



AI & Economic Cycle

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Panelists:



□ Education

- Ph.D, 工業與系統工程, Texas A&M University, USA (Major: Operations Research 作業研究/運籌學)
- M.S., 工業工程與工程管理, 國立清華大學
- B.S. & B.B.A., 應用數學暨資訊管理, 國立政治大學

□ Experience

- 教授，國立台灣大學資訊管理學系
- 教授兼所長，國立成功大學資訊工程學系暨製造資訊與系統研究所
- 副編輯，IEEE Transactions on Automation Science and Engineering (SCI)
- 工業工程學會秘書長、工業局新興技術專家顧問、半導體廠科技顧問

□ Award

- 科技部傑出研究獎(2022)
- IEEE Senior Member(2021)、呂鳳章先生紀念獎(2019)
- 美光教師Micron Teacher Award (2018)
- 李國鼎科技與人文講座研究獎 (2018)、科技部吳大猷先生紀念獎 (2017)

□ Research Interest

- 製造數據科學、智慧型製造系統、生產力與效率分析、排放權交易

消費電子關鍵晶片價崩盤

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記者楊伶雯、馬琬淳、李孟珊 / 台北報導

2022年8月18日 週四 上午6:53



半導體市況轉弱，繼驅動IC報價狂跌之後，另一指標元件微控制器 (MCU) 現貨價近期也出現崩盤走勢，主流規格產品價格本月暴跌27%，較先前高點大幅回檔逾七成，新唐、盛群、凌通、松翰等MCU供應商警戒，有業者已悲觀預期年底耶誕旺季行情恐報銷。

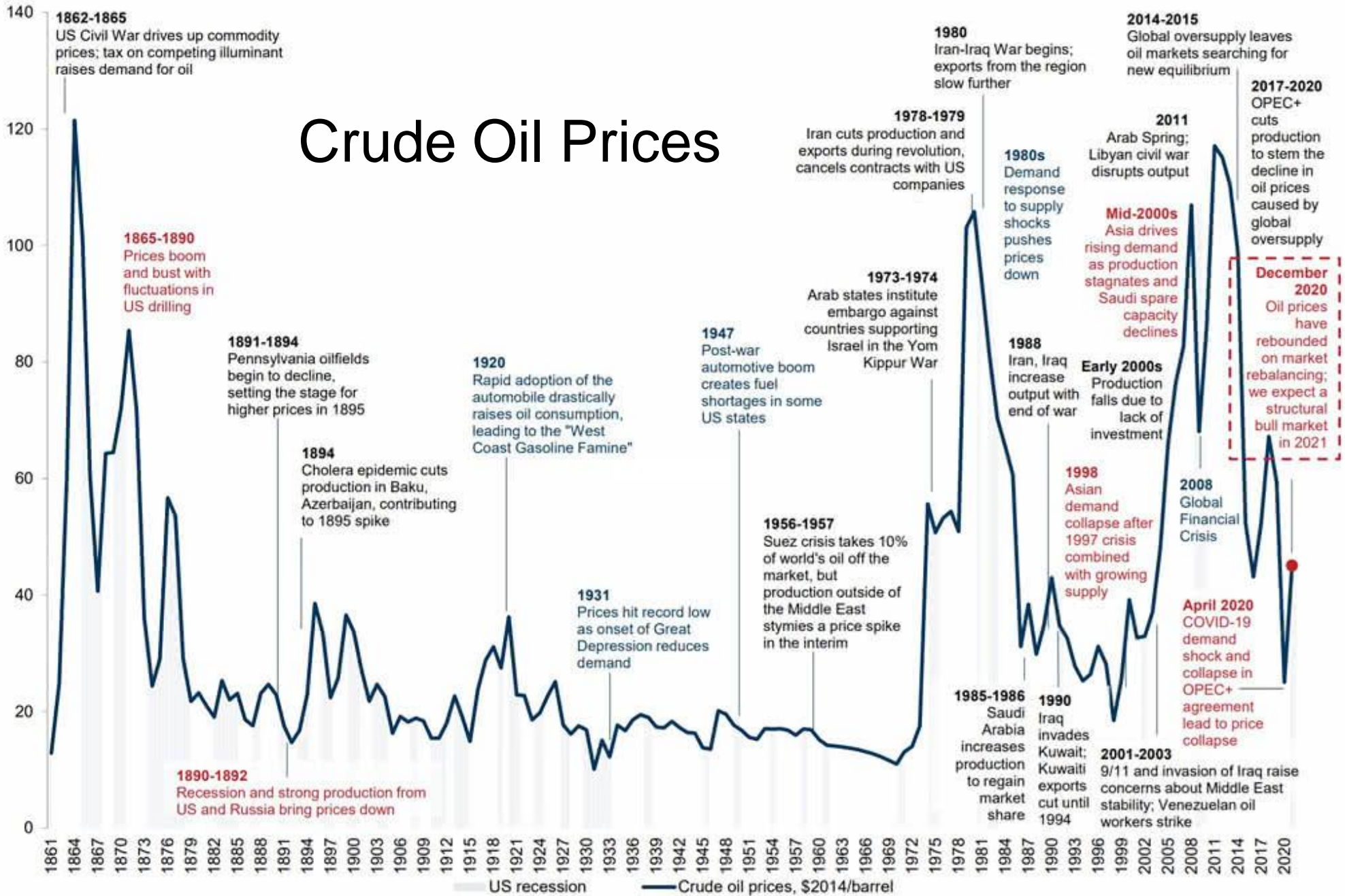
驅動IC、MCU都是消費性電子產品關鍵元件。業界人士指出，MCU因為具工作頻率低、晶片面積小、CMOS數目少、成本低、耗電量小等特色，小到鍵盤、滑鼠，大到冰箱、電視、烤麵包機等，幾乎所有消費性電子產品都會採用。MCU報價崩盤，凸顯通膨壓力使得消費者買氣大縮手，消費性電子產品庫存壓力龐大的現況。

