‘Accelerator and Magnet Infrastructure for Cooperation and Innovation’

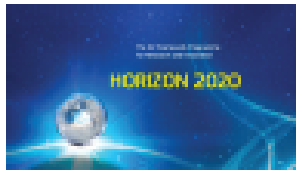
Olivier Napoly, coordinator

CEA/Irfu

EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR RESEARCH & INNOVATION
Research infrastructure

AMICI (Jan. 2017 – Oct. 2019)

EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR RESEARCH & INNOVATION
Research infrastructure



AMICI, for '**Accelerator and Magnet Infrastructure for Cooperation and Innovation**', is an Horizon 2020 '**Coordination and Support Action**' project, funded by the European Commission.

Its general goal is to **propose a model** for the **profitability** and **sustainability** of the **Technology Infrastructure** dedicated to **Accelerators and Superconducting Magnets** in Europe, serving **scientific research** and **innovation**.

- *AMICI is about EU leadership in Big Science (in a collaborative/competitive spirit with N. America and Asia ☺)*
- *From the Laboratories standpoint, the focus is on supporting **Technology Infrastructure** rather than R&D activities, for which European funded programmes existed (CARE, EuroTeV, EuCARD(2), ARIES, etc…) and will continue (ARIES-2)*
- *From the European Commission standpoint, the focus is on strengthening **innovation**, for which US holds leadership.*

AMICI Consortium

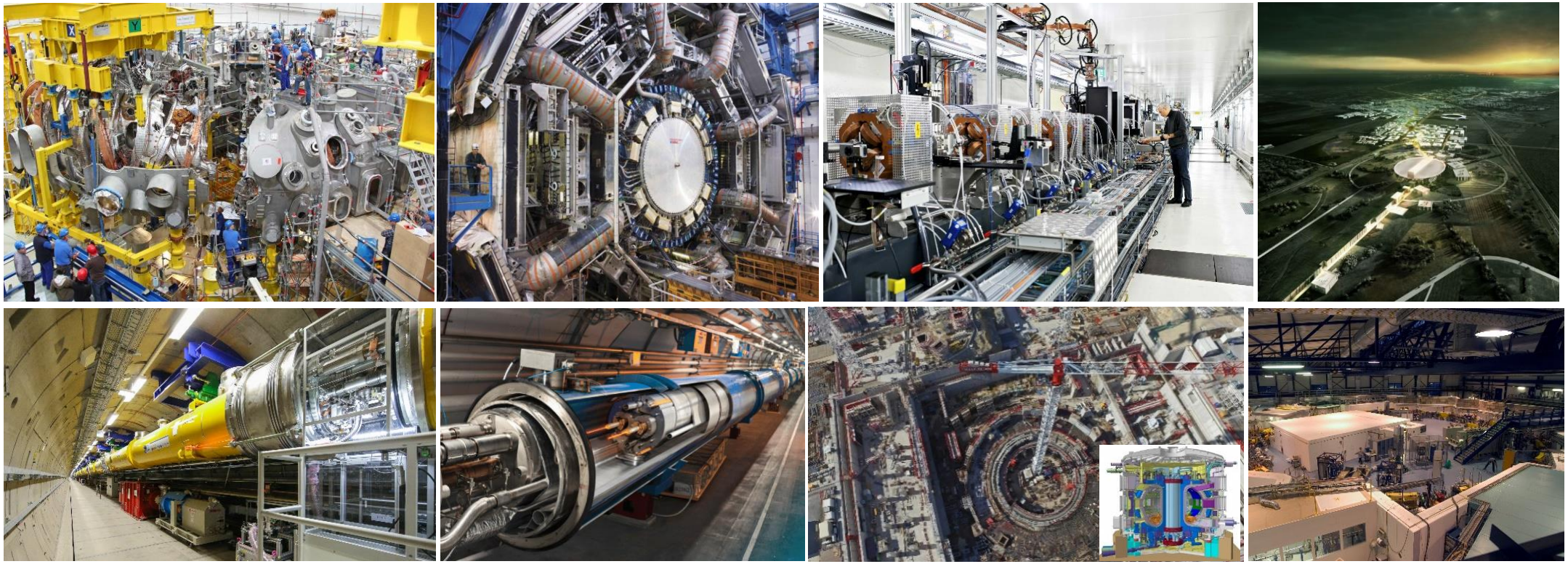
Big Science, Technology, Innovation

"Large-scale science projects address fundamental questions at the forefront of science and technology.
These projects require large and sustained infrastructures and a good collaboration on long time scales.
In turn, such projects provide unique equipment, challenging request for high technology and innovation, stimulating ideas that attract good people, and offer the occasion to bring people closer together."

Rolf Heuer, *The Role of Big Laboratories*,
Phys. Scr. T158 (2013)

Research Infrastructures

The collaboration between Technological Facilities and Industry has been seminal for the realization of unprecedented scientific endeavors, like LHC, W7X, EU-XFEL, SwissFEL, ESS and ITER, that have recently projected Europe to an undisputed position of worldwide leadership.



