

The International Iberian Nanotechnology Laboratory



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International Iberian Nanotechnology Laboratory

- 1) Location: **Braga- Portugal**
- 2) Status: **Intergovernmental Organization**
- 3) Researchers: **~200 scientists**
- 4) Total Staff: **~ 400 people**
- 5) Research Space: **40 Principal Investigators labs**



1) NANOMEDICINE:

Drug Delivery systems, molecular diagnosis systems and chips, cell therapies, imaging solutions, regenerative materials, biomolecular labels, synaptic process monitoring, tissue engineering, etc

2) ENVIRONMENT MONITORING AND FOOD CONTROL:

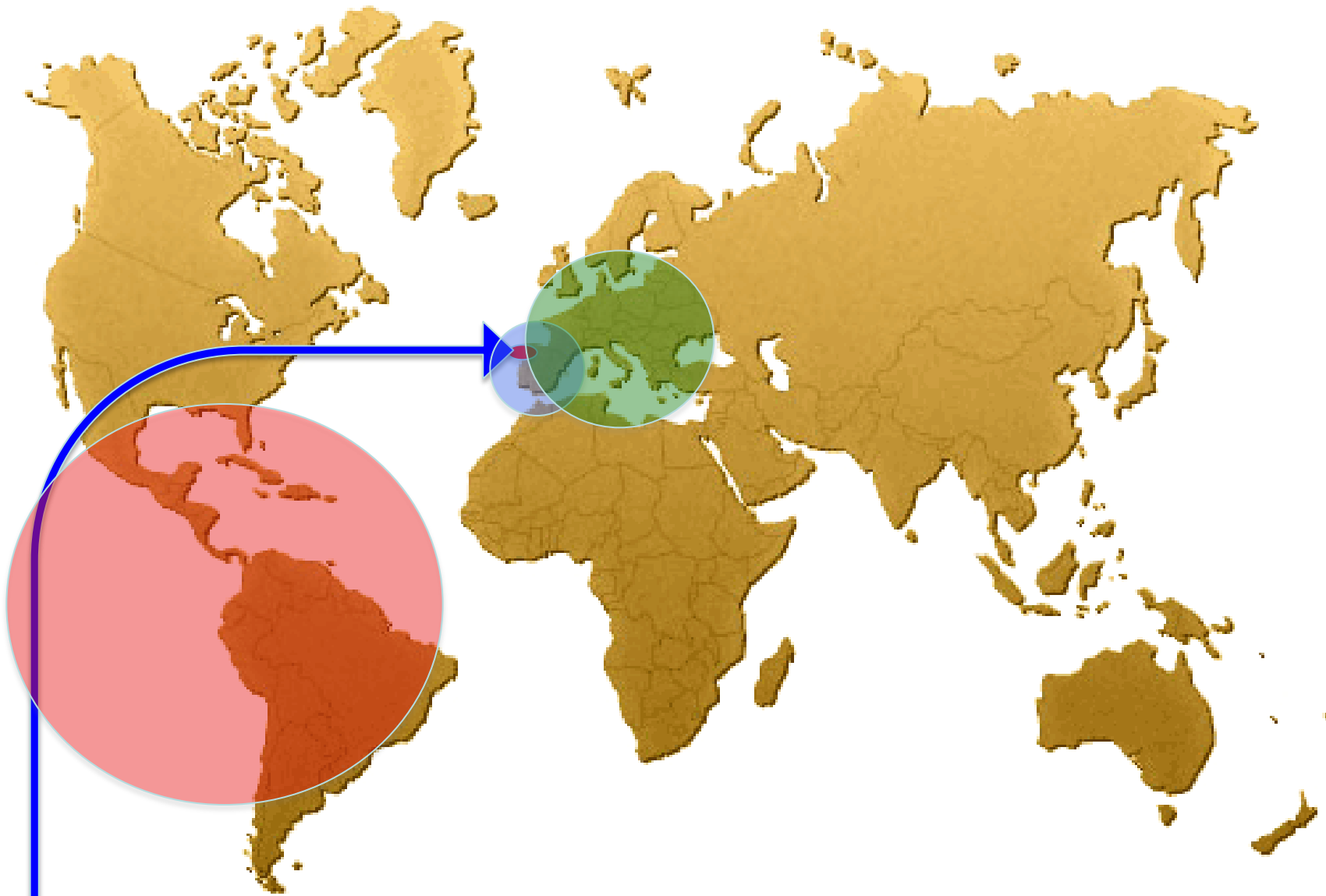
Nanotechnology applied to food industry, food safety and environmental control. Water and Soil control, air pollution monitoring, artificial nanopore sensors, lab-on-a-chip technologies, Smart Packaging and labels, food control process, biosensing technologies,