美系外資發布報告指出，根據最新通路調查，近期全球MCU指標廠意法半導體32位元MCU價格自7月的人民幣55元，下跌至人民幣40元，跌幅達27%，這部分是以7月修正過的報價來計算跌幅，先前7月MUC的現貨價達人民幣135元，以此換算，現階段價格已從高點暴跌逾七成，逼近「腰斬再腰斬」窘境。

<https://tw.news.yahoo.com/%E6%B6%88%E8%B2%BB%E9%9B%BB%E5%AD%90%E9%97%9C%E9%8D%B5%E6%99%B6%E7%89%87%E5%83%B9-%E5%B4%A9%E7%9B%A4-225319588.html>

您相信有「**經濟循環**」嗎？~

Crude Oil Prices

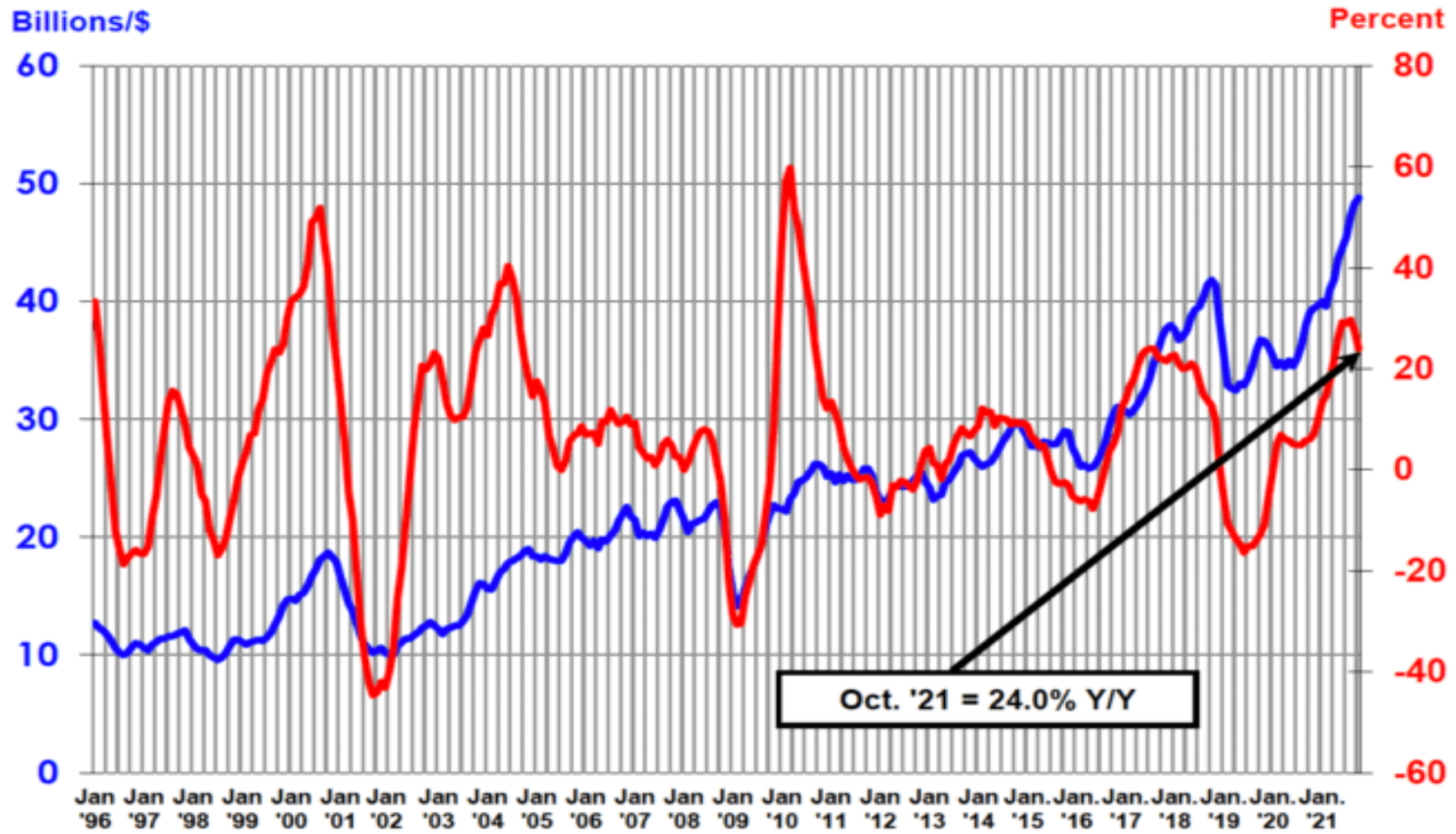


Source for data: BP, NBER/Federal Reserve Bank of St. Louis, Haver Analytics.

Source for annotations: ©James Hamilton, "Historical Oil Shocks," University of California, San Diego, February 2011; various news sources; Goldman Sachs Global Investment Research.