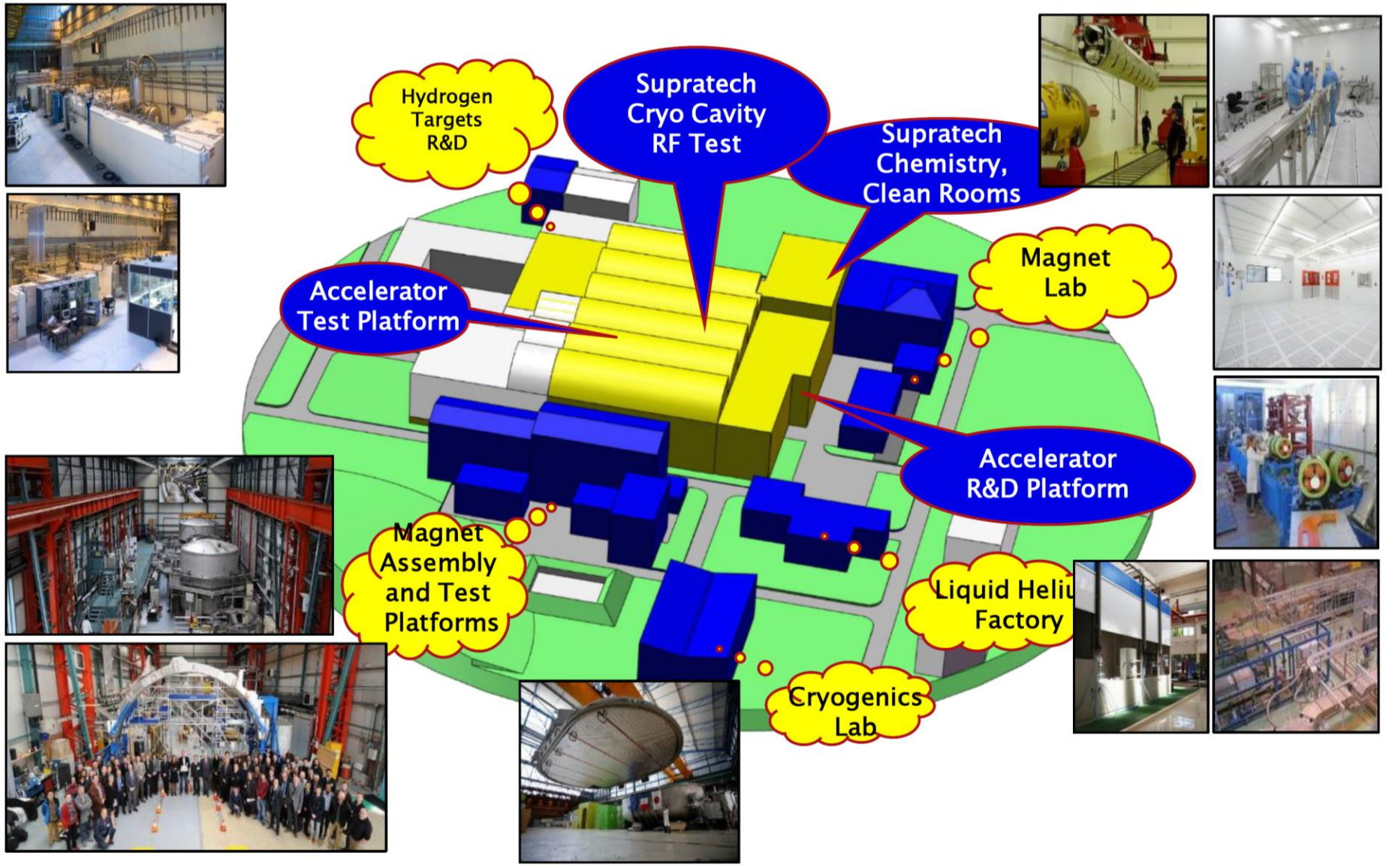
Technology Infrastructure

The construction of such projects is only possible through the de-facto realization of a large and distributed accelerator and SC magnet **Technology Infrastructure (TI)** including high technology systems built to unparalleled quality standards. **This TI represents a major investment and asset for Europe**.

It includes several technological facilities, located at research laboratories and industrial sites, and entails:

- sophisticated R&D platforms for key technologies,
- large-scale facilities for assembly, integration and verification,
- large concentrations of dedicated, highly-skilled personnel and,
- **long-standing relationships between laboratories and industry**.

Example of CEA Technological Facility



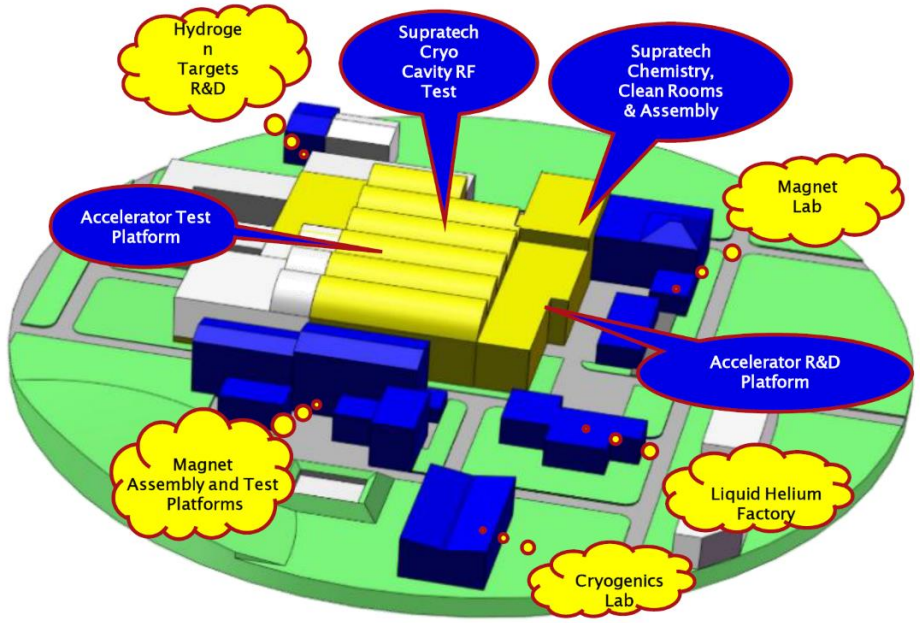
Synergium complex

- ✓ 25 000 m2
- ✓ 100 M€ technical platform
- ✓ 200 FTE
- ✓ 40 M€ / year turnover

