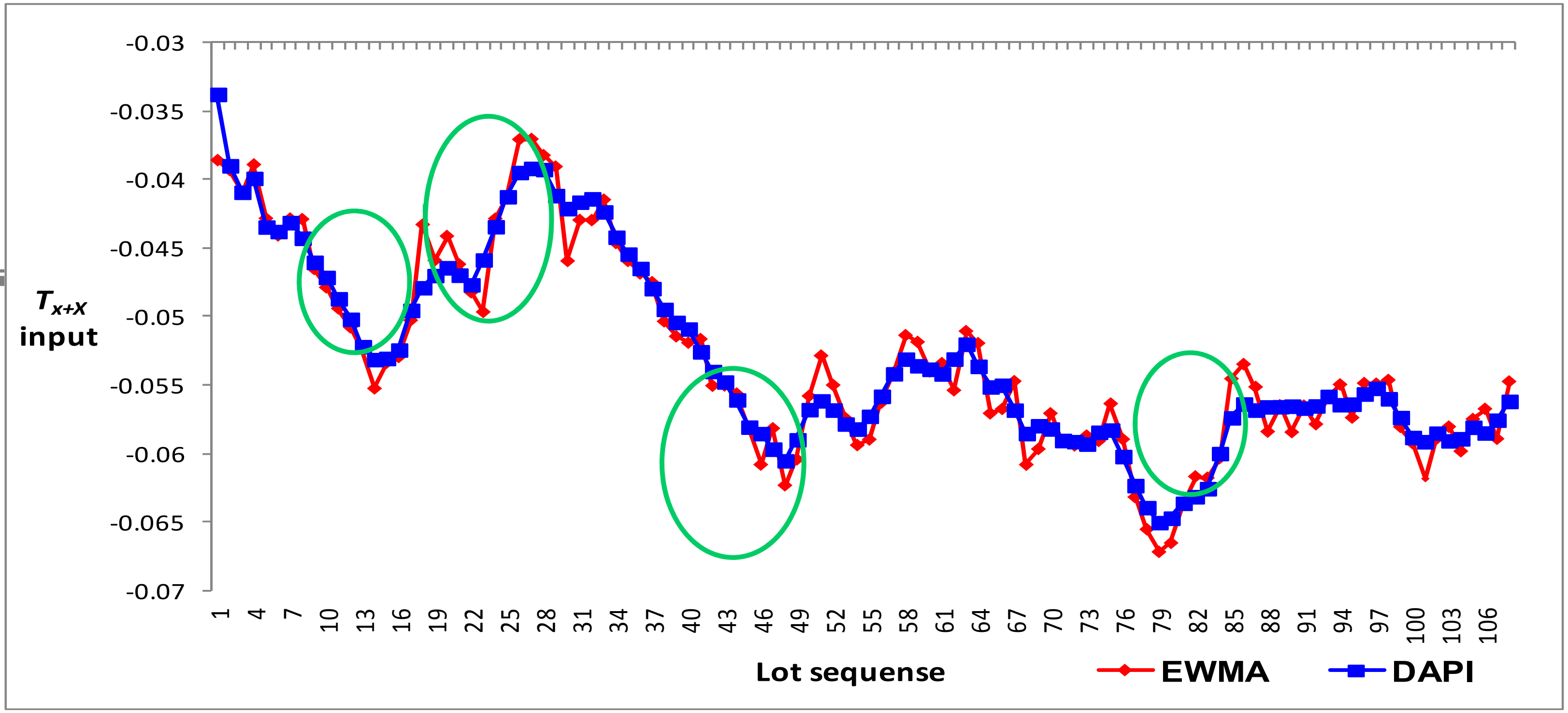
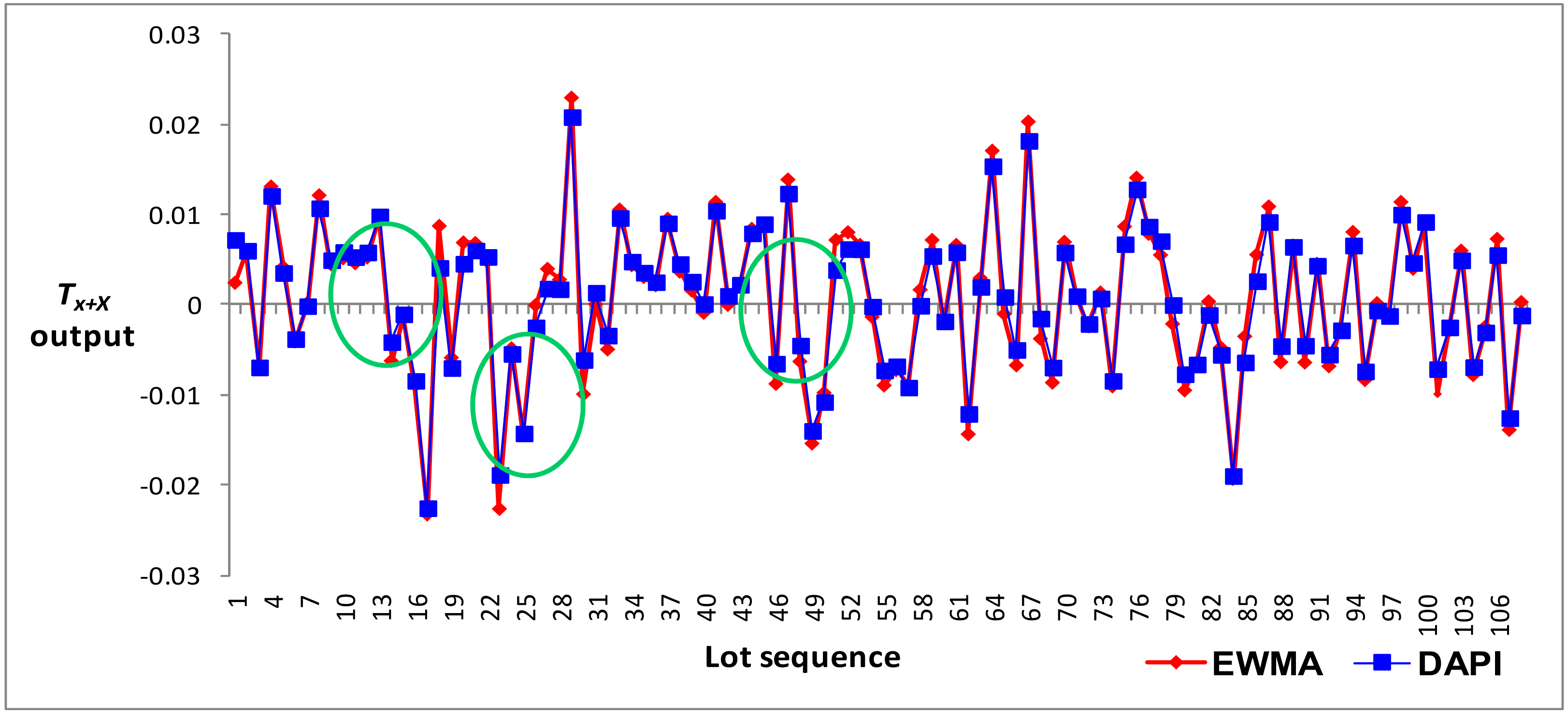
Empirical Study for Advanced Equipment/ Process Control (AEC/APC)





