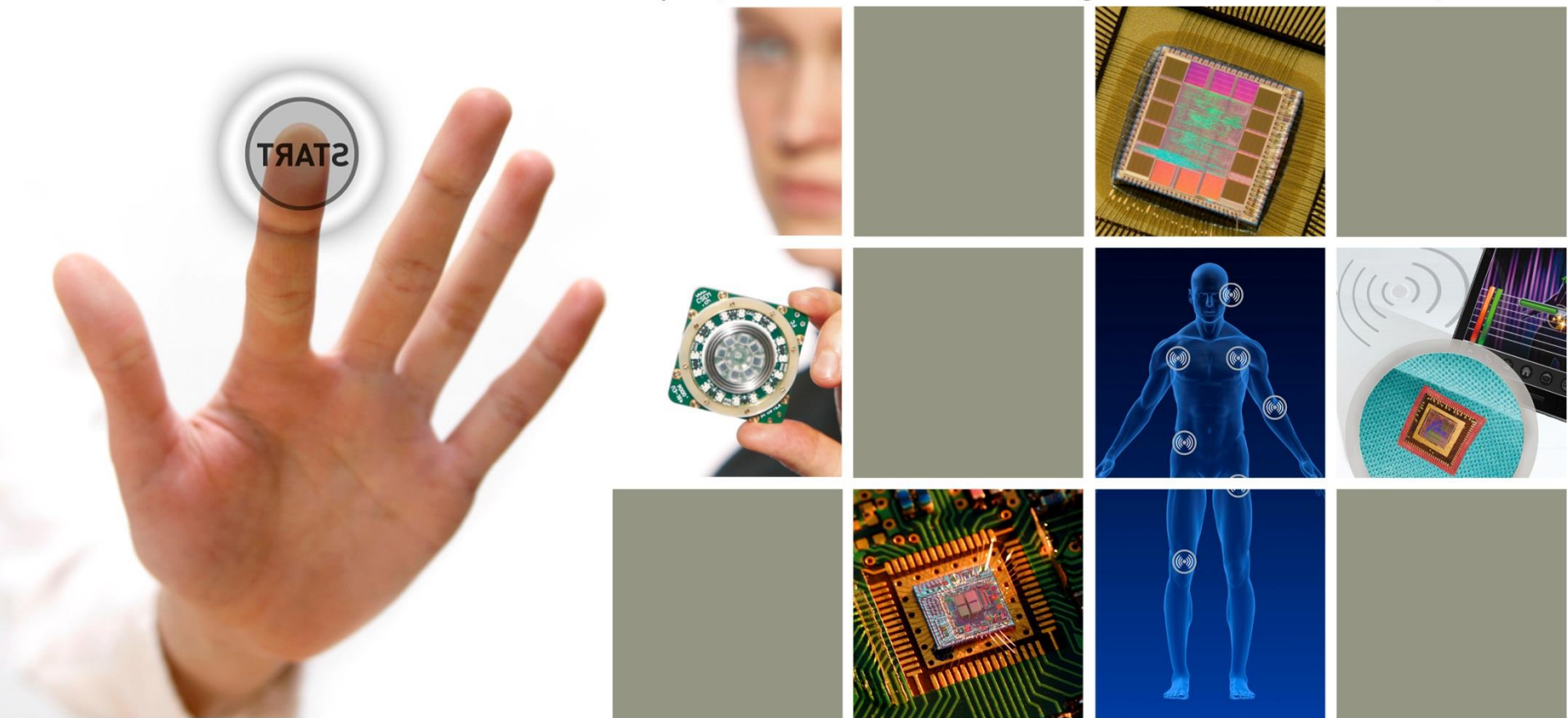


Dragan Manic

Deputy Division Head, Integrated & Wireless Systems



Outline

- My background
- Silicon foundries today - semiconductor global trends
- **Video** - leading CMOS wafer processing fab
- CMOS clean room environment
- Fab international & local suppliers
- Human resources
- Quality & reliability
- Conclusions

My background

- 1994 EE
 - Faculty of Electronic Engineering - EF, Nis, Srbija
- 2000 PhD
 - EPFL – Swiss Federal Institute of Technology, Lausanne, Switzerland
- 2000-2006
 - XEMICS SA & Semtech Corporation, Neuchâtel, Switzerland
- 2007 – Today
 - CSEM – Swiss Center for Electronics and Microtechnology, Neuchâtel, Switzerland