Worldwide Semiconductor Revenues

Year-to-Year Percent Change



Source: WSTS



- 全球重大「**事件**」(event)似乎是最關鍵因子

- 如果真的有cycle (重複性)
 - 燕子來了，就會**紅海**；燕子走了，就會**一哄而散**

 - 關注在影響cycle的因子，**提早準備**

 - Sensor安裝在哪？在客戶，end user身上，找到藍湖

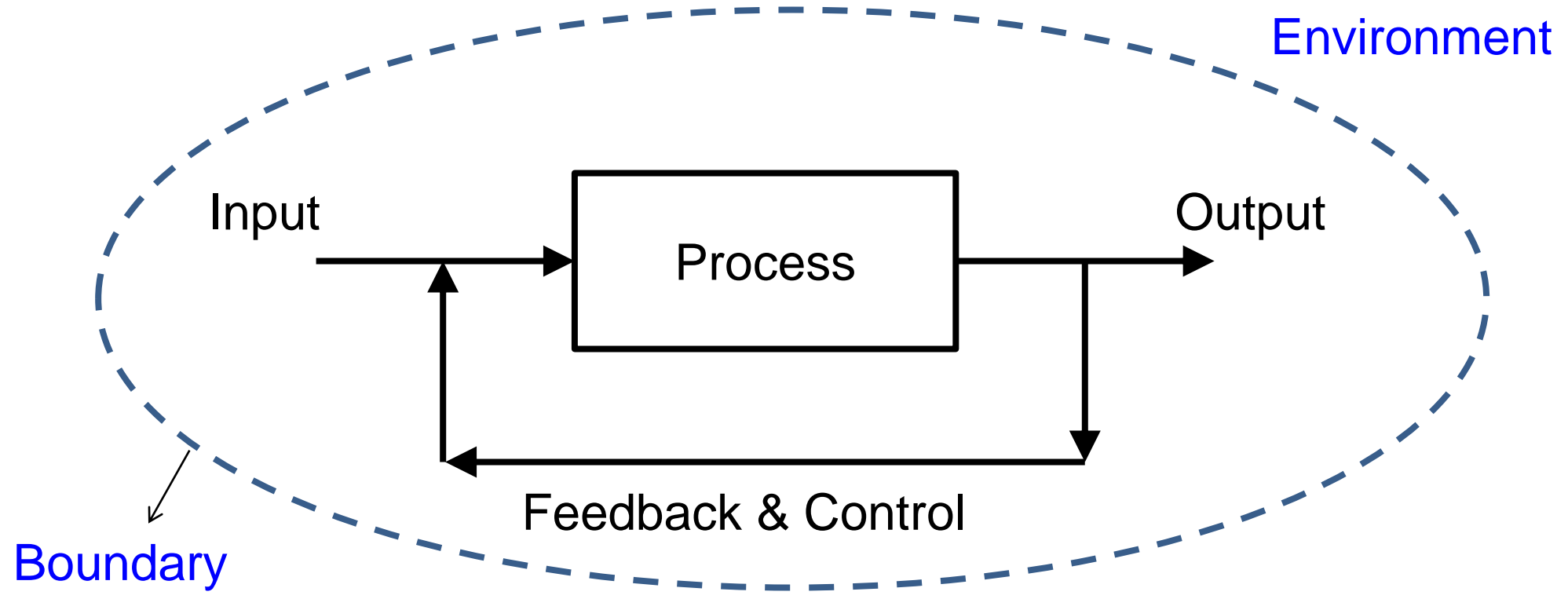
 - 專注本業的同時，請**刻意練習不擅長**但藍湖的領域，培養人才

- 如何檢視cycle？
 - 大歷史觀、大系統觀、長期重於短期、(學習)過程重於(獲利)結果
 - 但...長期重於短期、過程重於結果...董事與股東們會接受嗎？

 - 從**格局**與背後的**邏輯**來看，就避免了陰謀論(短期影響)與道德評價

 - 破局的唯一途徑：**主動積極**

□ 系統(systems)



- 數位神經系統(Bill Gates, 1999)
- “其實就是企業組織的資訊化架構，如同人類的神經系統，在面對內部與外部的變化時，能夠在最短的時間內即時回應，並訂出決策。”

- In a 2003-2017 survey with 2000 samples
 - McKinsey report that roughly one in ten companies manages to outgrow its peers both during downturns and in the subsequent recovery from.
- Observations: **Through-cycle outperformer** (mindset change)
 - Obs.1: Value Creation
 - Companies don't want growth for growth's sake. They want value creation.
 - Obs.2: Accelerate Growth in Downturn and Reshape the Portfolio
 - Their growth starts during the downturn and outperform in the recovery.
 - In 2007, right before the financial crisis, outperformers had about 20 percent more **excess cash** than their peers. After crisis in 2012 they had 53 percent higher excess cash (support reshaping portfolio → strategically placing bets).
 - Don't wait until things settle down because you lose the momentum you could capture from moving throughout the cycle. (**Initiative**主動權)
 - If you are not able to grow then, double down in the first two years of recovery.
 - Obs.3: CapEx and R&D Focus
 - In 2000 companies, when the recovery started, however, the outperformers increased their spending significantly, especially on capital expenditure (capex) and R&D—their spending was **three or four times** higher than the others.

□ Four Actions (Directions):

- Action1: Core Business (understand yourself)
 - Rather than knowing the exact moment of recovery, understood your preferred growth focus and invest when the opportunities started to emerge.
 - You should start placing some **strategic bets** while still in the downturn, then both broaden and deepen those investments when things start to improve.
- Action2: Moving to Adjacent Fields
 - One company had a **portfolio of construction and engineering services** at the start of the **last crisis** and it decided to diversify its industry exposure by moving into **environmental services**. It also went into **oil and gas equipment**. The contracyclical part of its portfolio grew substantially after the crisis.
- Action3: Geographic Expansion
 - During the down cycle, the outperformers expanded to other geographies at a rate that was **1.5 to two times** greater than the rest of our sample.
 - In 2007, a Portuguese retailer concluded that the Polish market was healthier, in terms of GDP and retail activity, than any of its other regions, and made targeted acquisitions, doubling its store presence in the country.