Manufacturing Big Data Analytics

IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING 1

Manufacturing Intelligence to Exploit the Value of Production and Tool Data to Reduce Cycle Time

Chung-Jen Kuo, Chen-Fu Chien, *Member, IEEE*, and Chen-Tao Chen

***Abstract*—Cycle time reduction is crucial for semiconductor wafer fabrication companies to maintain competitive advantages as the semiconductor industry is becoming more dynamic and changing faster. According to Little's Law, while maintaining the same throughput level, the reduction in Work-in-Process (WIP) will result in cycle time reduction. On one hand, the existing queueing models for predicting the WIP of tool sets in wafer fabrication facilities (fab) have limitations in real settings. On the other hand, little research has been done to predict the WIP of tool sets with tool dedication and waiting time constraint so as to control the corresponding WIP levels of various tool sets to reduce cycle time without affecting throughput. This study aims to fill the gap by proposing a manufacturing intelligence (MI) approach based on neural networks (NNs) to exploit the value of the wealthy production data and tool data for predicting the WIP levels of the tool sets for cycle time reduction. To validate this approach, empirical data were collected and analyzed in a leading semiconductor company. The comparison results have shown practical viability of this approach. Furthermore, the proposed approach can identify and improve the critical input factors for reducing the WIP to reduce cycle time in a fab.**

changing faster in consumer era. Therefore, time-to-market and cycle time reduction have become increasingly critical issues for both research and practice.

According to Little's Law, while maintaining the throughput level of individual tool sets in a fab, reducing the WIP levels will reduce the cycle time. There is a gap to effectively determine appropriate Work-in-Process (WIP) levels for various tool sets in a fab in light of dynamic nature of wafer fabrication and complicated product mix on line. Indeed, a number of queueing and simulation models have been developed in predicting the WIP or the cycle time of tool sets in a fab. However, most of the studies applying queueing models have limitations in real settings due to the requisite assumptions to which few real-world systems conform [1], [2]. In particular, conventional queueing theory assumes all the servers are identical in a service center. However, tool dedication constraint for wafer fabrication requires that certain tools in a tool set can process only part of products or processing steps. That is, the tools in the tool set are not identical

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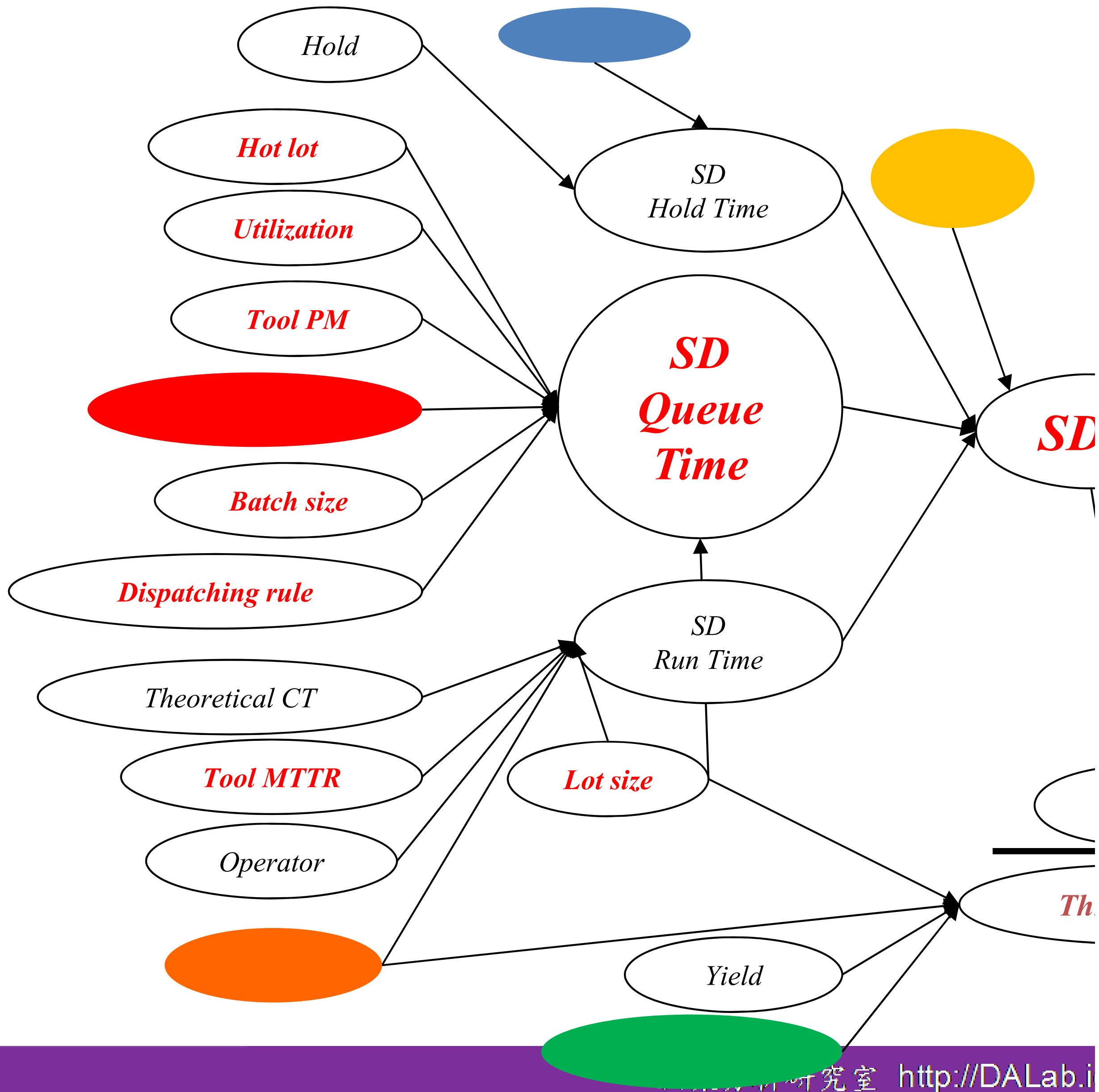
Influence Diagram of Cycle Time Reduction via Manufacturing Big Data Analytics