CSEM at a glance

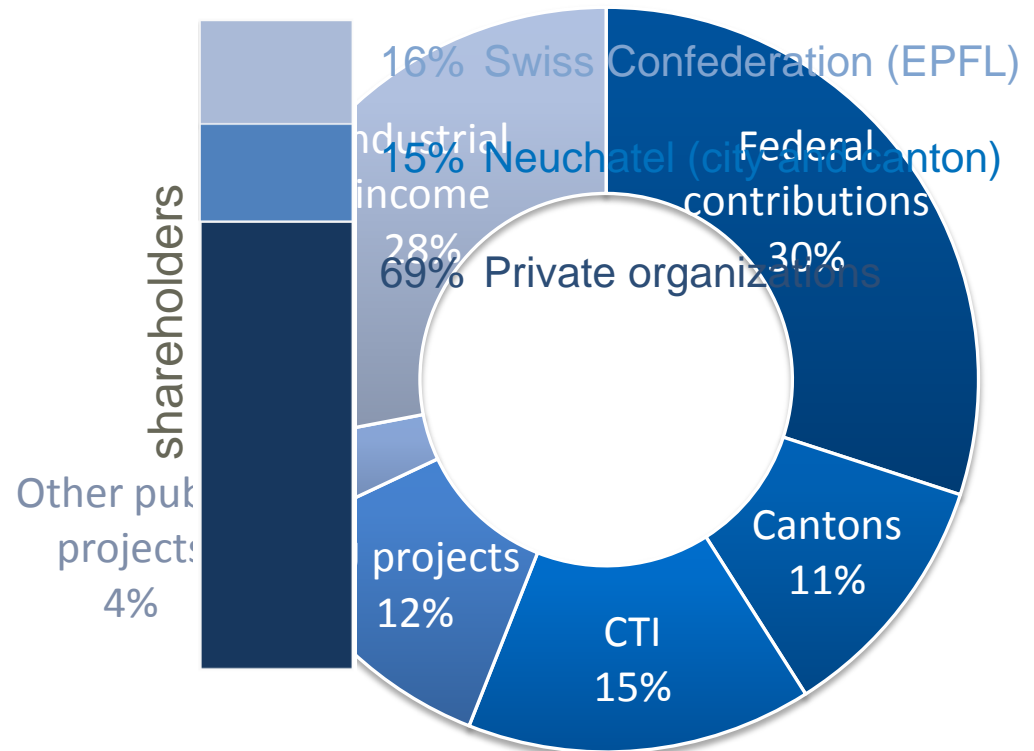
- Incorporated, not-for-profit **Research and Technology Organization (RTO)**, supported by the Swiss Government