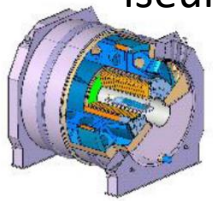
Member of the

European project

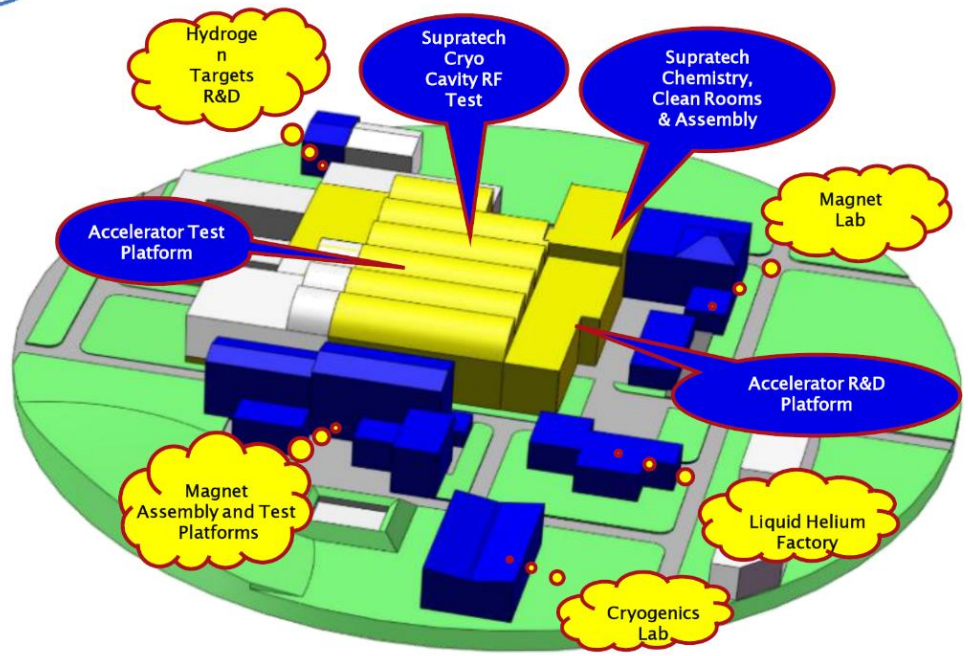
Example of CEA Technological Facility



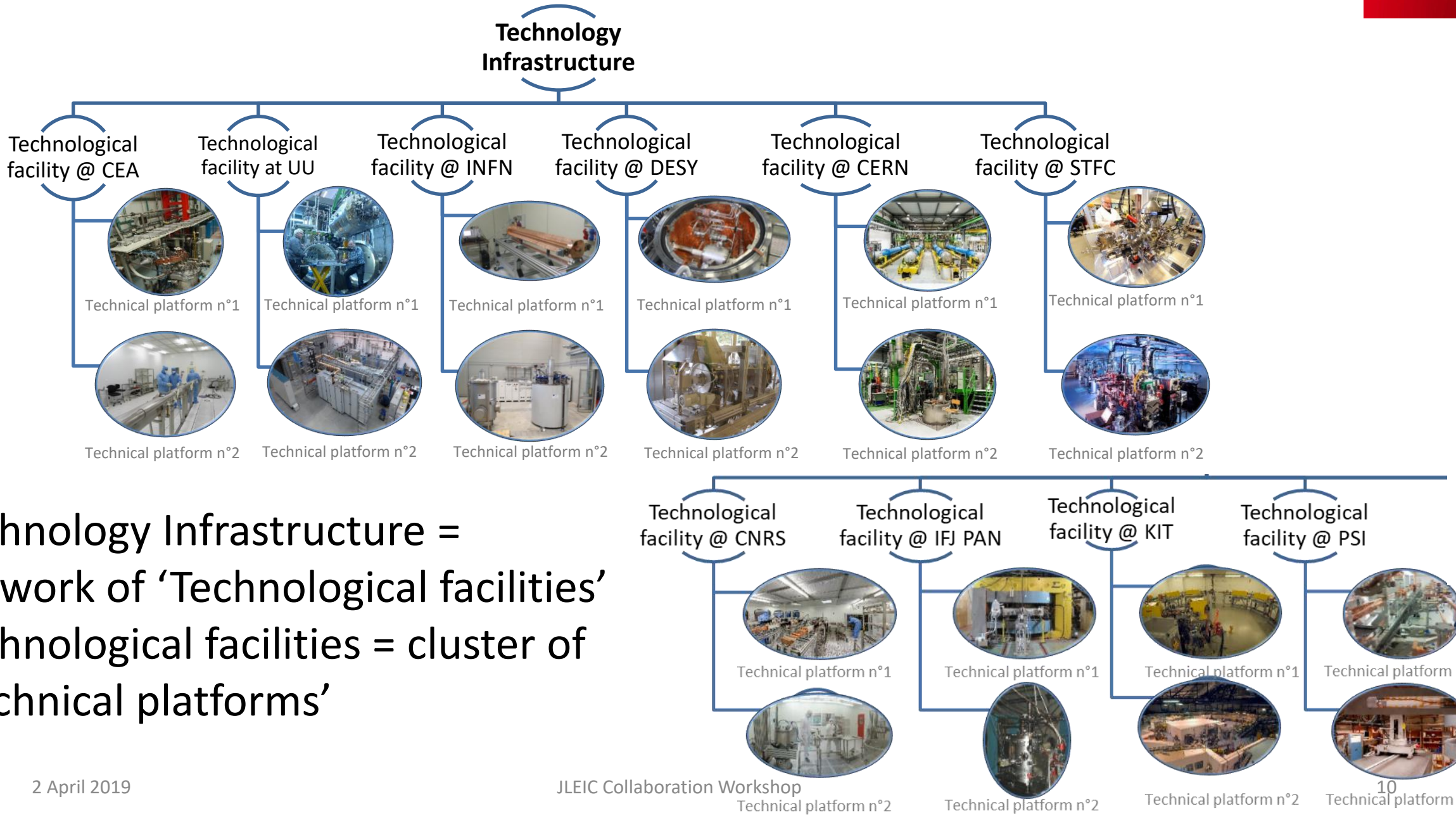
Iseult



Example of CEA Technological Facility

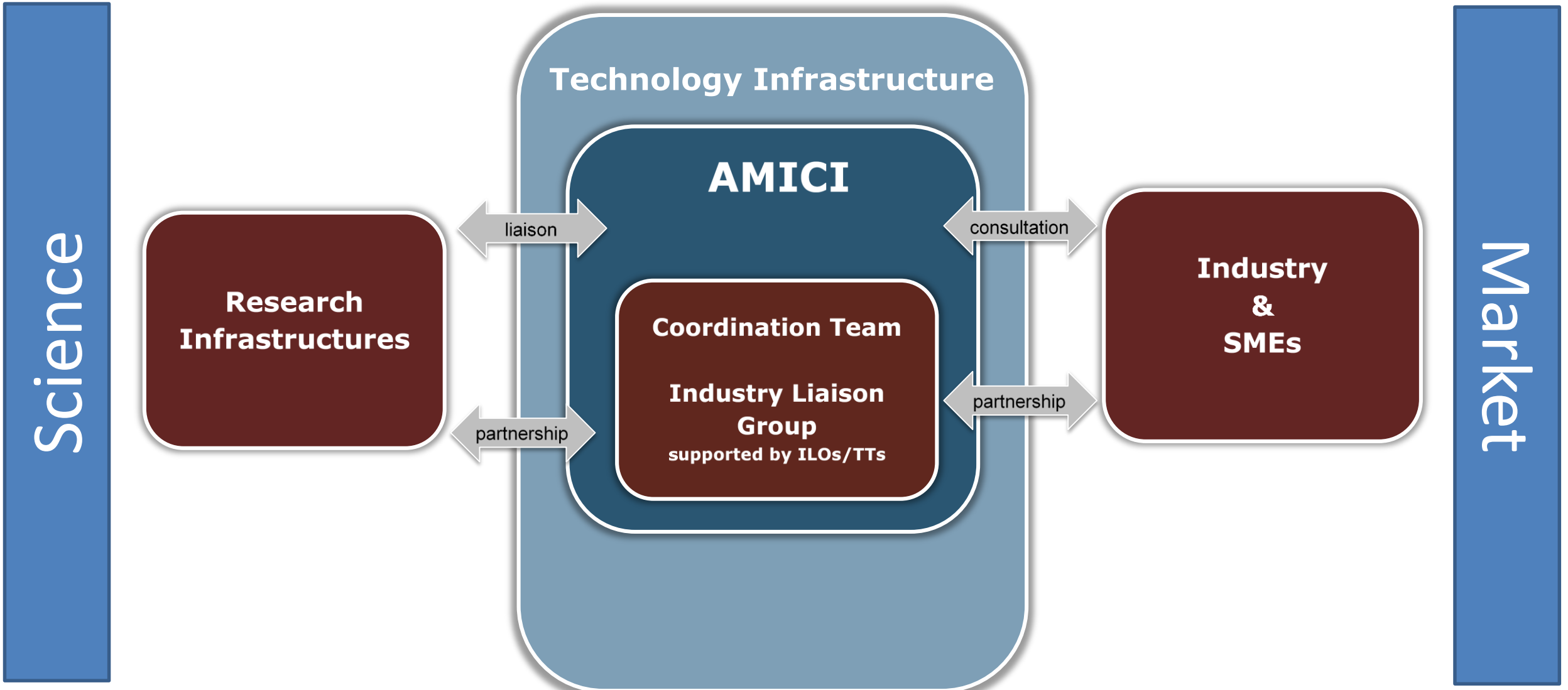


AMICI Technology Infrastructure

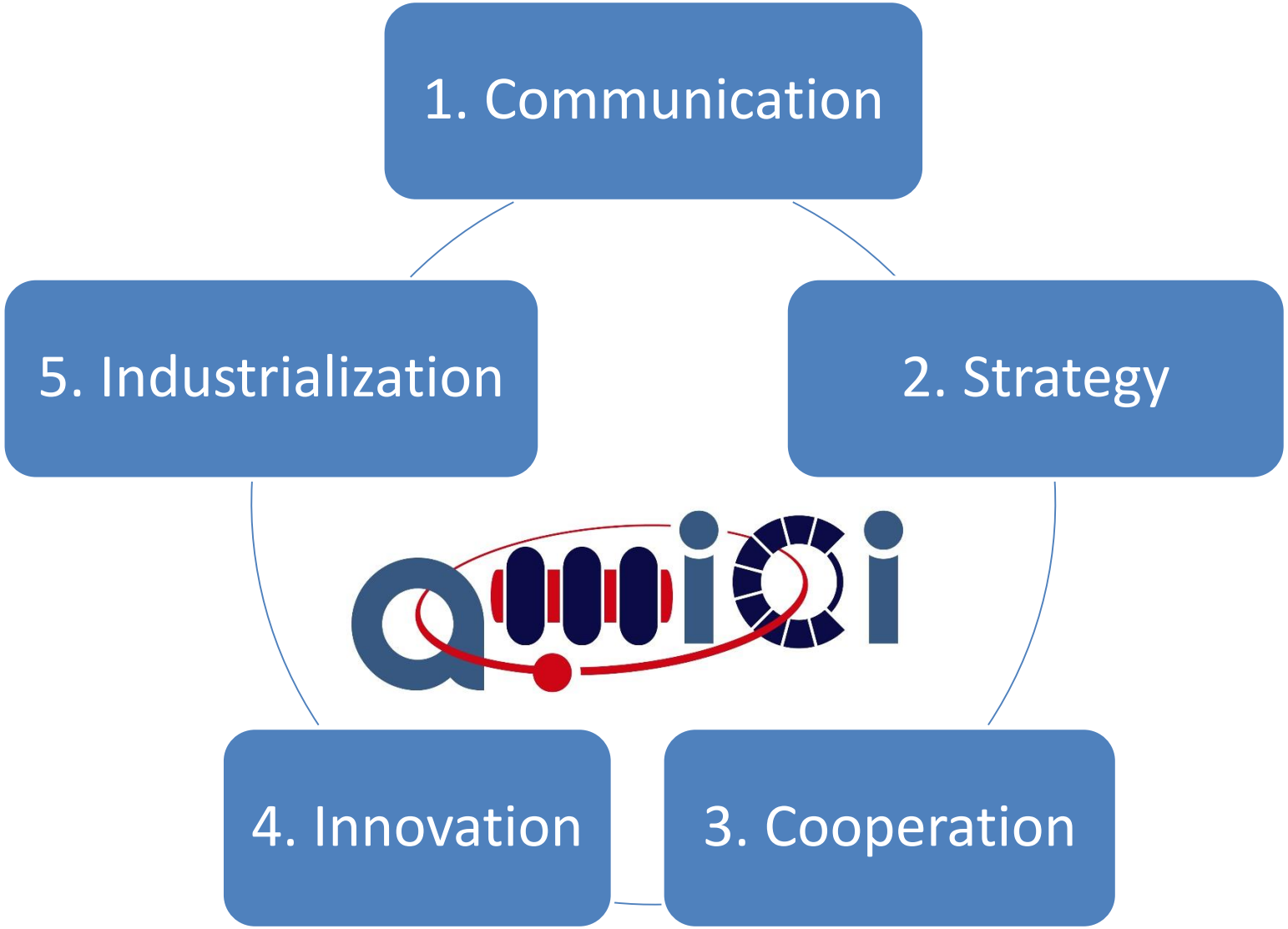


- Technology Infrastructure = network of ‘Technological facilities’