- Action4: Integration or Disruption of the Value Chain

- Programmatic M&A Strategy

- The through-cycle outperformers did **1.8 times** more deals during the downturn. Many did multiple deals using a programmatic M&A strategy.
- Programmatic M&A is not purely a volume play; it's a strategy for **systematically** building **new businesses, services, and capabilities**.
 - » Programmatic M&A is not about meeting a deal quota but rather about building a business or capability through a series of deals—maybe combined with organic business builds—to create something new and substantial.
- In digital M&A, there is often a high focus on **talent retention**.

- Divestitures Play

- They sell business segments that no longer fit the portfolio or make strategic sense to gain the dry powder, if you will, to make moves that make more sense.

□ Some Notes...

- Note1: Having your CEO on board
- Note2: Develop Digital Tools and Capabilities
 - When digital is radically changing the corporate cultures, that makes it an opportune time to integrate digital natives. All of us need to learn digital tools.
 - Firm-specific: invest in the **front end** of digital, in terms of **reaching more consumers**, or prioritize the **back end**, to make **processes more efficient**.
 - Traditional channels to online channels
 - One skin care manufacturer had salespeople posting their own videos with skin care tips. They paid influencers to drive demand. They live-streamed Valentine's Day events. They reallocated resources and innovated how to reach customers.
- Note3: Set the Bar High
- Note4: Not Stuck on Your Core Business (making big moves outside of the core...)
 - Systematically look at multiple directions of growth and **allocate our portfolio** to make sure you are ready in the right markets when opportunities emerge.
 - **NOT** think about strategy in **incremental ways**, as just tweaks to the budget from last year. The executive team needs to adopt a bolder mindset. If that mindset is there, everything else is doable.

心法：降**成本**是目的
 方法：降**變異**是過程
 作法：流程(ECRS)
 資源(作業研究)
 因子(數據科學)

縮時
 數位神經系統
 (Infra/CPS/DigitalTwin)

學理與方法論

降本
 降低變異/風險
 R&D-AI化
 (流程/資源/因子)

**AI之路
 該如何走？**

增效
 數位轉型/智能化
 (製造數據科學)

提質
 學習型組織/KM
 (教育訓練)

減存
 產銷平衡
 (產能彈性/最適規模)

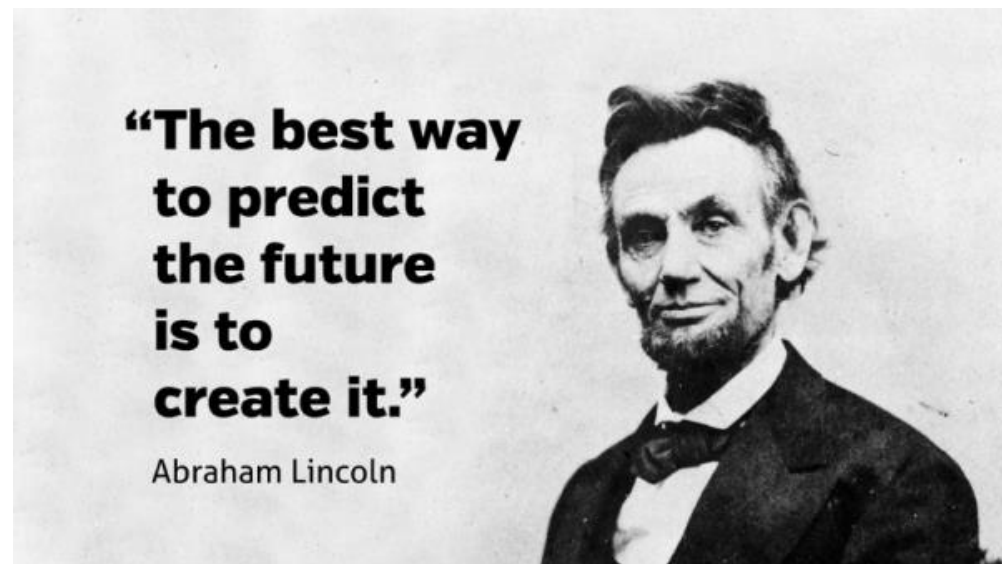
Capacity +
Uncertainty(降本) +
LeadTime(縮時)
 =Inventory