Factor	Relation with WIP	% of tool sets conform to the relation	Sensi-tivity ratio	Managerial implications
m	−	92%	0.83	--
u	−	93%	0.28	To relax tool dedication for non-critical products
λ	+	95%	1.06	--
C_a	+	87%	0.38	To smooth hour-to-hour lot arrivals
v	−	94%	1.37	To improve tool availability
D_v	+	73%	0.28	To balance non-available tool events among hours
s_0	+	86%	0.77	To shorten process time
C_{s0}	+	79%	0.18	To evaluate effect of merging similar recipes on WIP
l	+	81%	0.44	To merge or split lots until the mean lot size approach the optimal level
D_l	+	88%	0.24	
b	−→+	83%	0.72	To develop model to determine the optimal batch size by recipes
D_b	+	76%	0.37	
r	+	75%	0.46	To simplify number of recipes
rw	−	82%	0.22	To eliminate unnecessary waiting time constrains
tw	−	88%	0.56	To relax the specification for waiting time constraint

IEEE

IEEE Robotics and Automation Society

IEEE Transactions on Automation Science and Engineering

Best Paper Award

is hereby presented to

Chen-Fu Chien

For the paper co-authored with Chung-Jen Kuo and Jan-Daw Chen entitled "Manufacturing Intelligence to Exploit the Value of Production and Tool Data to Reduce Cycle Time," as published in the IEEE Transactions on Automation Science and Engineering; vol. 8, no. 1, January 2011, pp. 103-111

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David Orin
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Bruno Siciliano
RAS Awards Chair

August 2012

A Framework for Root Cause Detection of Sub-Batch Processing System for Semiconductor Manufacturing Big Data Analytics

Chen-Fu Chien, *Member, IEEE*, and Shih-Chung Chuang

***Abstract*—Root cause detecting and rapid yield ramping for advanced technology nodes are crucial to maintain competitive advantages for semiconductor manufacturing. Since the data structure is increasingly complicated in a fully automated wafer fabrication facility, it is difficult to diagnose the whole production system for fault detection. A number of approaches have been proposed for fault diagnosis and root cause detection. However, many constraints in real settings restrict the usage of conventional approaches, due to the big data with complicated data structure. In particular, a batch may not be considered as a run in the present sub-batch processing system for wafer fabrication, in which the processing paths of the wafers in a batch could be different. Motivated by realistic needs, this paper aims to develop a root cause detection framework for the sub-batch processing system. Briefly, the proposed framework consists of three phases: data preparation, data dimension reduction, and the sub-batch processing model construction and evaluation. The proposed approach has been validated by a sequence of simulations and an empirical study conducted in a leading semiconductor manufacturing company in Taiwan. The results have shown practical viability of the proposed approach. Indeed, the developed approach is incorporated in the engineering data analysis system in this case company.**