- Technological facilities = cluster of ‘Technical platforms’

The Technology Infrastructure Concept



AMICI Work Packages



WP1: Communication

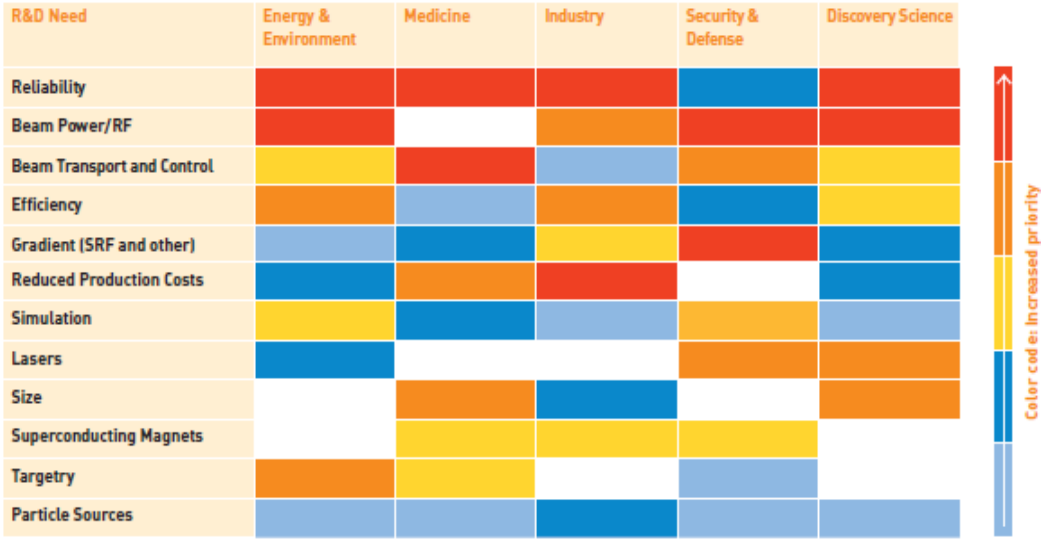
Main tool : http://eu-amici.eu

- Developing list and description of AMICI Technological Facilities
- Describing success stories for the **industrialization** of the construction of Research Infrastructures
- Describing success stories for the industry **innovation** for societal applications, using AMICI platforms
- Providing industry with easy access to TI contact and ongoing tenders
- etc…

WP2: Strategy

The *Strategy*-related activities aim at providing strategic insights into opportunities and needs of future basic research and applications, thus steering and sustaining the activity of the Technology Infrastructure