3) NANO ELECTRONICS:

NEMS/MEMS, Spintronics, Photonics, Nanofluidics,, Molecular electronics, Organic electronics, Nanotechnologies to support the previous research areas

4) NANOMANIPULATION:

Single molecule/atom manipulation, molecular motors, nanotweezers, self assembly controlled processes of building blocks for nanodevices.



Working between Braga (Portugal) and Santiago de Compostela (Spain) and involved in several activities for the promotion of Nanotechnology, mainly in Europe but also with strong connections in Latin America Countries.

Main European initiatives for promotion of Nanoelectronics



*Bringing together people with ideas
to set the R&D agenda
for nanoelectronics in Europe*



AENEAS mission is to represent R&D performers in the Joint Technology Initiative in the field of Nanoelectronics and to adopt and continue the activities of the European Technology Platform **ENIAC**. *INL is member of the AENEAS association*

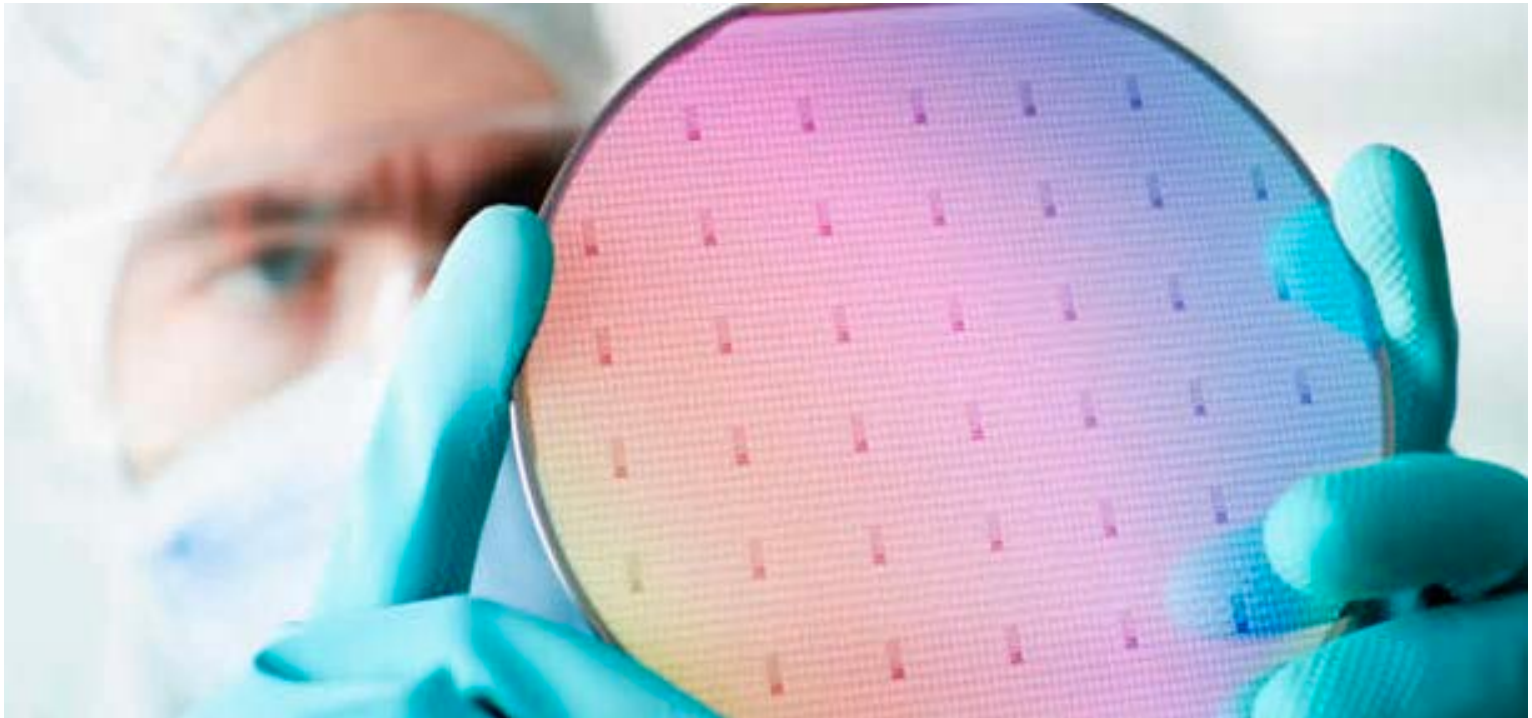


*A PUBLIC-PRIVATE PARTNERSHIP IN NANOELECTRONICS
STRENGTHENING EUROPEAN COMPETITIVENESS AND SUSTAINABILITY*

The ENIAC Joint Undertaking (JU) is a public-private partnership focusing on nanoelectronics that brings together Member/Associated States, the European Commission, and AENEAS (an association representing European R&D actors in this field).

Global figures in the electronics sector.