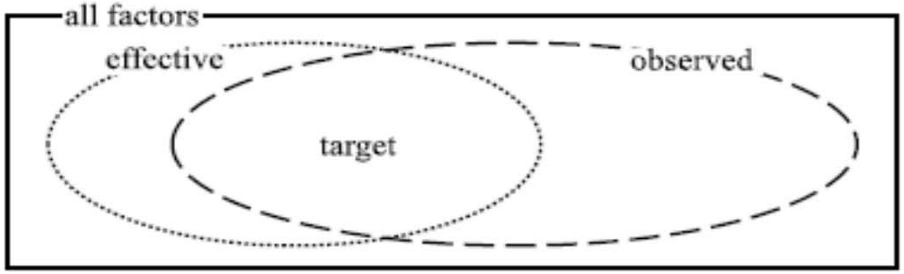
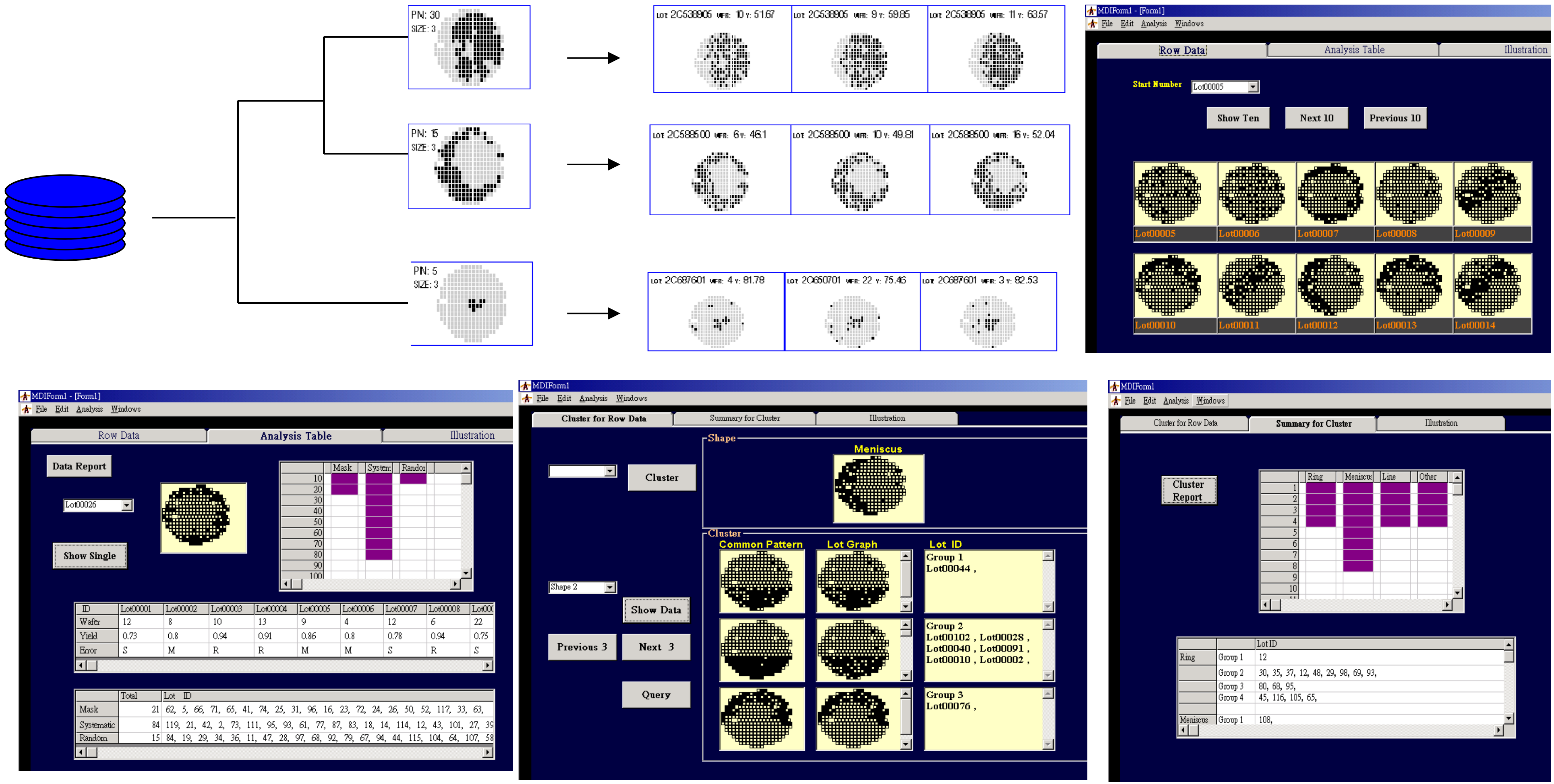


Fig. 1. Categories of the factors.

time-to-market [1]. The average sale price of the IC with short product life is quickly reduced [2], [3]. Thus, rapid root cause detection for yield ramp up for advanced technology migration is critical for semiconductor companies to maintain competitive advantages [3], [4]. Conventionally, the engineers diagnose the system and specific module to detect the root cause based on experiences and domain knowledge. Big data with a huge number of process features, in-line metrologies, product test results, and product data will be