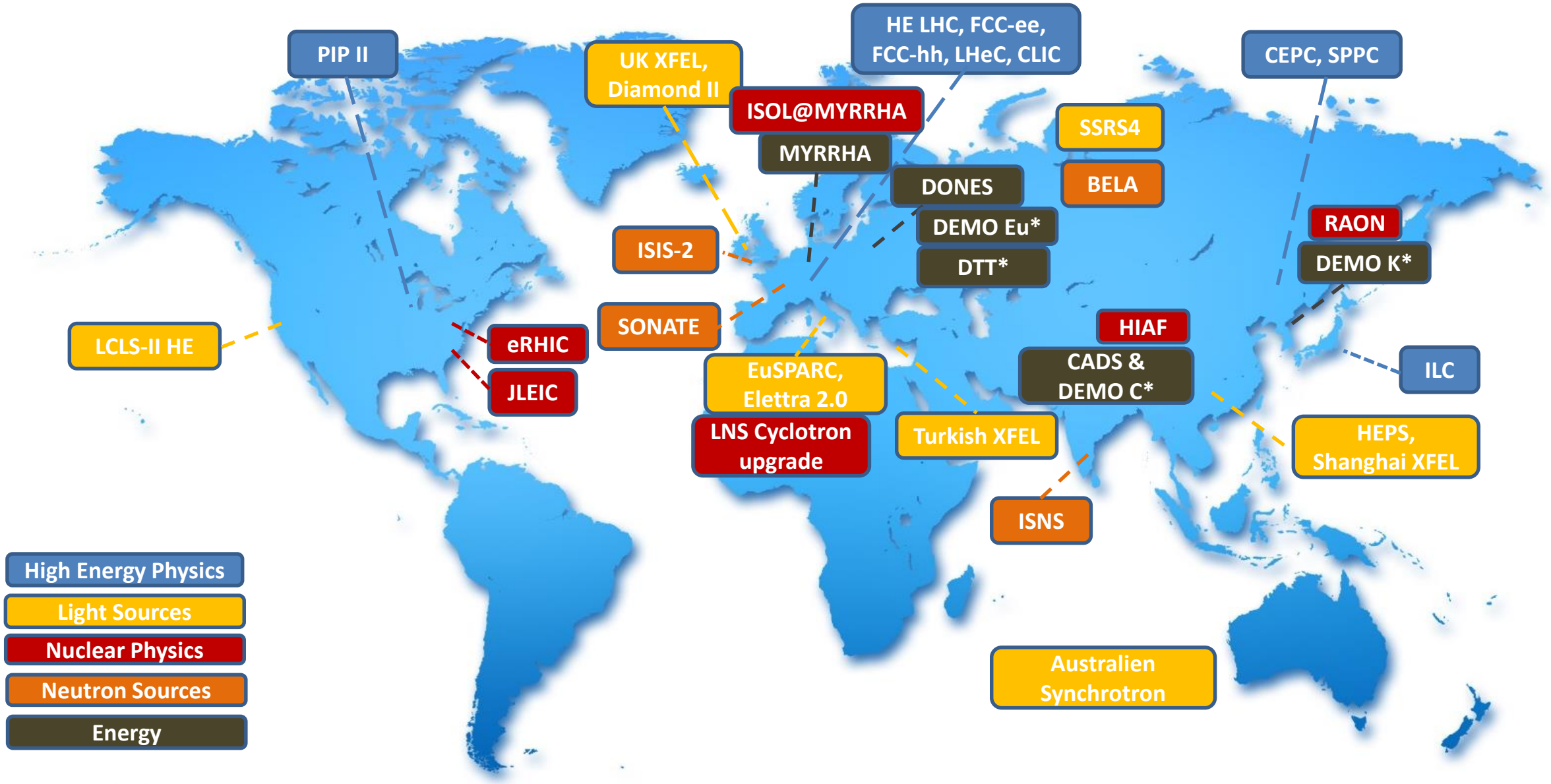
Accelerators for America's Future, DoE Report, 2010



This will be achieved by:

- collecting the scientific roadmaps Research Infrastructures in Europe (ESFRI) and in the global landscape,
- updating the Key Technological Areas (KTA) of accelerator and superconducting magnet science and technology, and describing their development plans
- demonstrating the central and irreplaceable role of the Technology Infrastructure for the European and global Research Infrastructures.

Global Landscape of Future Research Instruments



Key Technology Areas (KTAs)

Selected KTAs:

- **Particle sources** (ions sources ECR, EBIS, …)
- **Warm magnets and related vaccum technology** (permanent and NC iron magnets for 4th generation synchrotron, FFAG, ion separators…).
- **High field SC magnets** (Nb3Sn material and conductor development, HFM technologies).
- **Normal Conducting RF cavities** (RFQ and pill-box structures, very high surface fields, manufacturability, conditioning…).
- **SRF structures** (high Q0, high gradient, HTC materials, fabrication methods, SRF guns).
- **Radio Frequency power sources** (Continuous Wave RF sources, Solid State Amplifiers, High efficiency Klystrons).
- **Cryogenics** (High efficiency cryo-plants, cryogenic distribution, cryostat insulation, cryo-coolers).
- **Beam instrumentation** (non-invasive and RF diagnostics, beam control systems).

ESS LINAC Work Matrix

	Germany	France		Italy		Poland	Spain	Sweden		UK
	DESY	CEA	CNRS	Elettra	INFN	IFJ-PAN	ESS-Bilbao	ESS	Uppsala	STFC
Linac Components										
RF systems				✓			✓	✓		
LLRF									QUIQI	
Cryomodules		QUIQI	QUIQI							
SRF cavities		QUIQI	QUIQI		QUIQI					QUIQI
Powers Couplers		QUIQI	QUIQI							
Frequency Tuners		QUIQI	QUIQI							
Cold vacuum		QUIQI	QUIQI					✓		
Module Assembly		QUIQI	QUIQI							
Test Infrastructures										
RF cavities / couplers	QUIQI	QUIQI	QUIQI							QUIQI
RF cryomodules		QUIQI	QUIQI			QUIQI		✓	QUIQI	

ESS LINAC Work Matrix

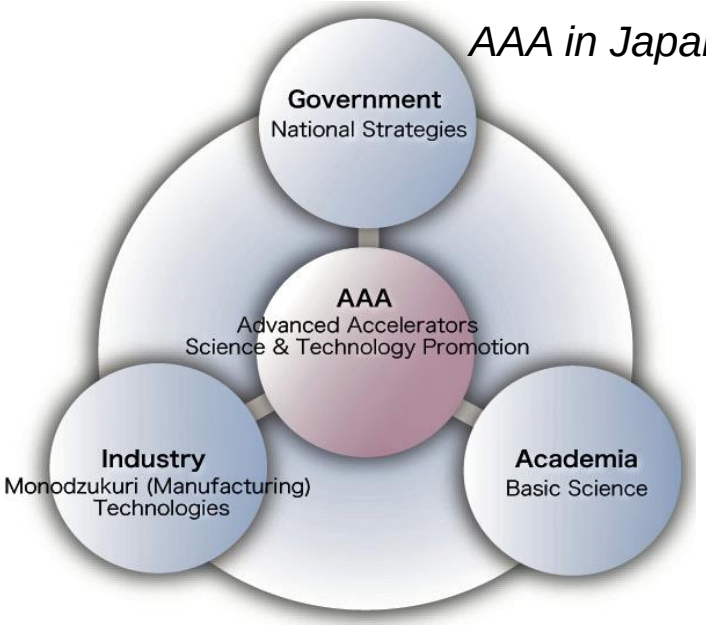
	Germany	France		Italy		Poland	Spain	Sweden		UK
	DESY	CEA	CNRS	Elettra	INFN	IFJ-PAN	ESS-Bilbao	ESS	Uppsala	STFC
Linac Components										
RF systems				✓			✓	✓		
LLRF										
Cryomodules										
SRF cavities										
								✓		
odule Assembly										
Test Infrastructures										
RF cavities / couplers										
RF cryomodules								✓		

Without the pre-existing AMICI competences and platforms, the ESS construction cost would have increased by < 10% but the construction duration would increased by > 7 years !