- **A public-private partnership**

- 31 % public
- 69 % private

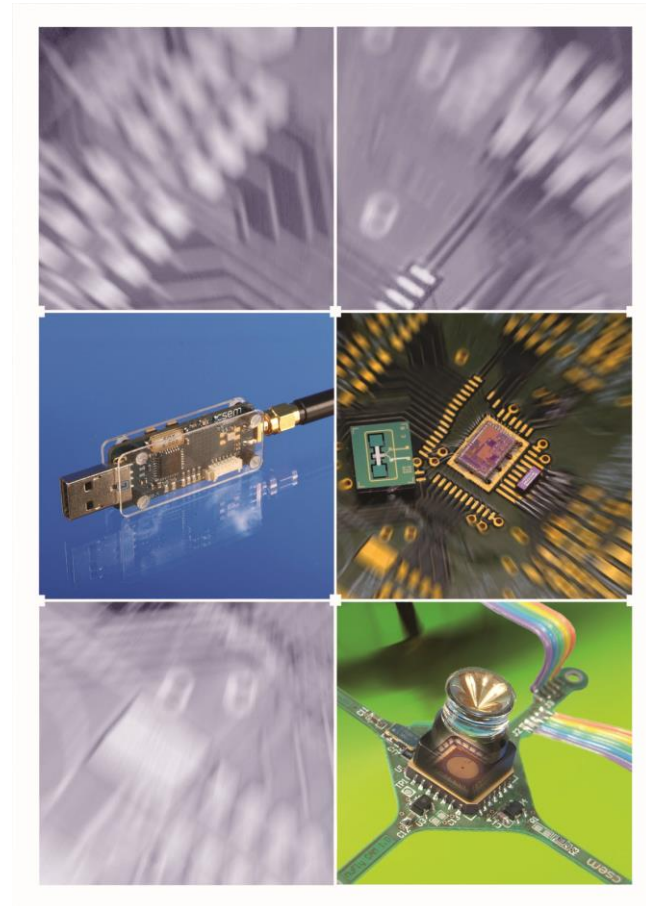
- **Key figures (2012)**

- Revenues ~ CHF 70.0 mio
- Employees ~ 400

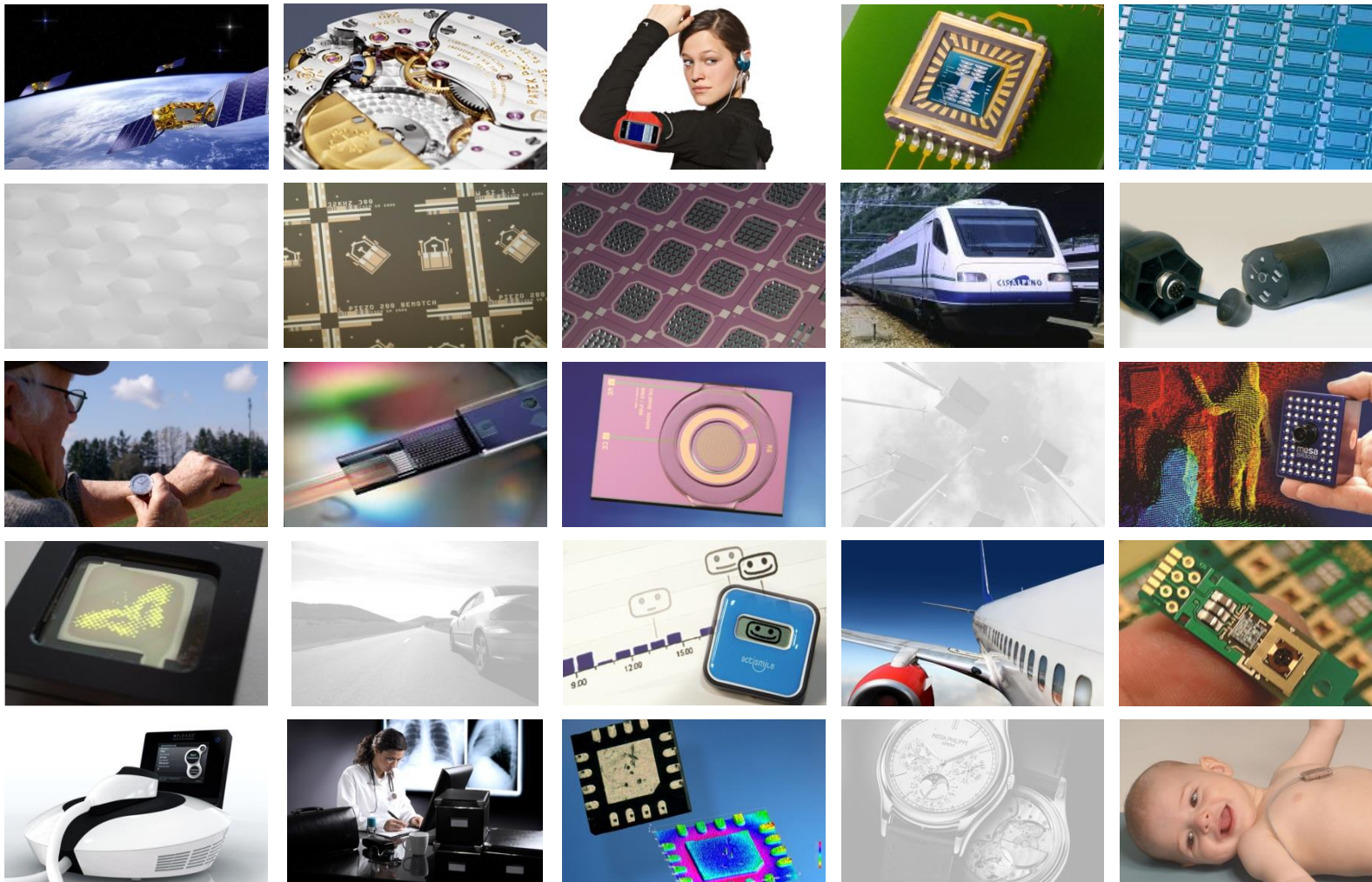


CSEM's technology programs

- MEMS
- Surface engineering
- Systems
- Ultra-low-power integrated systems



Fostering innovation ...



Microelectronics at CSEM

- 30 years history of low power IC design; roots in Swiss watch industry
- Leading edge **low-power** and **low-voltage** RF/Analog/Digital IC experience
- R&D of complex analog/digital **ASICs** and **System-on-Chip** (SoC)
- Team of 70 including **60 experienced designers & embedded software engineers**
- Global ASIC service :
 - **Design**
 - **Industrialization**
 - Management of the **Production and Test**
 - **Fabless** One-Stop **ASIC** Shop