WBM DSS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PN: 15
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MDIForm1 - [Form1]
File Edit Analysis Windows
Row Data
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Illustration
Start Number
Show Ten
Next 10
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Lot00005
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Lot00011
Lot00012
Lot00013
Lot00014
Data Report
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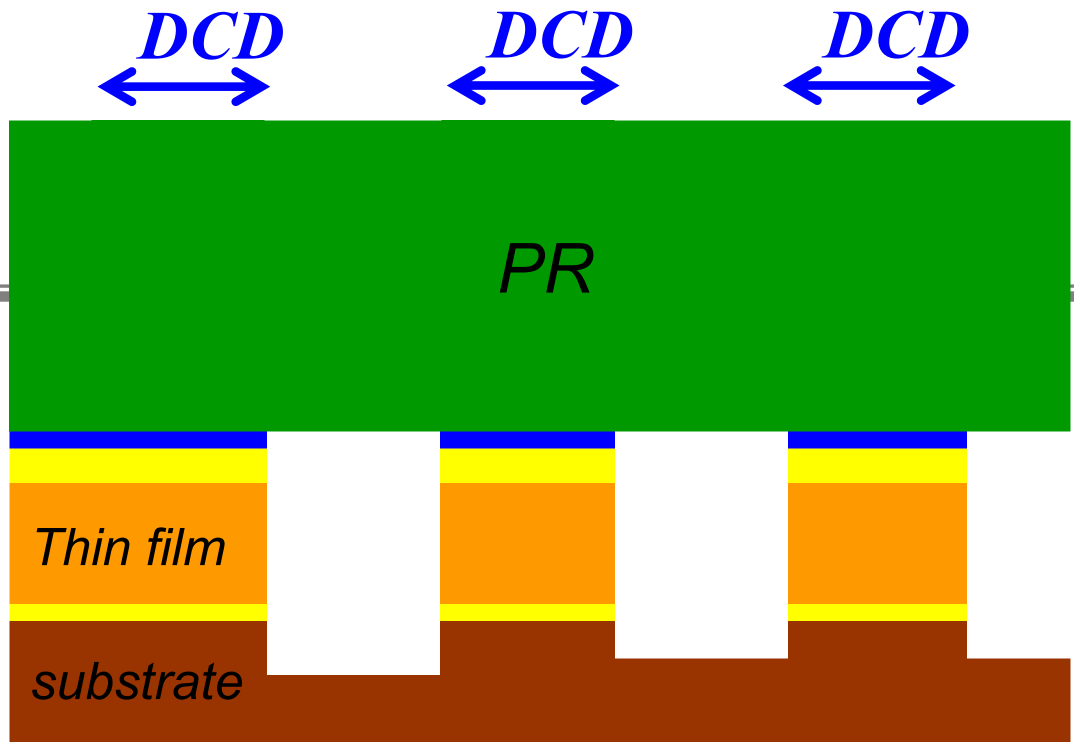
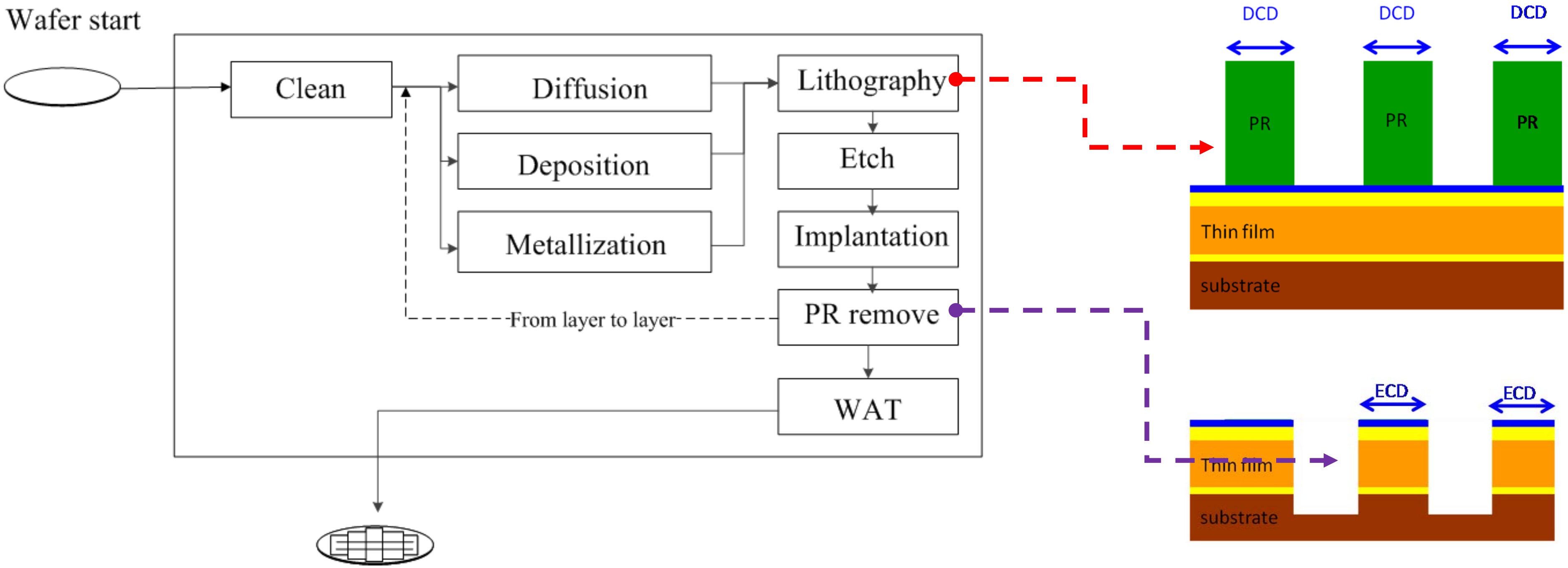
Shape
Meniscus
Cluster
Common Pattern
Lot Graph
Lot ID
Show Data
Previous 3
Next 3
Query
Cluster Report


DCD
DCD
DCD
PR
Thin film
substrate


Wafer start
Clean
Diffusion
Deposition
Metallization
Lithography
Etch
Implantation
PR remove
WAT
From layer to layer
DCD
DCD
DCD
PR
PR
PR
Thin film
substrate
ECD
ECD
Thin film
substrate

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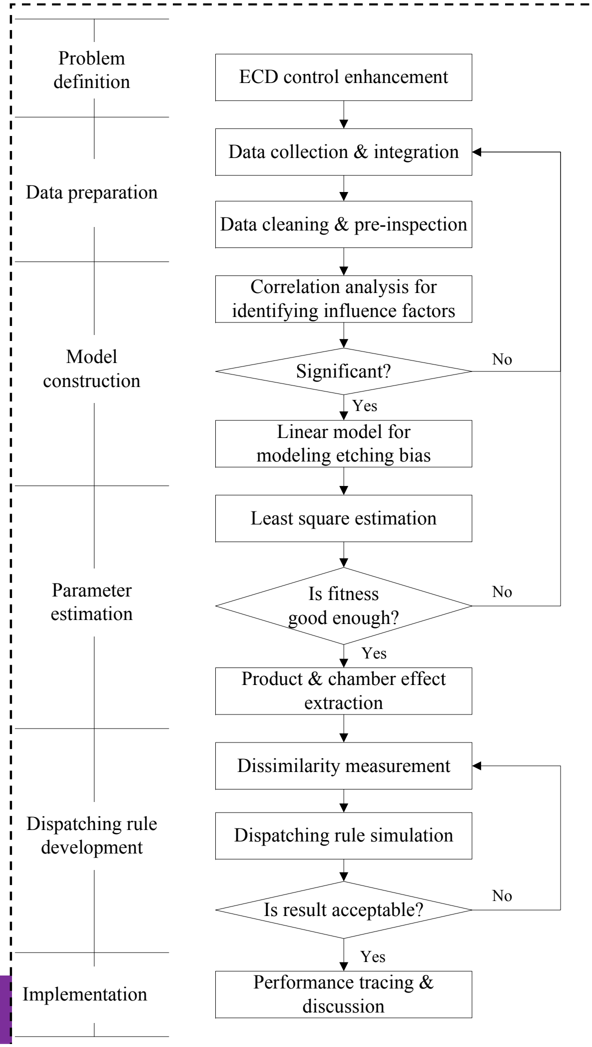
journal homepage: www.elsevier.com/locate/caor