□ 數位神經系統(Bill Gates, 1999)

- 即時監控
 - 透過sensor與IoT快速感知**內外部變化**
 - 快速反應緊急狀況，**避免最大損失**
- 資訊快速存取(big data)
 - 預測與決策
 - 資訊的**異質性**
- 問題偵測與定位
 - 準時上下班，則找問題一定要精準(在有限的時間人力下能做出成果)
- 如何精準問題？
 - 內部**老司機**
 - 外部顧問
 - 從財務**成本結構**下手
 - 尋找第二專長的商業機會點(跨領域)
 - 參與**產業技術**研習會、聽頂尖專家演講(走在技術趨勢上)

□ 比爾蓋茲的15個「神」預測

- 比價網站
- 行動裝置
- 透過網路即時付費、理財、改善健康照護
- 個人助理和物聯網
- 線上監控住家
- 社交媒體
- 自動推薦、促銷
- 運動賽事即時討論網站
- 智慧型廣告
- 看電視時會有網路連結
- 網路論壇
- 網路社群
- 專案管理軟體
- 網路徵才
- 商業社群軟體



- 2017年全球頂尖顧問公司麥肯錫就對台灣發出警訊，數位轉型是臺灣企業的當務之急，若有延遲恐將危及經濟發展
- 企業先釐清需求所在，找出問題後，再透過數位科技解決。釐清數位化、數位優化、數位轉型與數位再造四者的定義，才能循序漸進完成目標。



數位轉型基石



營運卓越
顧客體驗



商模再造



價值主張
重新定義

http://mckinseychina.com/wp-content/uploads/2017/10/McKinsey_Taiwans-Digital-Imperative-EN.pdf

□ 數位化 Digitization

- 減少實體傳遞降低**資訊不對稱**
- As-Is : 靠**人工**方式營運，資料以**紙本**記錄、技術靠**口耳**相傳，儲存不易，更難延伸數據價值
- To-Be : **資訊電子化**過程，讓數據方能被累積、管理、應用。
- 包括文字、圖片、音訊、信號等

□ 數位轉型 Digital Transformation

- **非自己怎麼看，而是別人怎麼想**
- 在組織的各個層面皆整合應用科技以效率化**公司內外**流程
- **重新對資源作定義**，開發新的價值鏈(value chain)

□ 數位優化 Digitalization

- IT+OT : 結合數位科技至現有的營運**流程**中的過程，達到縮時、增效、減存、提質、降本
- ECRS : 消除(Eliminate)、合併(Combine)、重組(Rearrange)、簡化(Simplify)方式將**流程精實化**
- 包括Email、社群媒體、整合企業功能的API、供應商平台等

□ 數位再造 Digital Reinvention

- **組織**對於**價值主張**的重新定義
- 真正意識到消費者的需求，並且從中發展與定位相應的主張
- **人機協作**的組織變革(功能導向 → 問題導向)

人為中心



萬物聯網



□ 善用AI工具

- 人腦不易分析的，給AI 做
 - SPC2.0、上下游的交互作用、即時監控、大規模計算...
- 用AI，快速收斂問題
 - POC (proof of concept): Tableau, RPA, JMP
- 以有「代表性」的樣本或事件為主，來進行分析與驗證

□ 迷思：AI要百分之百比人好才上線？

- 人管理財所帶來的彈性 vs. AI的「一般化」模組需要在場域「客製化」
 - 很少一開始就做的比人好的...而是不斷地訓練...
- AI需要錯誤的數據/失敗的教訓，才能「學」

□ 上線/實作時避免最大損失

- 當廠區product-mix複雜度高，仍以「人」為主，能摘的果實先摘
- 之後便可隨著時間(數據變多)fine tune

□ Lean (identify non-value-added process and remove it)

- Value and Conflict: Value Stream Mapping (VSM)
- Waste elimination (8 muda, Womack and Jones, 2003)
 - 1. Transportation
 - 2. Inventory
 - 3. Motion
 - 4. Waiting
 - 5. Overproduction
 - 6. Overprocessing
 - 7. Defects
 - 8. Eschewed Talents
- Continuous flow
 - **Line Balancing**
- Pull production system