- 1) Global semiconductor market reached \$226 billion in 2009, directly stimulating a larger electronics industry valued at over a \$1,100 billion.
- 2) Altogether, the electronics sector and related service providers represented a market of \$6,3 trillion in 2009, equivalent to 10% of global GDP
- 3) The electronics sector had 5% average annual increase in the past decade, the growth rate of the electronics industry today is higher than that of global GDP.



European figures in the electronics sector.

- 1) Micro- and nanoelectronics are a key enabling technology for the European economy – as well recognized in the Europe 2020 strategy.
- 1) Europe consumes some 13% of worldwide semiconductor output.
- 1) Europe accounts for only 10% of the global wafer-processing capacity.
- 2) Unfavorable cost structures for manufacture in Europe have led to semiconductor production moving increasingly to Asia.



European figures in the electronics sector.

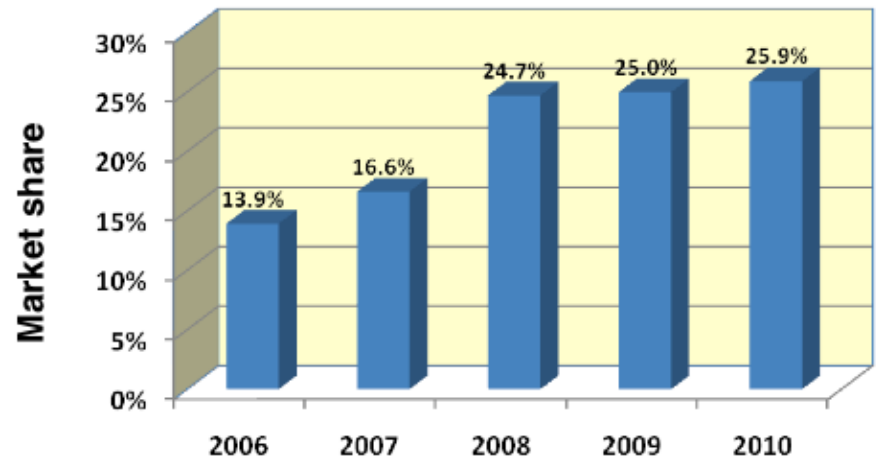
Europe is losing market share in the area of Integrated Devices Manufacturers:

- 40% market share in 5 years (2006-2010)
- 11.6% in average per year
- There is a pessimistic view for European Integrated Device Manufacturers



But Europe is doing a good job in the Semiconductor Equipment Manufacturers market:

- Exceeding \$10B in 2010
- Compound Annual Growth Rate: > +15%
- Important increase of market share