Integrated & Wireless Systems

Embedded Vision Systems

SoC & Mixed-Signal Design

RF & Analog IC Design

Embedded Wireless Systems

Innovation for extended battery life

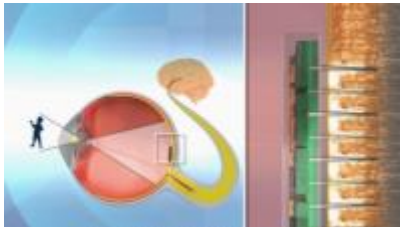
Portable medical



Industrial control



Medical implants



Consumer



AMR



GPS

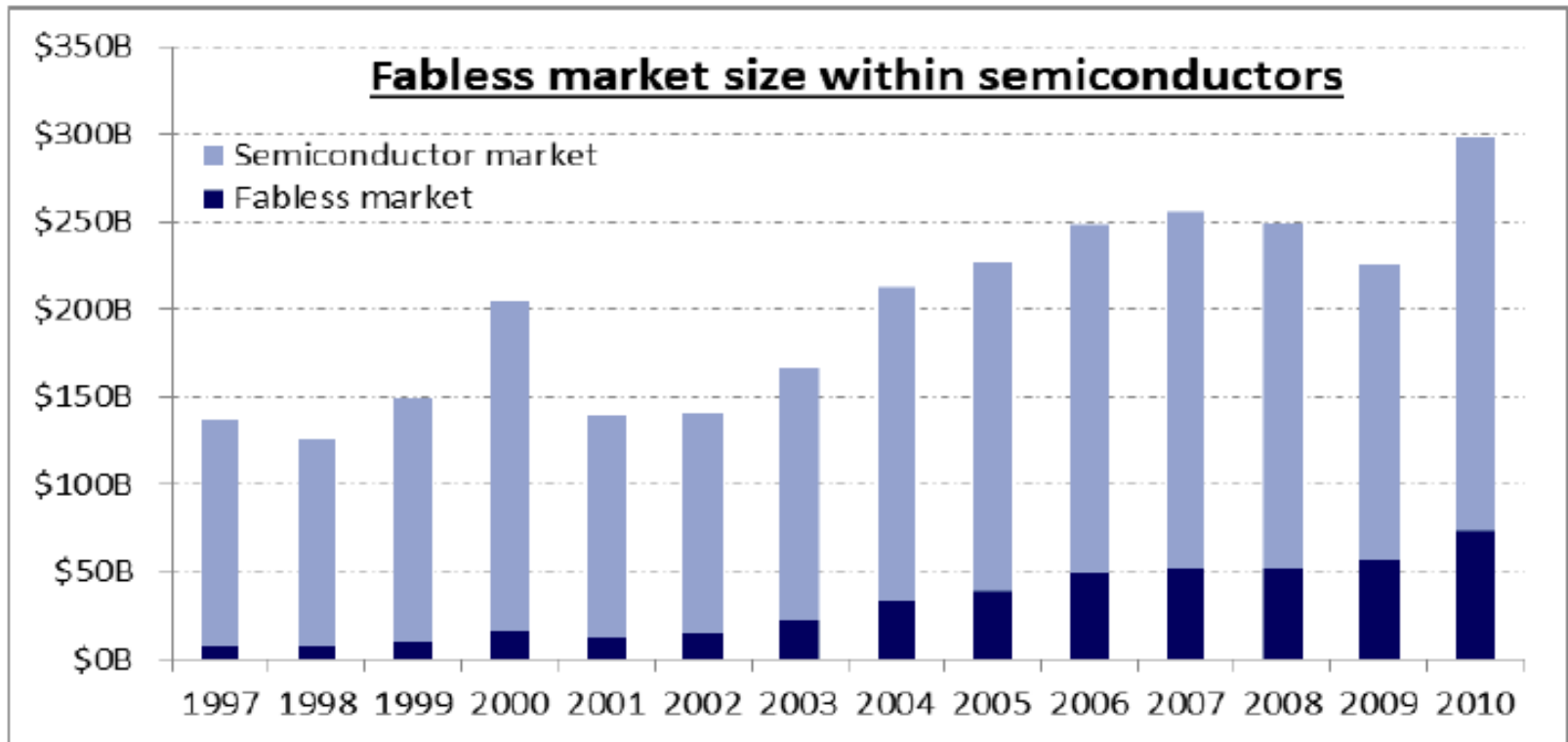


Security



Global semiconductor market

- Semiconductor market today is >300 billion dollar market