不要把浪費自動化了

AI並非取代人力...
人機共存、相輔相成

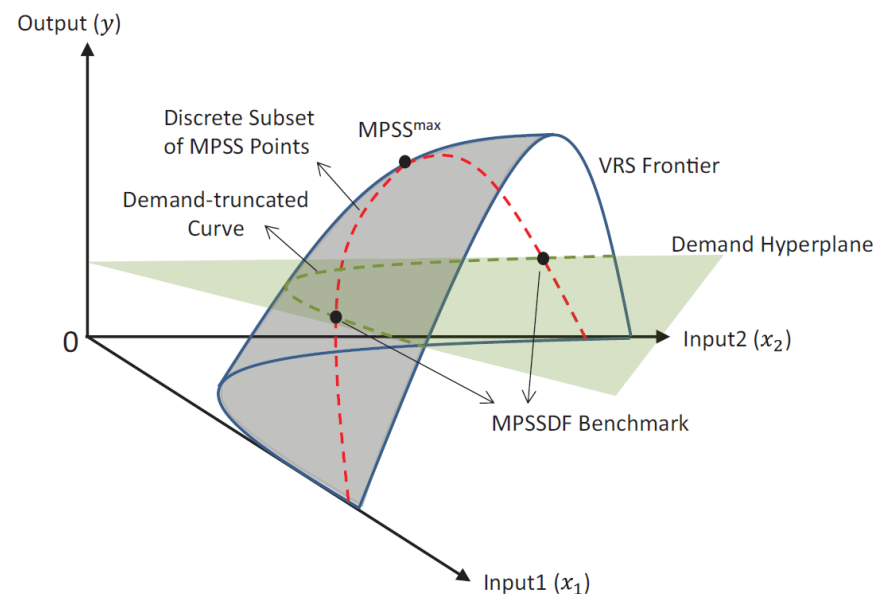
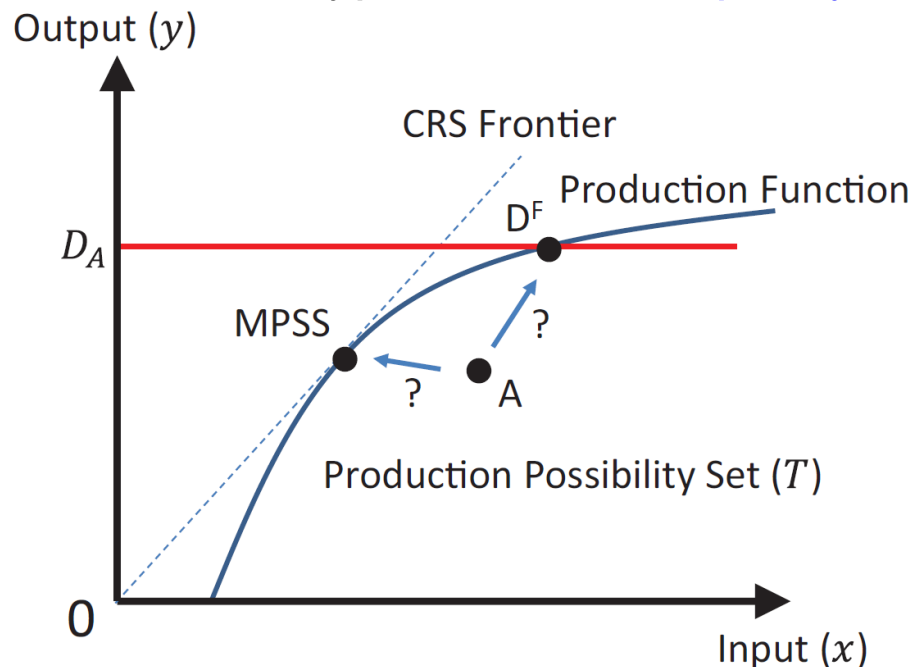


組織演化與新制度的建立

減存- 最適生產規模 (產能彈性)

□ 最適生產規模(most productive scale size, MPSS)vs.需求滿足

- Two Types of Risk: Capacity Shortage vs. Capacity Surplus



□ Results

- 長期發展，最適生產規模為穩健(robust)產能的基礎
- 相較於需求變異與缺貨/存貨風險，邊際生產力的影響最大
- 產能彈性的建構：加班、外包、廠區backup、租機台、不同tech-layer的切換(降低綁機所造成的產能損失)

Lee, C.-Y., and Charles, V., 2022. A robust capacity expansion integrating the perspectives of marginal productivity and capacity regret. European Journal of Operational Research, 296 (2), 557-569.