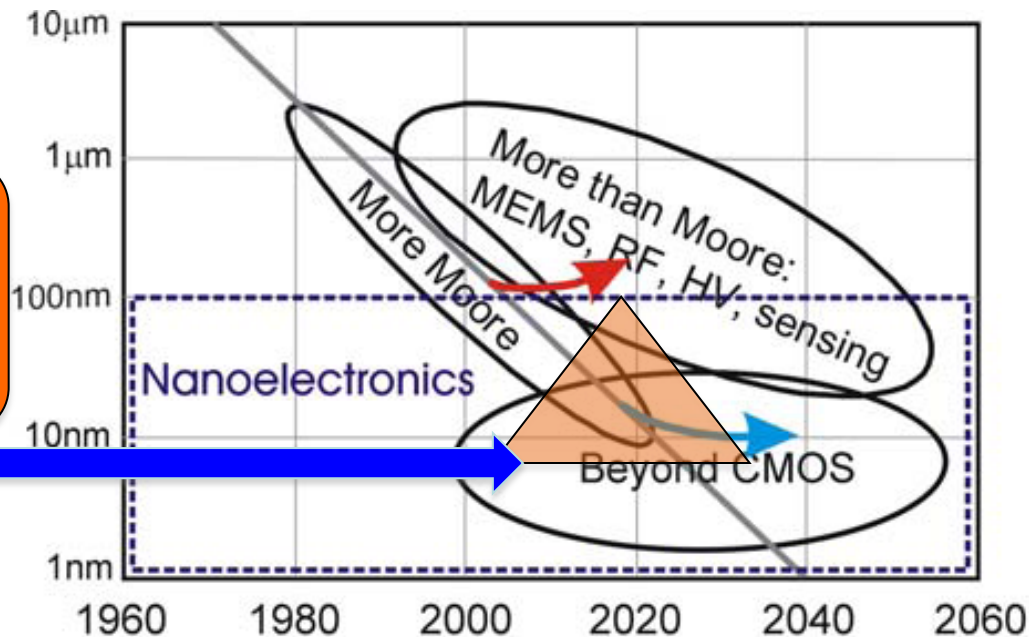


Fabless companies and **Foundries** are also losing market share and competitiveness against Asian and American rivals

Expected impacts in the European electronics sector in the near future?

There are 3 clear tendencies around electronics:

- 1) The 'More Moore' through **further developments on advanced CMOS technologies.**
- 2) The "Beyond CMOS" domain deals with disruptive technologies and devices that involve partial (hybridization) or total replacement solutions of silicon CMOS.
- 3) The 'More than Moore' (MtM) approach that includes technologies that enable **non digital micro/nanoelectronic functions.**



INL aims to play a leading role through the integration of different technologies

Examples of INL Technologies

Added Functionalities

Adsorbing coatings

Microchannels

Graphene devices

High-Q surface micromachined oscillators

10 μm

suspended a-Si:H/Al structure

glass substrate

Al gate electrode

Top down (Micro/Nanomechanical Resonators for sensing applications)

$n^+ \text{-a-Si:H}$ bridges
 $w = 10 \mu\text{m}, t = 0.4 \mu\text{m}$
glass substrate