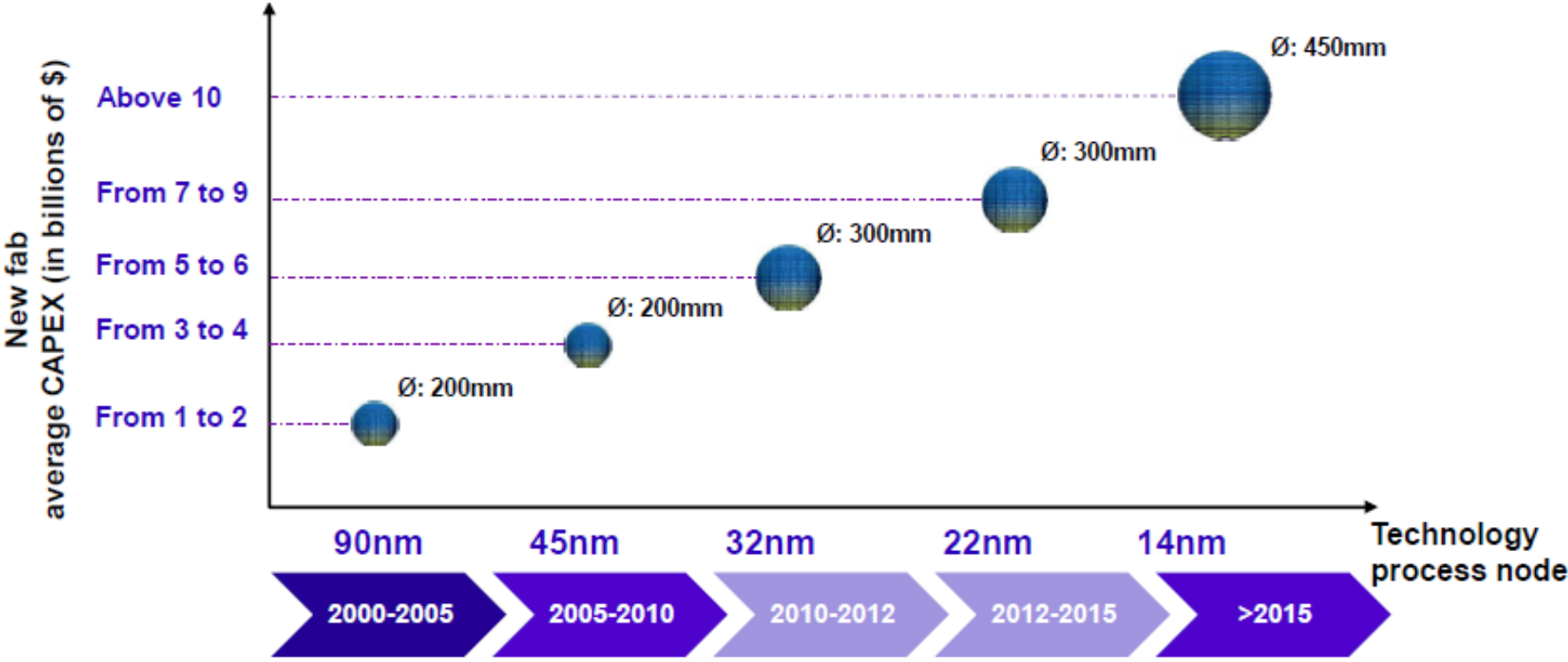
Source: IC Insights, Infineon and Yole Développement

Top 12 Worldwide semiconductor foundries by revenue (Millions of U.S. Dollars)

Rank	Company	2012 Revenue
1	TSMC	17130
2	Globalfoundries	4200
3	UMC	3602
4	SMIC	1702
5	Samsung	1295
6	TowerJazz	639
7	IBM Microelectronics	634
8	Powerchip Technology	614
9	Hua Hong NEC	602
10	Vanguard International	580
11	Dongbu HiTek	478
12	MagnaChip Semiconductor	390
	Others	2711
	Total Market	34577