□ 學習型組織 (Peter Senge, 《第五項修練》, 1990)

- 由於環境變遷之快速，系統需要能夠及時反應外在環境的變化，不論是要「**逃避環境**」、「**適應環境**」、還是「**改變環境**」，這個**系統**都需要「**做(do something)**」些什麼以在環境中求生存
- 書中提出一個重要問題：企業和組織，如何發展適應環境的能力呢？
 - 綜觀全書後的簡要答案：**組織不能再依靠單一領導人來運籌帷幄，而必須要全體上下合作，不斷學習與創新。** → 「學習型組織」
- 我以為「**智慧要分享、利益要分配、責任要分擔、行動要合一**」

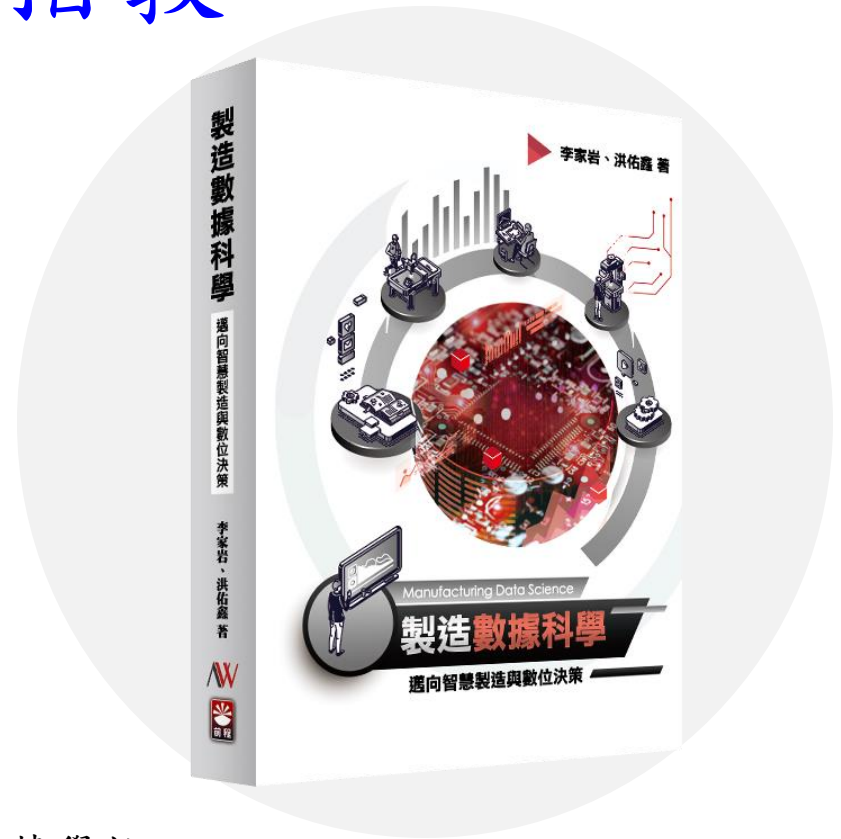
$$\text{組織績效} = (\text{決策力} \times \text{執行力}) \text{分享力}$$

- 學習型組織不單是「喊」出來的...更是一步步踏實地「**走(執行)**」出來的...
- 因此學習型組織與其說是一個**主動成長**的組織，還不如說是一個面對環境改變「不得已」進而調整自己，提升自己**免疫力(immune)**的一個系統

感謝大家的支持跟參與 還請多多指教



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台灣人工智慧學校
- 智慧製造與生產線上的資料科學
http://polab.im.ntu.edu.tw/Talk/Data_Science_in_Manufacturing.pdf
- 預測之外：跨越預測與決策間的鴻溝
http://polab.im.ntu.edu.tw/Talk/20201114_Beyond%20the%20Prediction.pdf