power integrations™

"As we enter a new century, the industry appears intent to follow the 'letter' of Moore's Law – but can it still engender its 'spirit'?"*

R. Barsan, "Moore's Law 2000", EE Times, December 1999

The Semiconductor Industry – 40 Years Later

Radu Barsan – October, 2017
CAS-2017, Sinaia, Romania

ac-dc converters | led drivers | igbt drivers

CAS at 40 – Congratulations and Many More Returns!

The Early Days, Leading up to CAS… 1976-1978

(from left to right)

1976 ICCE: Barsan, Bulucea, Oldham, Vladimirescu, Vanco, Prisecaru

1976 ICCE: Profeta, Dusa, Barsan, Vladimirescu, Oldham, Bulucea, Constantinescu

1978 ESDERC: Bulucea, Barsan

1977 ICCE: Barsan, Profeta

1978 IEDM: Bulucea, Barsan

The Early Days… CAS-1980

(from left to right)

Vatasescu, Barsan

Popescu, Ardelean, Barsan, Postolache, Chitila, Cobianu, future Mrs. Barsan, Ionita, Gheorghiu, Dan…

Vatasescu, future Mrs. Barsan, Barsan

Barsan (presenting)

The Early Days… Gaining Momentum

(from left to right)

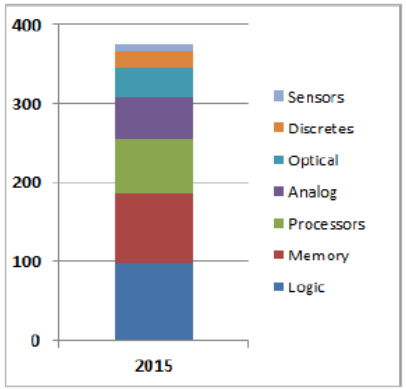
1981(?) ICCE, Staff of MOS Laboratory, starting Microelectronica: Barsan, Ardelean, Voicu, Bulucea, Profeta, Delibaltov, Ungureanu, Gheorghian, Mihai, Ionita, Nicuta, Stangu, […] Veron, Jelea, Iorgulescu

CAS-1985 Organizing Committee: Barsan, Bazu, Jelea,[…], Vancu, Bulucea, Gozner,[…]

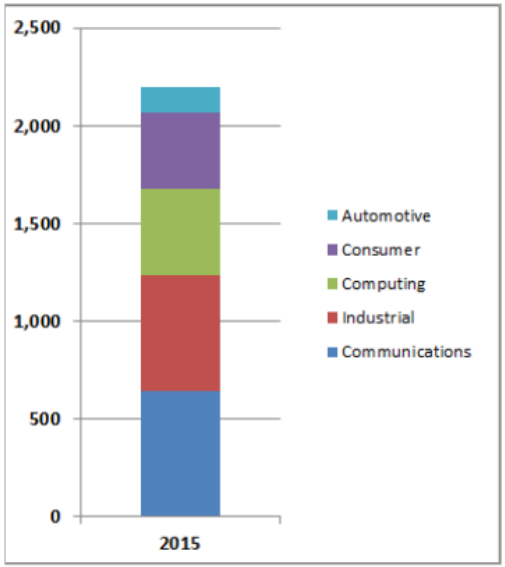
Apologies for forgetting some of the names… Please fill in the blanks!