$f_{\text{res}} \propto 1/L^2$

PET

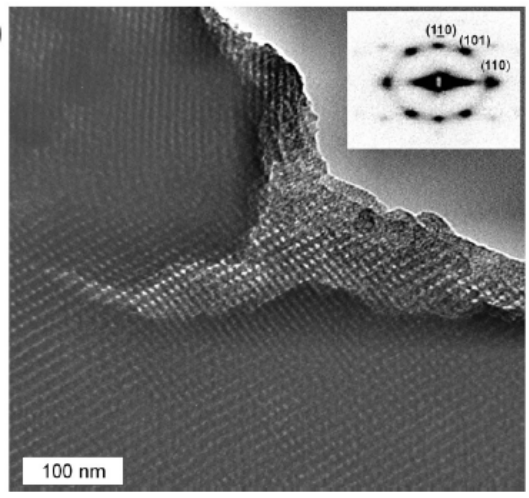
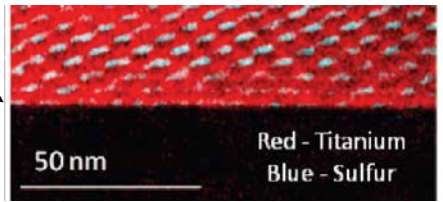
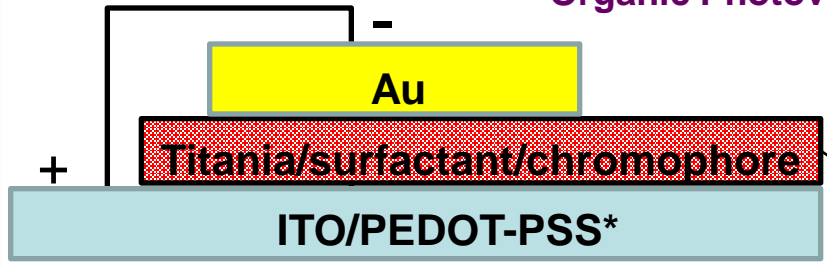
$P = 10^{-6}$ Torr, $V_G = 0$

$n = 5$
 $n = 4$
 $n = 3$
 $n = 2$
 $n = 1$

$L = 10 \rightarrow 5 \mu\text{m}$
 $t = 0.4 \rightarrow 3 \mu\text{m}$
 $\Rightarrow f_{\text{res}} = \alpha (t/L^2) \sqrt{E/\rho} \Rightarrow$
 $f_{\text{res}} \approx 30 \rightarrow 1000 \text{MHz}$

Dr. Joao Gaspar, International Iberian nanotechnology laboratory

Bottom Up Organic Photovoltaics for Solar Energy



Expected Impacts on the near future. Technologies to follow.

- In the short term technologies to **extension CMOS** will lead the market.
- Applications from **Single electron transistors** (SETs) are expected in the medium term.
- **Molecular devices** are creating great expectations. DNA molecules utilizing self-assembly processes to perform computational steps are a major area of development in this field.
- Advances on **Spintronics**, **Ferromagnetics** and **Nanophotonics** will be driving technologies on the development of Nanoelectronics in the short and medium term.

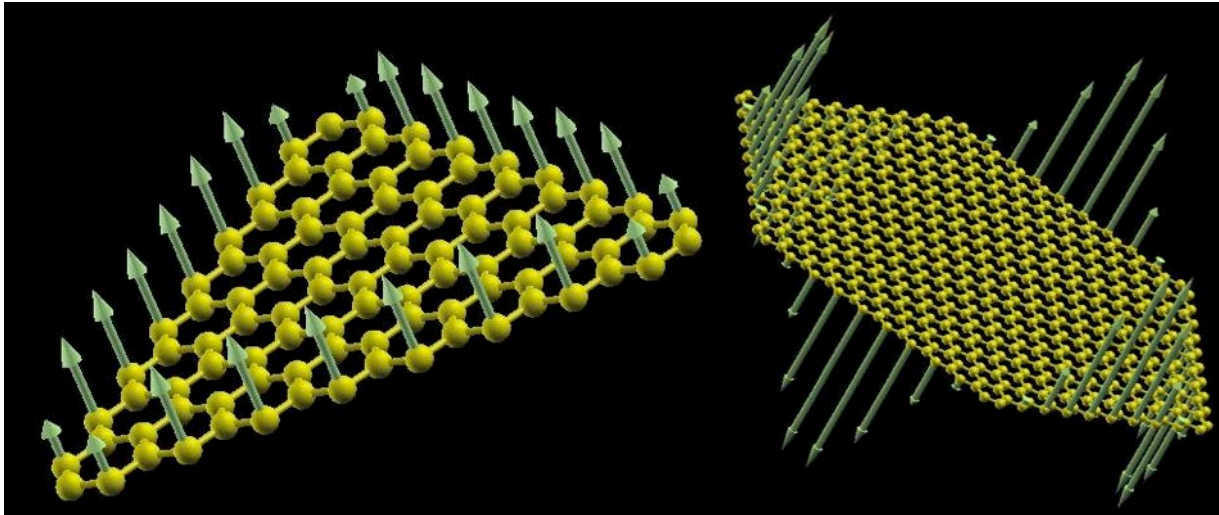


Image source: Dr. Fernandez-Rossier , International Iberian nanotechnology laboratory