A novel approach to hedge and compensate the critical dimension variation of the developed-and-etched circuit patterns for yield enhancement in semiconductor manufacturing

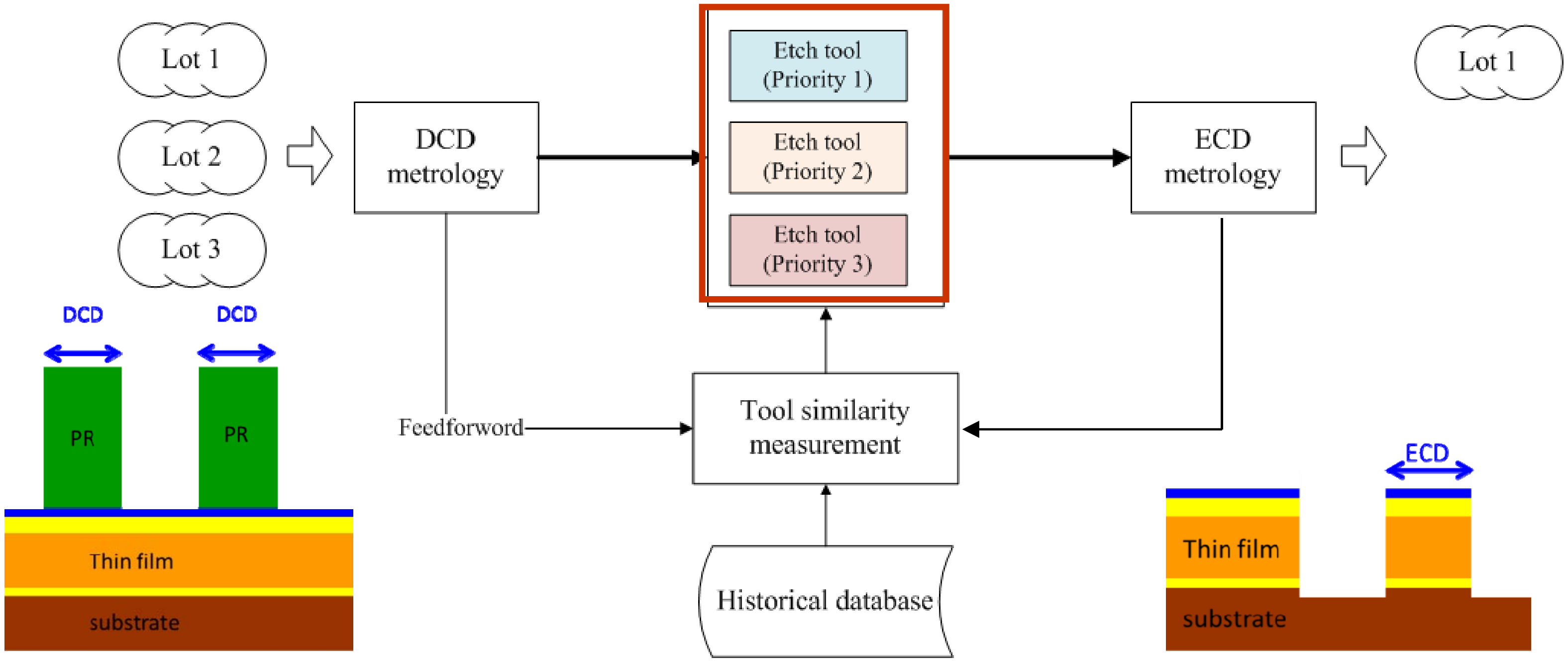
Chen-Fu Chien [a,*], Ying-Jen Chen [a], Chia-Yu Hsu [b]

- **Problem definition**
- **Data preparation**
- **Model construction**
- **Parameter estimation**
- **Dispatching rule development & offline validation**
- **Implementation**



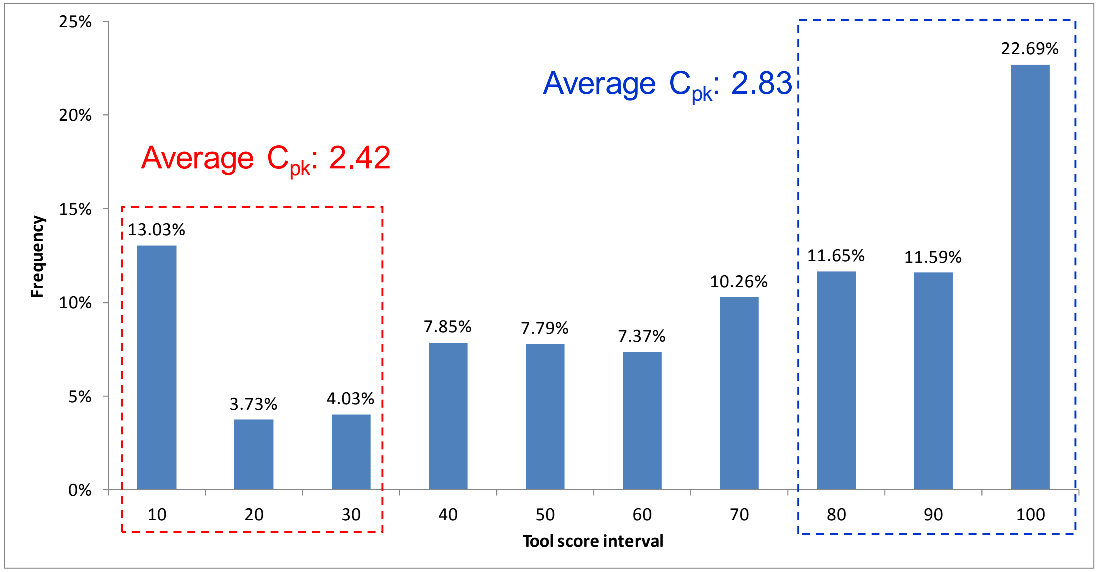
Manufacturing intelligence framework for DCD-ECD variation reduction