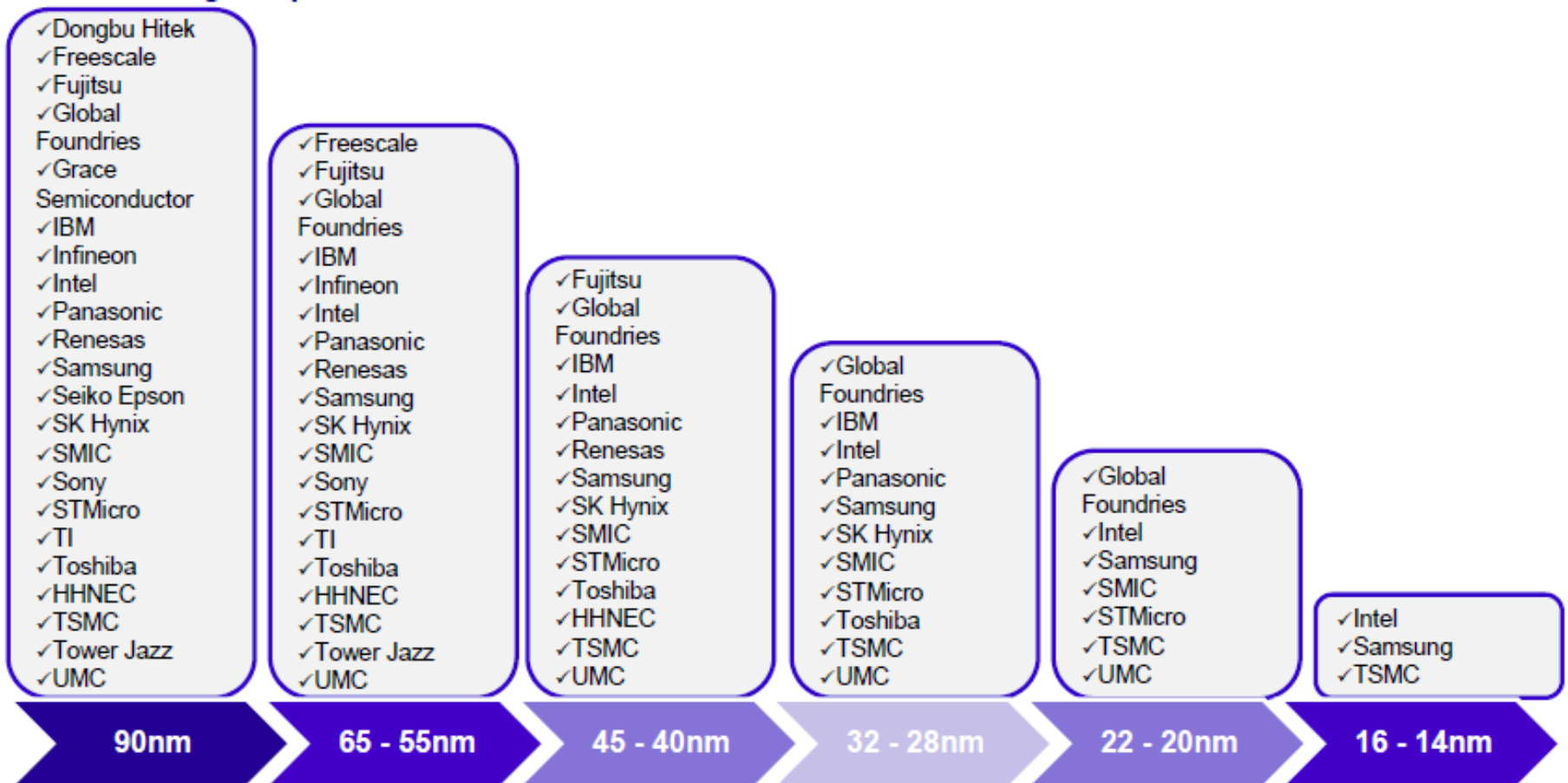
Source: Gartner

Technology process nodes & CAPEX



Source: Yole Développement

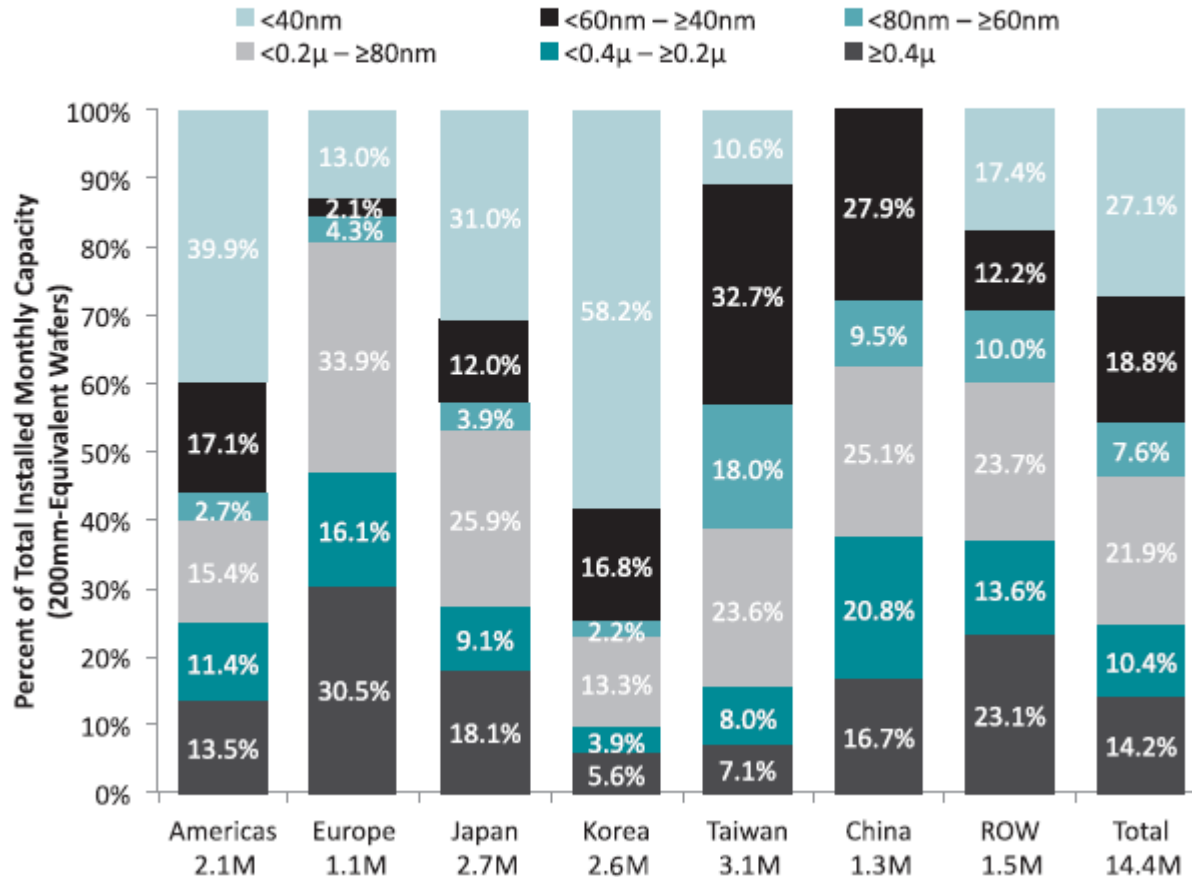
Semiconductor foundry main players



Source: GSA

Global Capacity