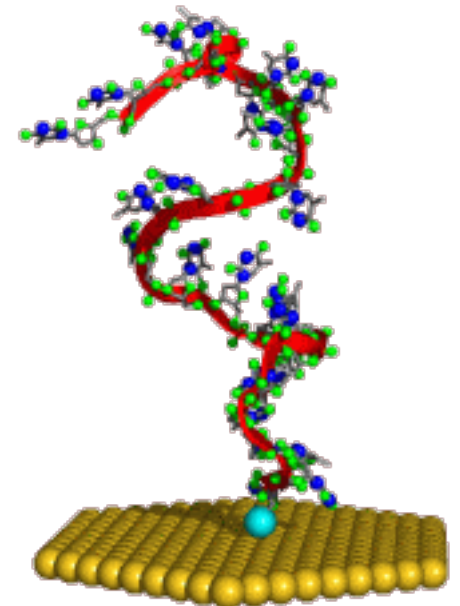


Image source: Dr. Dmitri Petrovykh, International Iberian nanotechnology laboratory

Expected Impacts on the near future. Grand Challenges in Europe

AUTOMOTIVE AND TRANSPORT.

- ‘Intelligent Electric Vehicle,
- ‘Safety and Co-operative Traffic Management,

COMMUNICATION & DIGITAL LIFESTYLES.

- “Nanoelectronics for its Integration in Internet Multimedia Services.
- “Nanoelectronics as part of an Evolution To A Digital Life Style”,

ENERGY EFFICIENCY

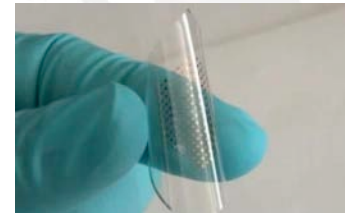
- “Sustainable and Efficient Energy Generation”
- “Energy Distribution and Management – Smart Grid”
- “Reduction of Energy Consumption”

HEALTH AND THE AGING SOCIETY .

- “Home Healthcare”
- “Hospital Healthcare”
- “Heuristic Healthcare”

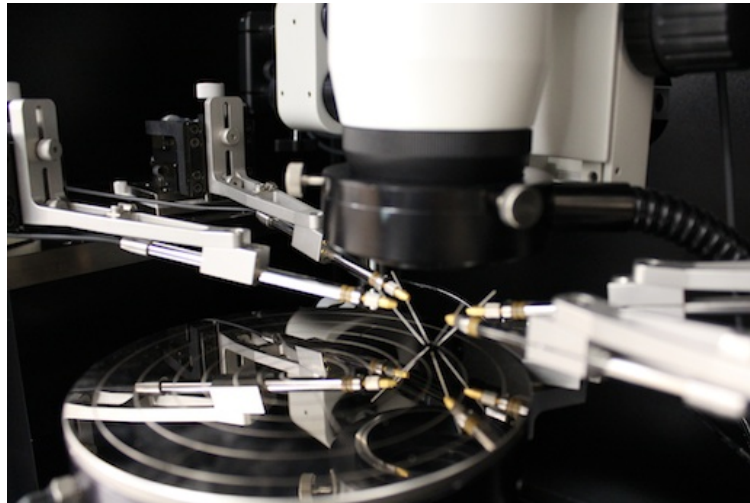
SAFETY & SECURITY

- “Consumer and Citizens Security”
- “Enabling Technologies for Trust, Security and Safety”