- Estimate the chamber effects via mining historical data.
- Define similarity measurement for etching chambers and tools, respectively, to match with DCD results of wafers.
- Determine tool priority for each process lot to support real-time tool assignment and production control.



Validation and Implementation

- **The C_{pk} improvement was 20% in average after implementation in an empirical study for a few months for a field test in Taiwan.**
- **The scaling score is used to monitor the operational effectiveness of the dispatching rules to trace the control performance.**



Product	Before implementation				After implementation				C_{pk} improvement
	Number of lot	RMSE	Standard deviation	C_{pk}	Number of lot	RMSE	Standard deviation	C_{pk}	
A	163	0.0075	0.0073	2.34	140	0.0063	0.0061	2.84	21.39%
B	100	0.0103	0.0068	2.56	108	0.0101	0.0062	2.82	10.12%
C	98	0.0073	0.0073	2.25	136	0.0066	0.0066	2.51	11.28%
D	239	0.0084	0.0084	1.61	493	0.0058	0.0058	2.40	48.87%
E	105	0.0108	0.0096	1.90	156	0.0080	0.0079	2.49	30.95%
F	215	0.0099	0.0083	2.19	274	0.0069	0.0072	2.72	24.30%
G	183	0.0091	0.0085	2.22	219	0.0083	0.0085	2.35	5.56%
H	224	0.0090	0.0086	2.23	370	0.0076	0.0074	2.80	25.69%

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Artificial Intelligence for Intelligent Manufacturing Systems Research Center

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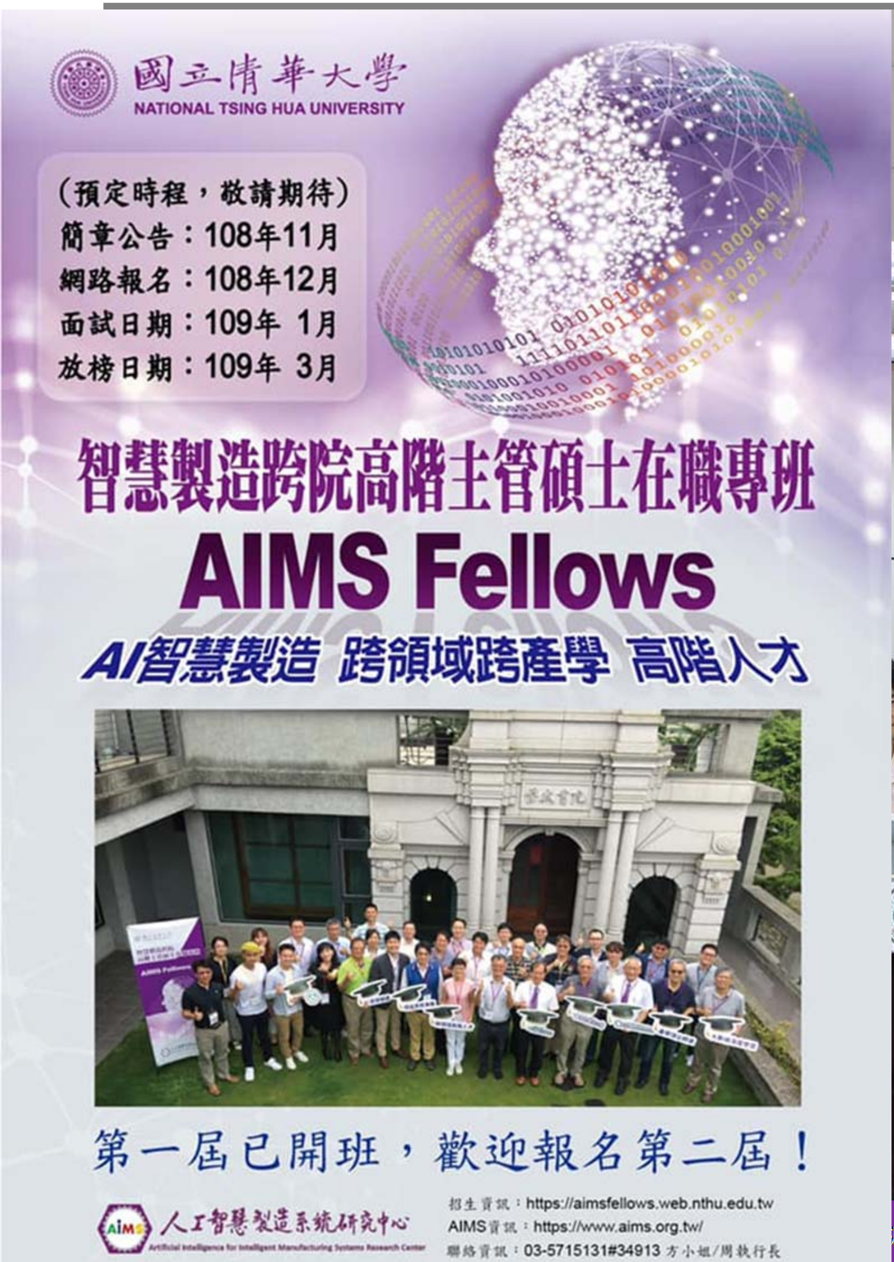
(2 year MS degree)