**Installed Monthly Capacity for Each Geographic Region
by Minimum Geometry as of Dec-2012**



Source: IC Insights

Moore's Law & more

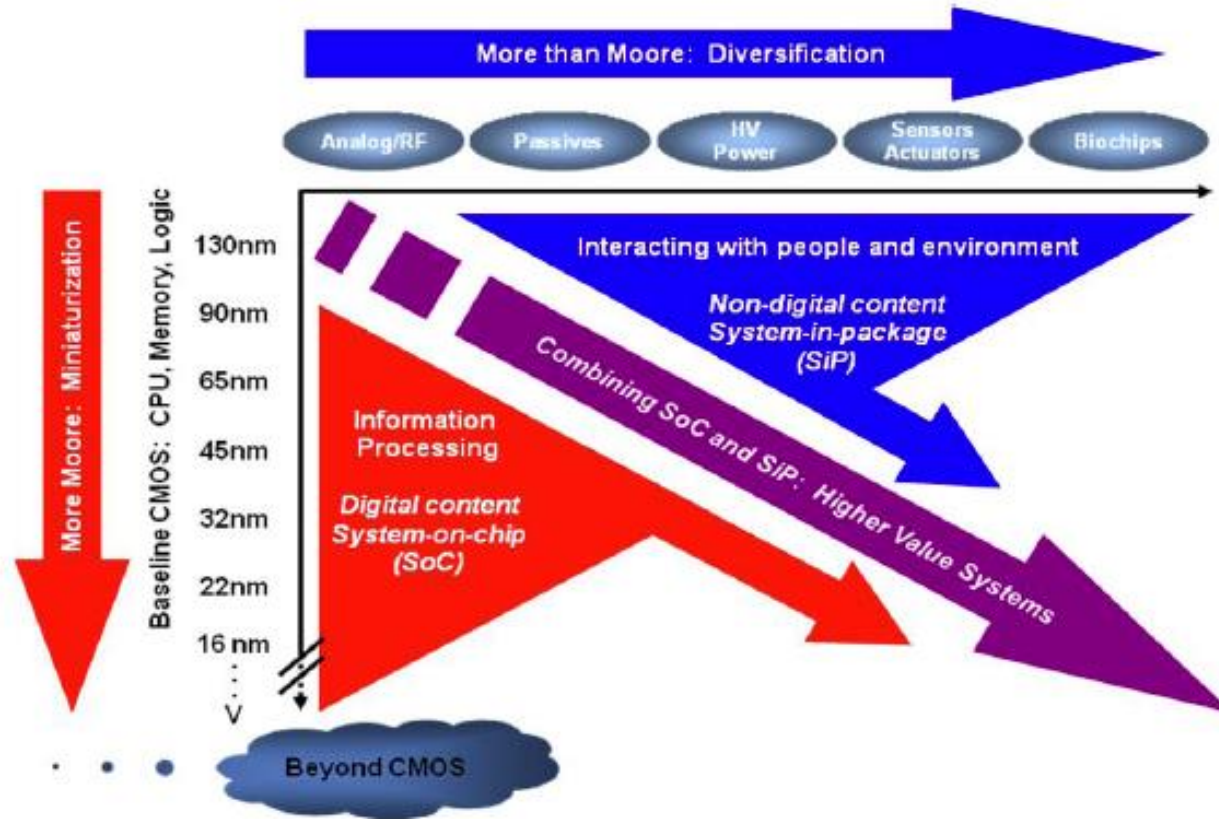


Figure 5

Moore's Law and More

Source: ITRS

In summary - what are the semiconductor global trends?