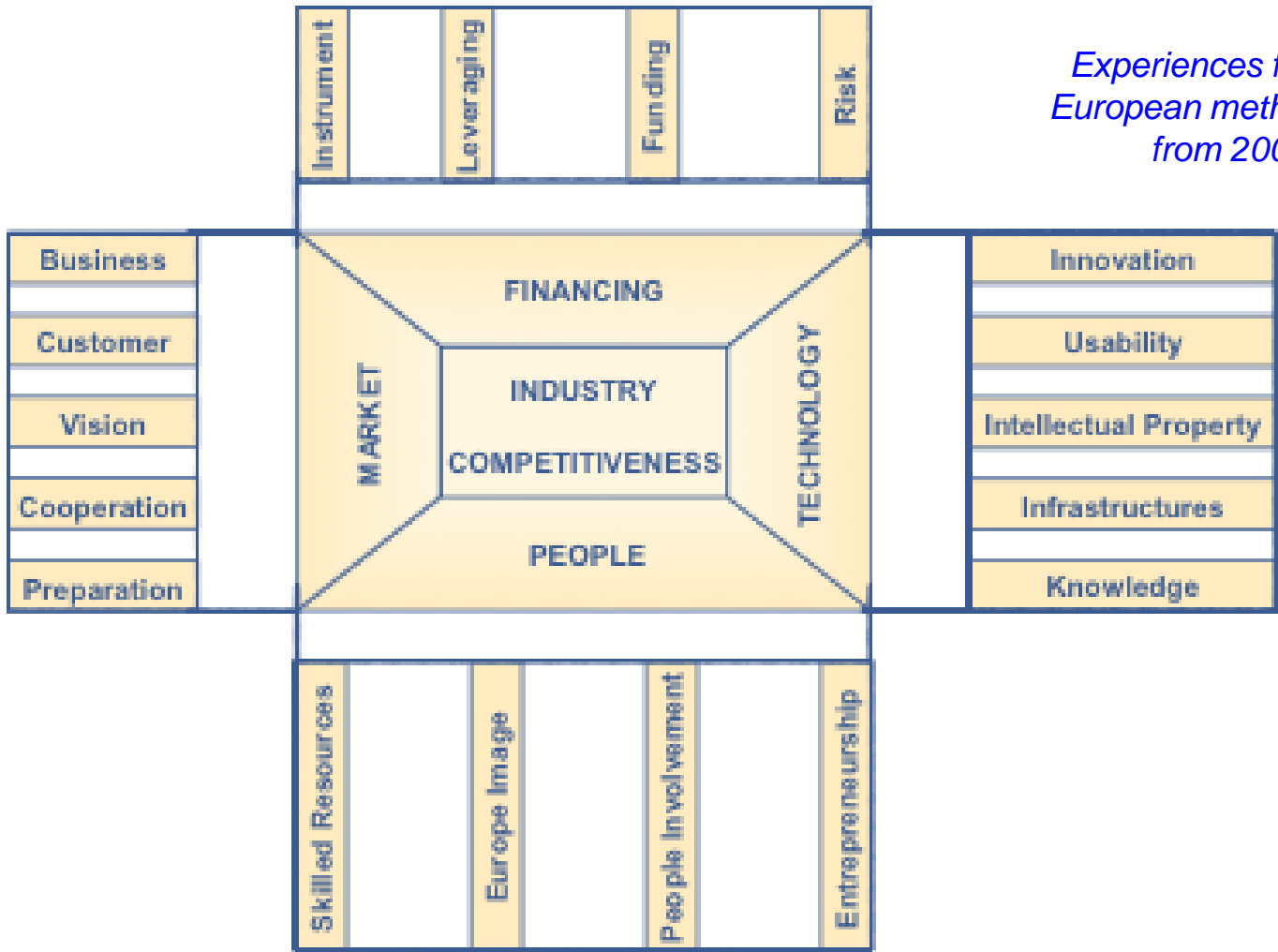


Measuring Nanoelectronics industry evolution in Europe

- We expect a higher impact of Nanoelectronics in a variety of industries across Europe.
- We need to measure the evolution of this rapid evolving industry and take decisions soon.
- The need for reliable metrics has been in the agendas of many European policy makers for long time.
- A reliable and consistent set of metrics will be very valuable but they seem difficult to implement.