WP3: Cooperation

The *Cooperation*-related activities studies the conditions of the coordination of the Technology Infrastructure in order to harmonise its operation and increase its efficiency, and to establish a co-innovation platform with industry.

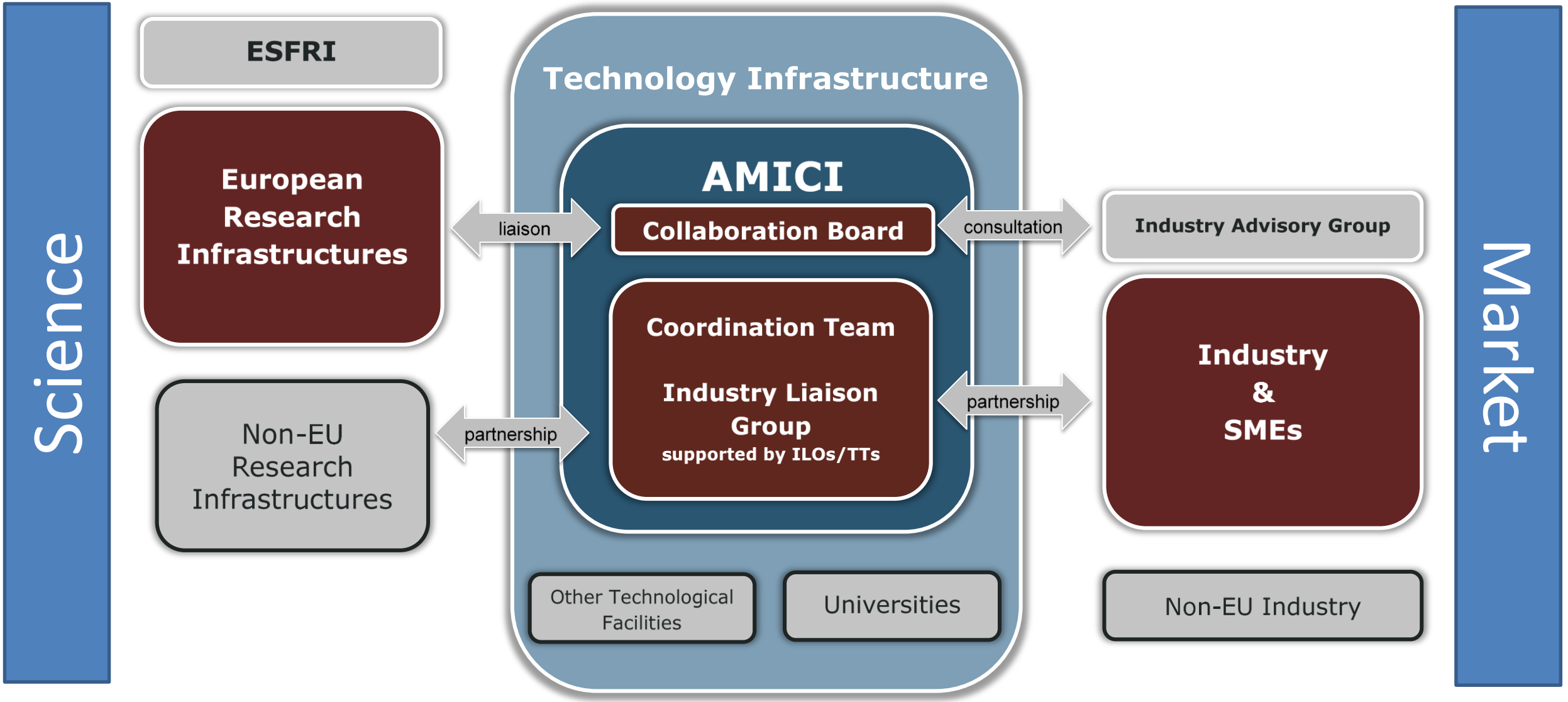
AAA in Japan



These investigations will be performed by:

- defining the eligibility criteria for the participation/association to the Technology Infrastructure,
- developing a coordination model for the use of eligible TFs and industries
- supporting the integration into local, regional and global innovation systems.

AMICI Collaboration Agreement



WP4: Innovation

The *Innovation*-related activities aim at transferring the knowledge and know-how of research laboratories to industry and creating new products and new applications of direct benefit to society.

For that purpose, Industry will access a pool of technical platforms made available by European research and technology organizations, such as:

- test beam facilities,
- cryogenics, magnet and RF facilities and test benches,
- laboratories for material analysis and vacuum technology, for chemistry and surface characterization, for beam electronics and instrumentation,
- clean rooms and assembly halls including the equipment and the associated human expertise.