- Big market
- High production volumes
- Huge investments
- Activity shift toward Asia
- Fabless business increasing
- CMOS technology domination
- Intensive R&D for “More Moore (Moore’s law)”
- Less players in More Moore
- More Moore & More-Than-Moore in parallel

Video (youtube.com)

- [An example of a leading CMOS, fully automated, wafer processing fab](#)
- Automation; 500-1000 steps per lot
- Main Manufacturing Areas
 - Diffusion
 - Ion Implantation
 - Chemical Vapor Deposition (CVD)
 - Photo Lithography
 - Etching
 - Physical Vapor Deposition (PVD)
 - Chemical Mechanical Polishing (CMP)
 - Process Control & Inspection
 - Testing & Packaging

CMOS clean room environment - Huge manufacturing facility!

- Large infrastructure with several floors
 - Including an easy access to the fab the equipment installations for service and maintenance
 - Huge, closed machines (clusters) – several tones each
 - Deionized water installation
 - Vibration isolation
 - Clean air conditioning including also temperature & humidity control
 - Materials & wafer storage
 - Hazardous chemicals storage and security including sensor systems ...
- Continuous, guaranteed (back-up) power (large) supply
 - 1.4 to 1.6 kWh (chip fabrication) per 1 cm² IC => 20MW for 30kwfr/m



Fab international & local suppliers

- Equipment/tools
- Consumables
 - Chemicals
 - Materials
 - ...
 - Cloths cleaning
 - ...
- Services
 - Logistics / Customs
 - IT
 - ...



Design services



GLOBAL SOLUTIONS ECOSYSTEM PARTNERS

Serving all aspects of design enablement and turnkey services, OPC/mask operations and assembly solutions.

Design
Tools

Library
Solutions

IP
Solutions

SoC Design
Services

Mask Services
Partners

Assembly/ Test
Services

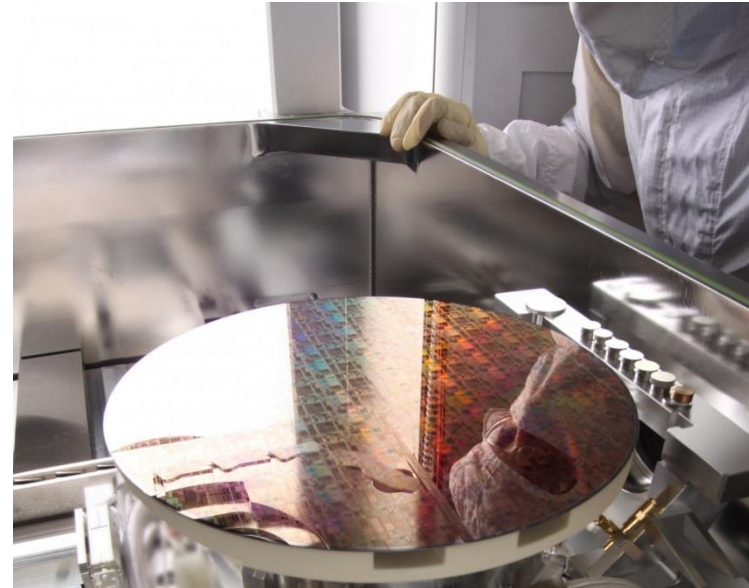
Analog & Mixed
Signal/RF
Design Services

Human resources (non exhaustive list)

- 24h/7d non-stop operation
- Process engineers (no real R&D; process porting)
- Operators
- Maintenance engineers
- Electrical engineers
- IT engineers
- Quality & reliability engineers
- Material scientists and chemistry experts
- Customer support/application engineers
- Business and administration ...
- **A modern fab => easily up to 1000 people; many with high qualifications**

Quality & reliability

- **Discipline**
 - Strict application of quality procedures
- Document control
- Qualification plans & reliability testing
- Engineering Change Notice
- In-line process control
- Process Control Monitoring (silicon gating PCM)
- Failure & structural Analysis
- Quarterly reliability monitoring



Conclusions

- Semiconductor fab is serious business decision requiring extensive investments
- Could generate numerous qualified jobs and side companies, including IC design
- Technology could be ported to the new fab (no important R&D)
- Engineers, operators ... can be trained during the installation phase
- Numerous international experts would be required to manage, install and maintain the fab
- It would be great chance for the Serbian High-Tec development

- **Can Serbia offer the right environment and qualified staff?**

Thank you for your attention!