Semiconductors Create Unparalleled Value Across the Economy

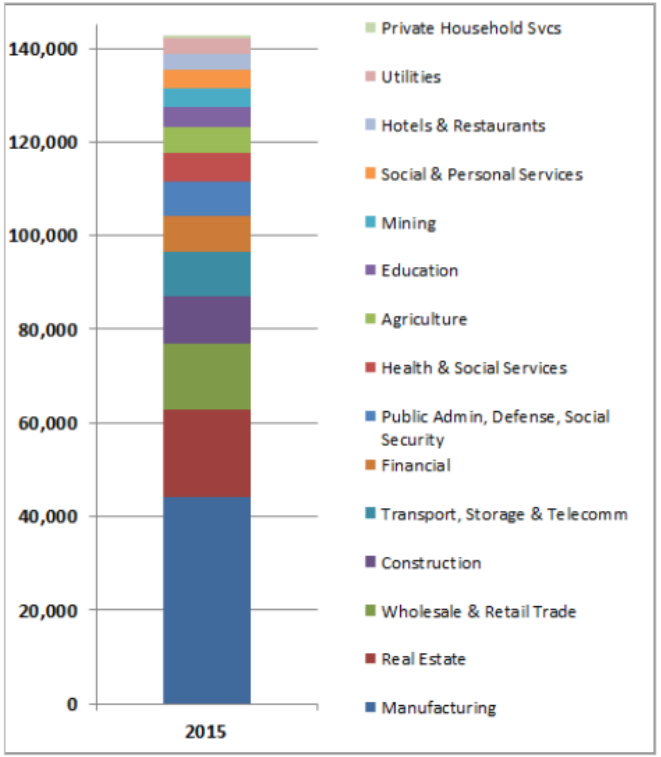
Semiconductor sales $375 billion



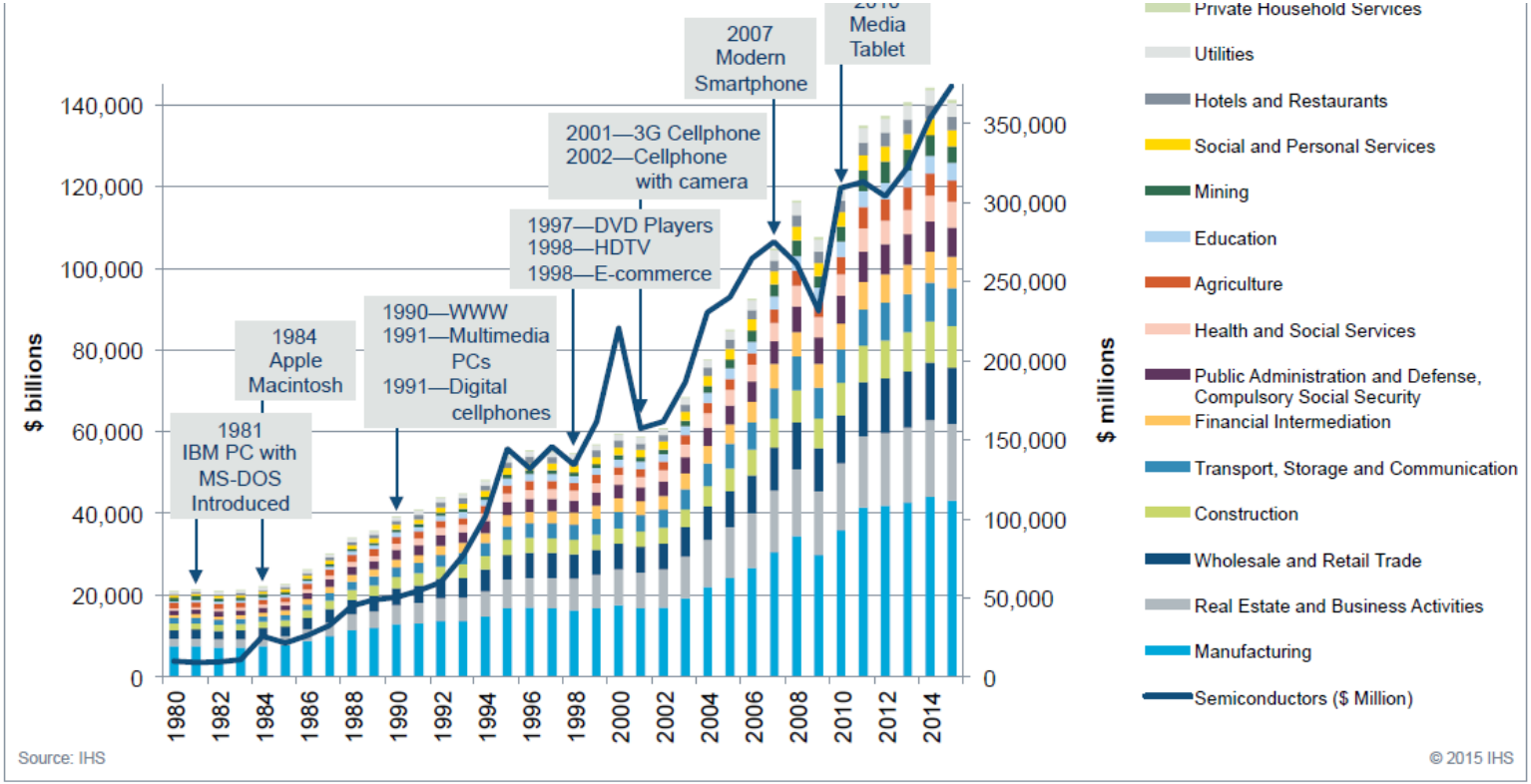
Equipment sales $2.2 trillion



Total sales $143 trillion

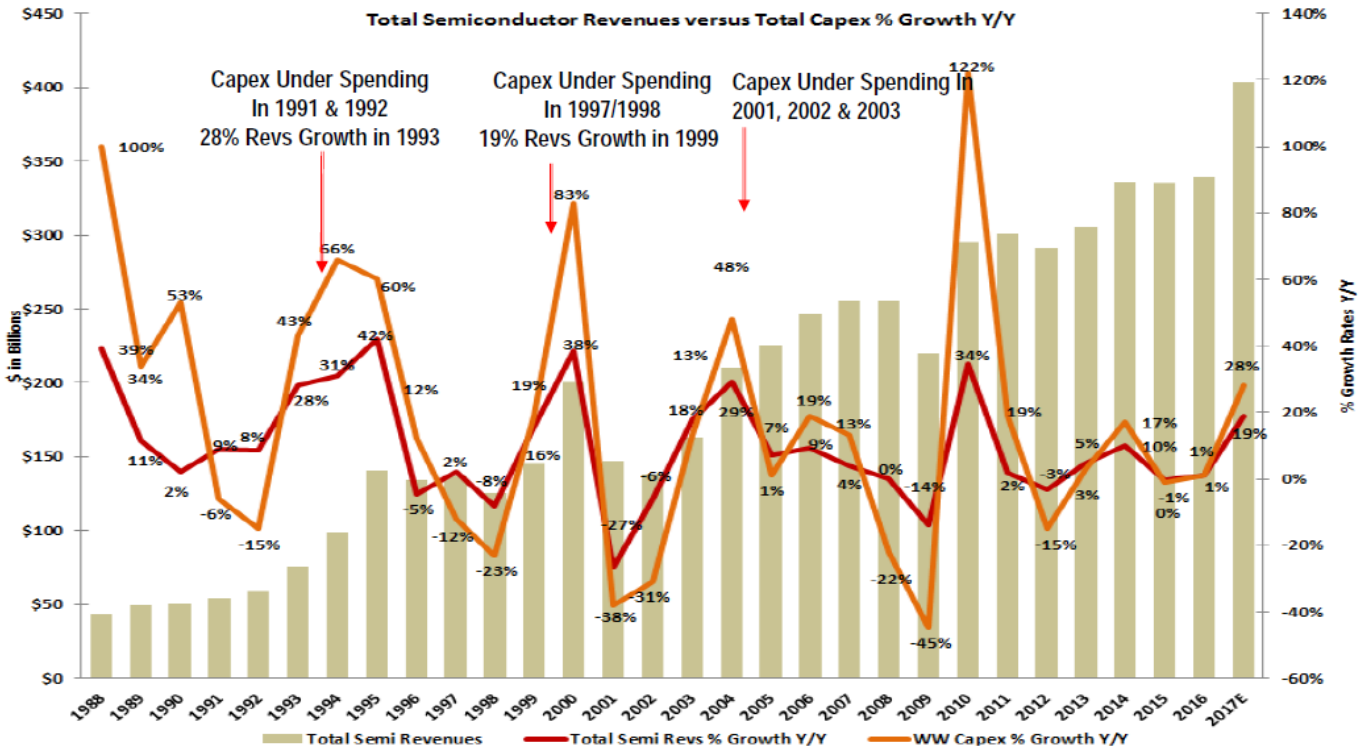


Global Output (left axis) Correlates Well With Semiconductors



A $400 Billion Industry…

…marked by the (in)famous semiconductor industry boom and bust cycles caused by over/under investment



Industrial Impact

- **The semiconductor industry has impacted and sometimes shaped most other modern industries, from "high-tech" to commodities**
  - Communications, connectivity, the Internet, social networking, mobility, B2B
  - Shopping, entertainment, education, *smart*-everything, IoT
  - Photonics, lighting, optical communications
  - Automotive, traction, military, space exploration
  - Power generation, transmission, and distribution, clean energy, *clean*-everything
  - DNA sequencing, neural computing, AI, etc…
- **Methods of development, statistical design, design automation, CAD, simulation, modeling**
- **Manufacturing methods, economy of scale, quality control, capacity/uptime utilization**
- **Business models: Si foundries, fabless, IP, licensing, supply chains, JV's, CM's, distribution**
- **Investment models: the venture capital industry (long since moved on to other spaces)**
- **Non-Si: compound, LED, lasers, sensors, WBG, *nano*-everything, spintronics, quantum-etc**
- **And also false premises: "if you make it on Silicon, it will follow Moore's Law"…**