Technology Infrastructure for Innovation

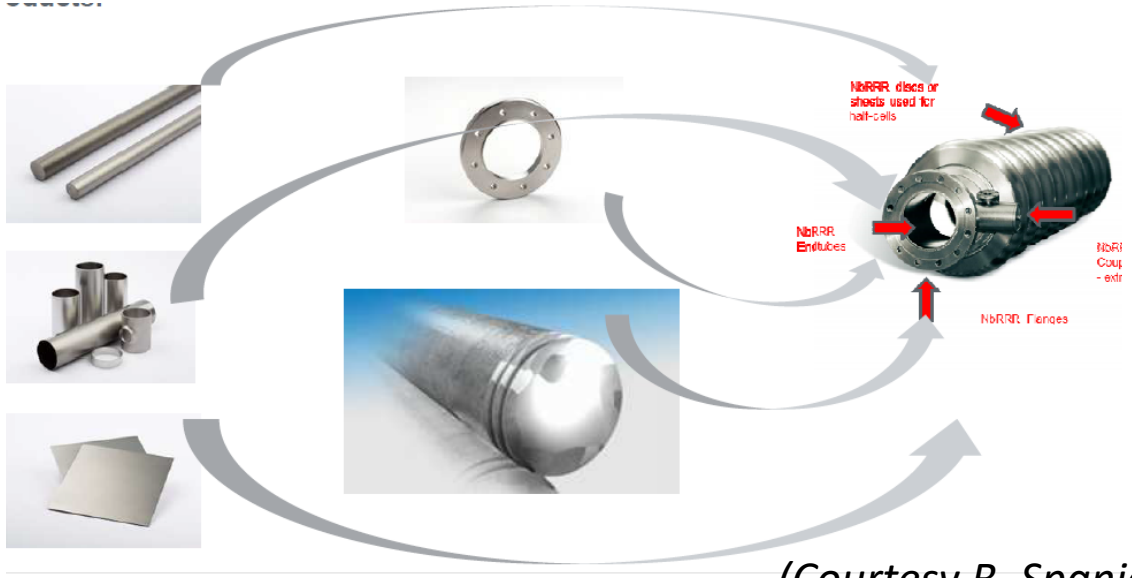
Technology infrastructure – Main generic characteristics :

- **Early stage of industry development**, where partnership with research organization is needed
- **Open environment** to bring together research and technology organisations, large companies and SMEs
- Innovative manufacturing processes and **accelerated time to market**
- **Flexibility** to adapt to specific needs of companies
- **Intellectual Property Rights associated services** and competences

Fair competition must not be violated, neither within EU nor worlwide.

WP5: Industrialization

The *Industrialization*-related activities aim at keeping industry at the forefront of the international competition, in terms of technology, quality and costs, in view of the construction of future scientific research instruments in Europe and worldwide.



(Courtesy B. Spaniol)

This will be achieved by fostering collaboration initiatives and opportunities between Industry and the TI that include:

- professional training and apprenticeship,
- certification studies and training (e.g. vacuum, cleanliness, welding, etc.),
- harmonization and standardization studies (e.g. cryogenics, material, etc.).

WP5: Proto-Database for Material

Components | Material | Properties

Components

- SRF Cavity
  - Lhe Tank
  - Magnetic Shields
  - Thermal Shields

Material

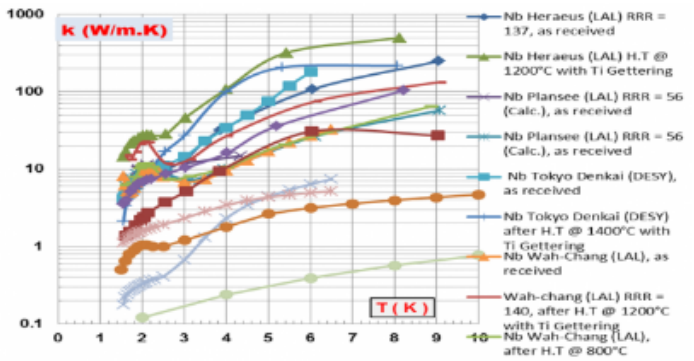
- Nb
  - NbTi

Properties

- Conductivity
- Resistivity
- Thermal data
- Thermal conductivity
- Young modulus

Thermal conductivity

Nobium



Tc: 9.26 K

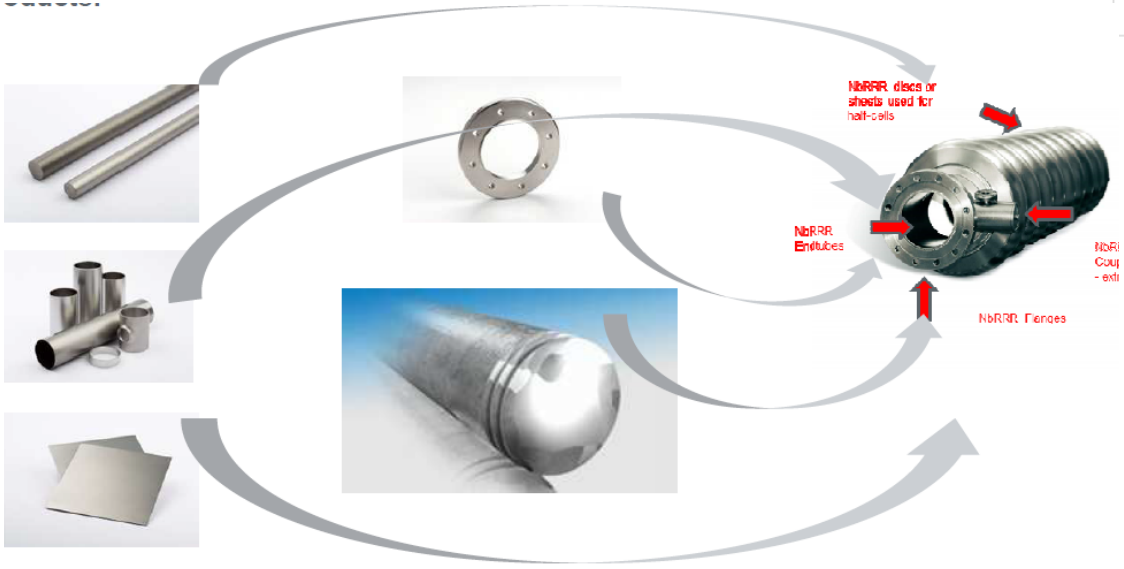
Hc: 0.82 T

Type: II

Source: Physical and mechanical metallurgy of high purity Nb for accelerator cavities, T. R. Bieler, et al.

Download Source

Download PDF card



2020: post-AMICI Horizon

Objective:

- convince EU Commission of the importance of the **Technology Infrastructure**, along with with Research Infrastructures, for RI sustainability, in a new scheme associating more closely industry and innovation,
- follow-up of AMICI by proposing a Collaboration Agreement between the main EU laboratories, with terms of associations for Universities and non-European laboratories

AMICI is only a first step towards a European **TI**