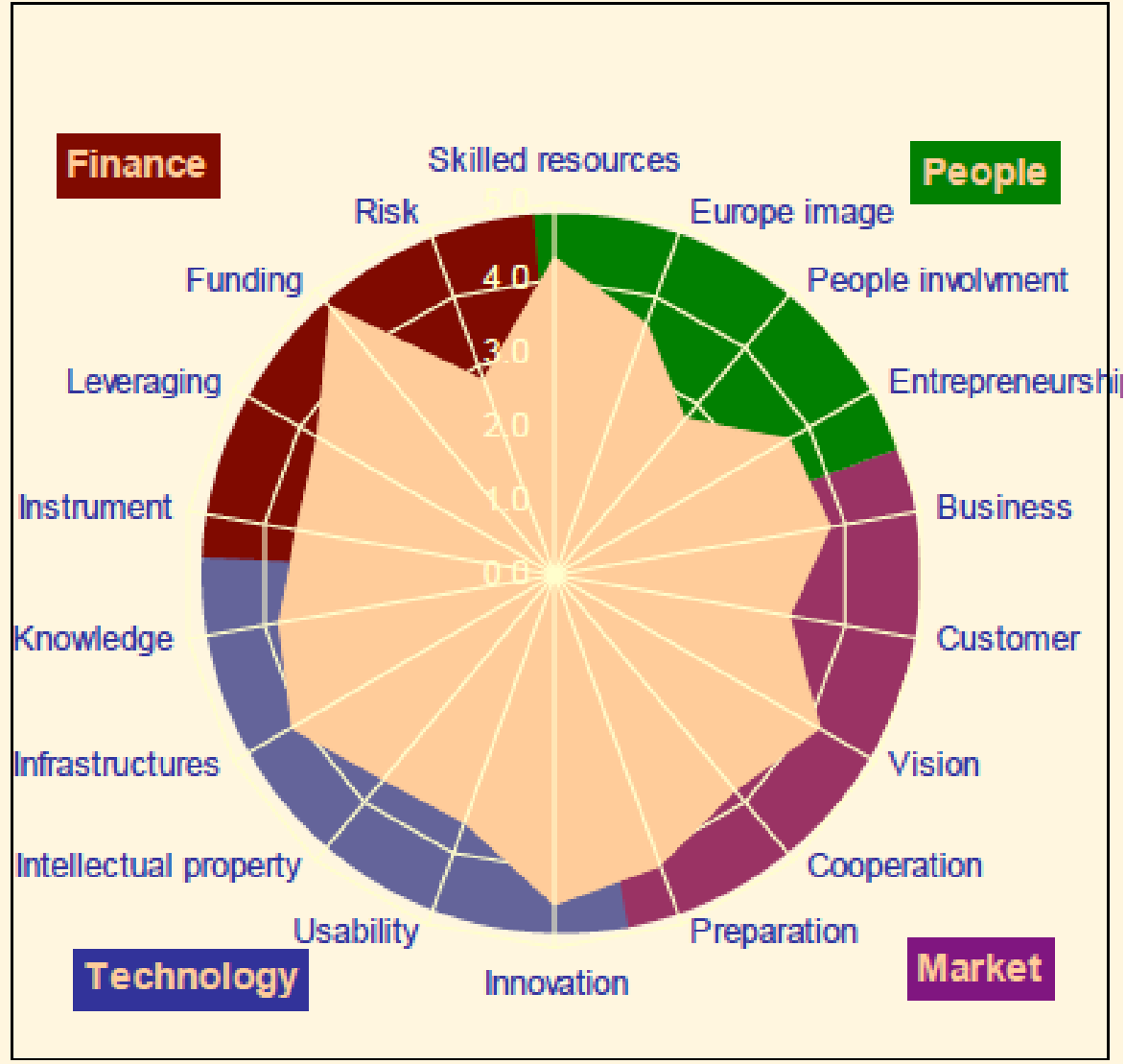
Measuring the evolution of the Nanoelectronics in Europe.



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The analysis of Nanoelectronics industry based on four main pillars and 18 different key factors

Measuring the evolution of the Nanoelectronics in Europe.



Thank you
Obrigado
Gracias

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