Industry3.5 International Symposium

International Symposium on Industry3.5 for Intelligent Manufacturing

September 25 - 27, 2019, National Tsing Hua University, Hsinchu, Taiwan

https://www.aims.org.tw/industry3.5/

Aims and Topics:

Global manufacturing networks are facing disruptive challenges due to newly technologies such as Artificial Intelligence, Big Data, Internet of Things, and 5G. Leading nations including Germany and USA have reemphasized the importance of advanced manufacturing and initiated national manufacturing strategies such as Industry 4.0 and AMP. The manufacturing sectors in Asia-pacific regions and emerging countries are playing important roles for economic growth and job opportunities, yet their industrial structures may not be ready for the migration for Industry 4.0 directly.

"Industry 3.5" that is proposed as a **hybrid strategy between the existing Industry 3.0 and to-be Industry 4.0**. This international symposium calls for **disruptive innovations** from theoretical research, methodological developments, case studies, and industrial practice to address the needs for **humanizing industrial revolutions and sustainable migration** including, yet not limited, the following topics:

Internet of things (IOT)	Big Data Analytics & Data Mining	Cyber Physical System
Circular Economics	Smart Production	Smart Agriculture
Green Supply Chain & Sustainability	Total Resource Management	IE Education/ Curriculum Design
Deep Learning Applications	AI & Computational Intelligence	User Experience & Innovative Design
Augmented Reality & Virtual Reality	Advanced Process/equipment Control	Enterprise Resource Planning
Virtual Metrology	Defect Detection and Classification	Image Analysis, Visual Inspection
Evolutionary Algorithm	Simulation Optimization	AMHS/ Automatic Guided Vehicle

Keynote speech, Exhibit, and Factory Visiting:

Industry3.5 Symposium will provide a platform to facilitate related activities such as keynote speeches, factory visiting and exhibition to enrich the conference. Details can be founded in https://www.aims.org.tw/industry3.5/

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Department of Industrial Engineering and Engineering Management, National Tsing Hua University, Taiwan

Important Dates:

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Notice of Acceptance:	**August 10, 2019**
Deadline for Camera Ready Manuscript:	**September 1, 2019**

Registration Fee:

Regular registration:	**US$300** (Early bird, before August 15, 2019) / **US$500** (Regular)
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清華-台積電 卓越製造中心 NTHU-TSMC Center for Manufacturing Excellence

https://www.aims.org.tw/industry3.5/

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cfchien@mx.nthu.edu.tw

Principal investigator

Prof. Chen-Fu Chien

Biography

Dr. Chen-Fu Chien is Tsinghua Chair Prof. & Micron Chair Prof. at IEEM Departement, National Tsing Hua University (NTHU). He is the Director of AI for Intelligent Manufacturing Systems (AIMS) Research Center and the Convener of Industrial Engineering and Management Program, Ministry of Science & Technology (MOST).

University

National Tsing Hua University

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TAGS

Intelligent Manufacturing | AI | Big Data | Digital Transformation | Industry

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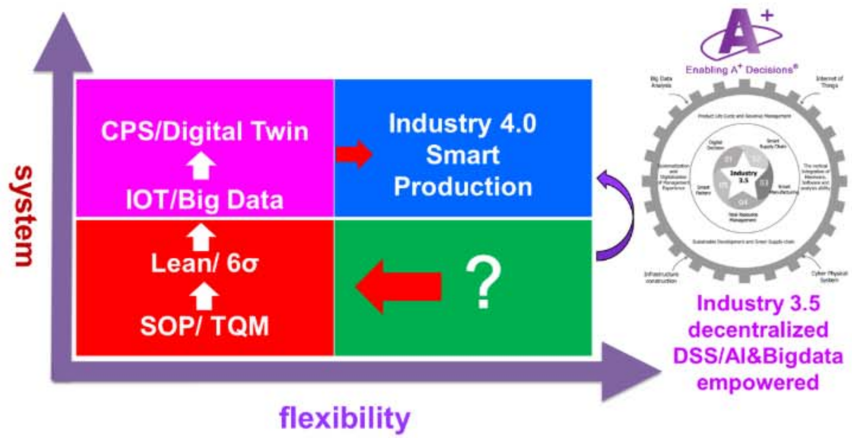
ENGINEERING & TECHNOLOGIES | Text & Image | February 26,2019

Leading nations including Germany and the USA have reemphasized manufacturing and proposed national strategies such as Industry 4.0 and AMP; China is also promoting Made in China 2025 to upgrade her industrial structure. The paradigm of global manufacturing is changing, and the increasing adoption of AI, big data analytics, cloud computing, Internet of Things (IoT), intelligent machines and robotics has empowered manufacturing intelligence for smart production and agile supply chains.

The industry structure of most emerging countries might not be ready for the migration of Industry 4.0, or for facing other challenges such as governing, promoting productivity, maintaining economic growth and creating jobs. Therefore, the AI for Intelligent Manufacturing Systems (AIMS) Research Center, one of the MOST AI centers, aims to integrate various efforts to empower intelligent manufacturing and digital transformation for Made in Taiwan to maintain its competitive advantages. The teams have proposed Industry 3.5 as a hybrid strategy between Industry 3.0 and the to-be Industry 4.0. They have developed core technologies which have validated the approaches through a number of in-depth industrial collaborations with leading companies in different fields including the high-tech manufacturing, assembly, process, and textile industries. With the innovative solutions AIMS has developed, Taiwan is able to play a leadership role in the new manufacturing paradigm of Industry 3.5 and share our experiences with other emergent countries (such as ASEAN countries) facing similar issues.



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