Societal Impact

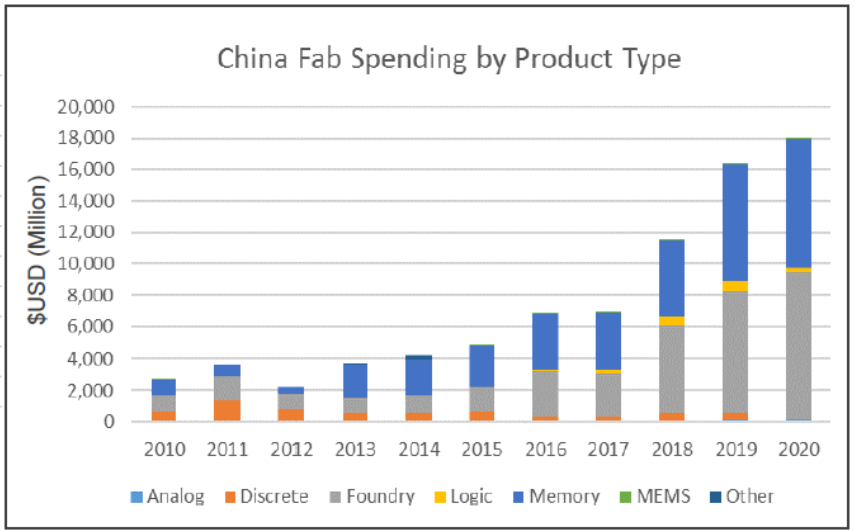
- Stone age, Bronze age, Iron age, … Silicon age,… Digital age – “Digital Divide”
- Google, Facebook, Amazon, Netflix, Uber, Airbnb, Twitter, LinkedIn, …
- *Mobile/Wireless*-everything, IoT, Cloud…
- Globalization – political impact: the world is increasingly dependent on semiconductors
- Globalization: FSA becomes (global) GSA; NTRS becomes (Int’l) ITRS
- Spawned new professions, new management methods, new (“high-tech”) work relationships
- Mature industry, accelerating consolidation
- Employment, geographical migration of manufacturing and R&D: Si Valley has no Si left…
- Advancement of manufacturing and R&D in countries which reached critical mass
- Unaffordable investments in equipment and manufacturing capacities – now multi-$B
- Trend is to concentrate manufacturing capacities in places where large investment decisions are made by the government

R&D and Commercialization – Driven by CapEx

- Role of academia in fundamental research
- Must bridge the gap between *invention* and production-worthy, commercial *innovation*
- Transition from corporate R&D (e.g. Bell Labs, HP, GE) to collaborative or subscription-based R&D (e.g. IMEC)
- Corporate R&D will continue in niche applications, small enough to not require or attract large resources
- Process IP has moved almost entirely to the tools – equipment manufacturers still prosper
- Slowing trend of process/device innovation in private venture startups – designing apps is far more lucrative and less capital intensive
- "More then Moore" areas are expanding thanks to higher innovation content and lower CapEx: automotive, MEMS, sensors, compound semis, integrated photonics, life sciences (lab-on-a-chip), etc.

After US, Europe, Japan, and Taiwan – It's China's Turn to Lead the Way…

Source: World Fab Forecast report (September 2017, SEMI)



Source: SEMI World Fab Forecast, June 2017

- …with surging fab investments and technology acquisitions: goal is self-sufficiency by 2025
- $150B investment fund to increase WW share from 9% to 70%...

感谢您的关注*

**Thank you for your attention*

Radu Barsan: 40-Year Career Highlights

- **VP Technology – Power Integrations, San Jose, California**
  - Power conversion semiconductors
- **President and CEO – RIO Inc, Santa Clara, California**
  - Integrated photonic semiconductors
- **VP Engineering – Phaethon Communications, Fremont, California**
  - Devices for optical communications
- **VP Technology and Engineering – Cirrus Logic, Fremont, California**
  - Mixed-signal, analog, and graphics semiconductors
- **Manager Technology Development – AMD, Sunnyvale, California**
  - Microprocessors, flash memory, and programmable logic
- **Manager Technology Development – Cypress Semiconductor, San Jose, California**
  - SRAM and programmable logic
- **Director MOS Fab – Microelectronica, Bucharest, Romania**
  - CMOS logic, RAM, custom design semiconductors
- **Researcher – ICCE, Bucharest, Romania**
  - MOS devices, technologies, and circuits
  - Member of founding committee of CAS
- **Ph.D.'s from Catholic University of Louvain, Belgium, and Bucharest Polytechnic, Romania**