

New markets and technologies offered by the European accelerator Technology Infrastructure



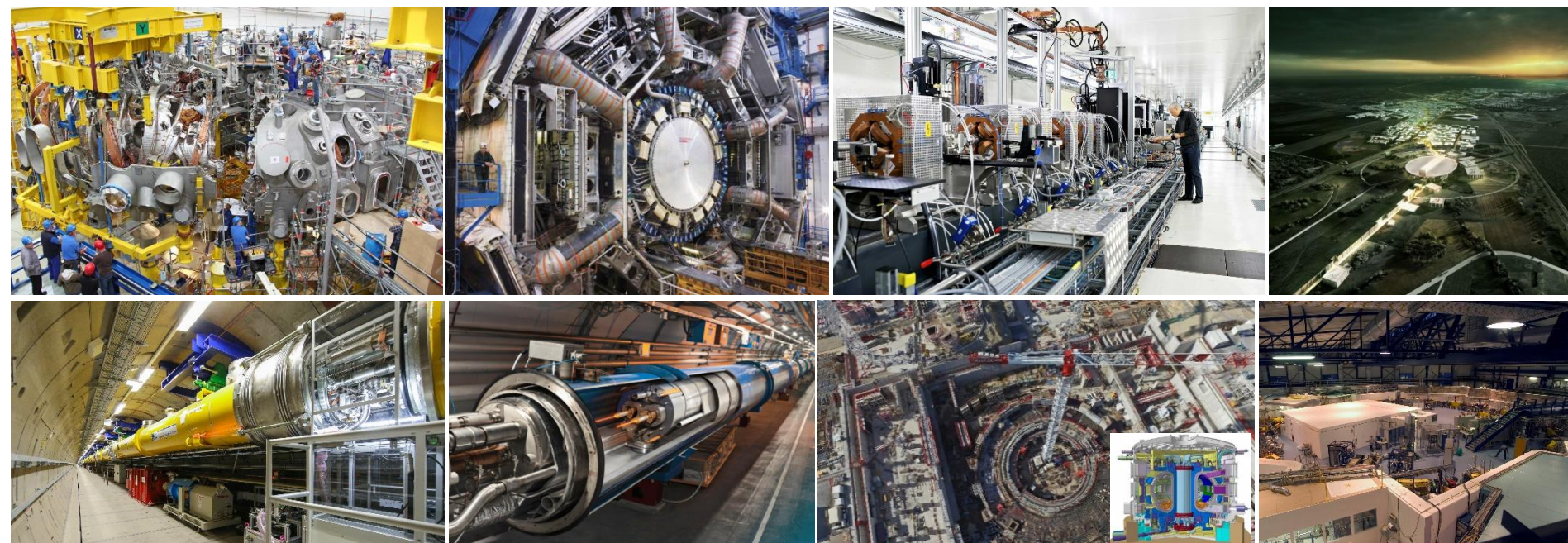
Olivier Napoly, coordinator
CEA/Irfu



EUROPEAN COMMISSION
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Research infrastructure



The collaboration between European 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.



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)** of 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.**



From Science to Innovation: Technology

The scientific quest for fundamental discoveries is a progress force for our societies. Through **Technology**, it carries an indirect societal influence via **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)

The **Technology Infrastructure** is the **basement** of *any* future large-scale accelerator and SC magnet construction projects, spanning



It spans the whole TRL spectrum with an emphasis on the **Preparation** and **Implementation** phases, corresponding to **Prototyping (3-5)** and **Industrialization (>5)** of components.



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AMICI, for ‘**Accelerator and Magnet Infrastructure for Cooperation and Innovation**’, is an H2020 ‘**Coordination and Support Action**’ project.

Its general goal is to **propose a model** for the **profitability** and **sustainability** of the **Technological Facilities** dedicated to **Accelerators and Superconducting Magnets** in Europe, based on the engagement of the European Commission, the National Agencies and the Industry, and serving **innovation** and **scientific research**.

AMICI is charged with the challenging task of building the conditions for consolidating and exploiting these **Technological Facilities** :

- **to strengthen the capabilities of European companies to compete on the global market**, as qualified suppliers of components for accelerators and big superconductor magnets,
- and also **in the development of innovative applications in advanced sectors such as healthcare, energy, environment and space**.



**Science & Technology
Facilities Council**

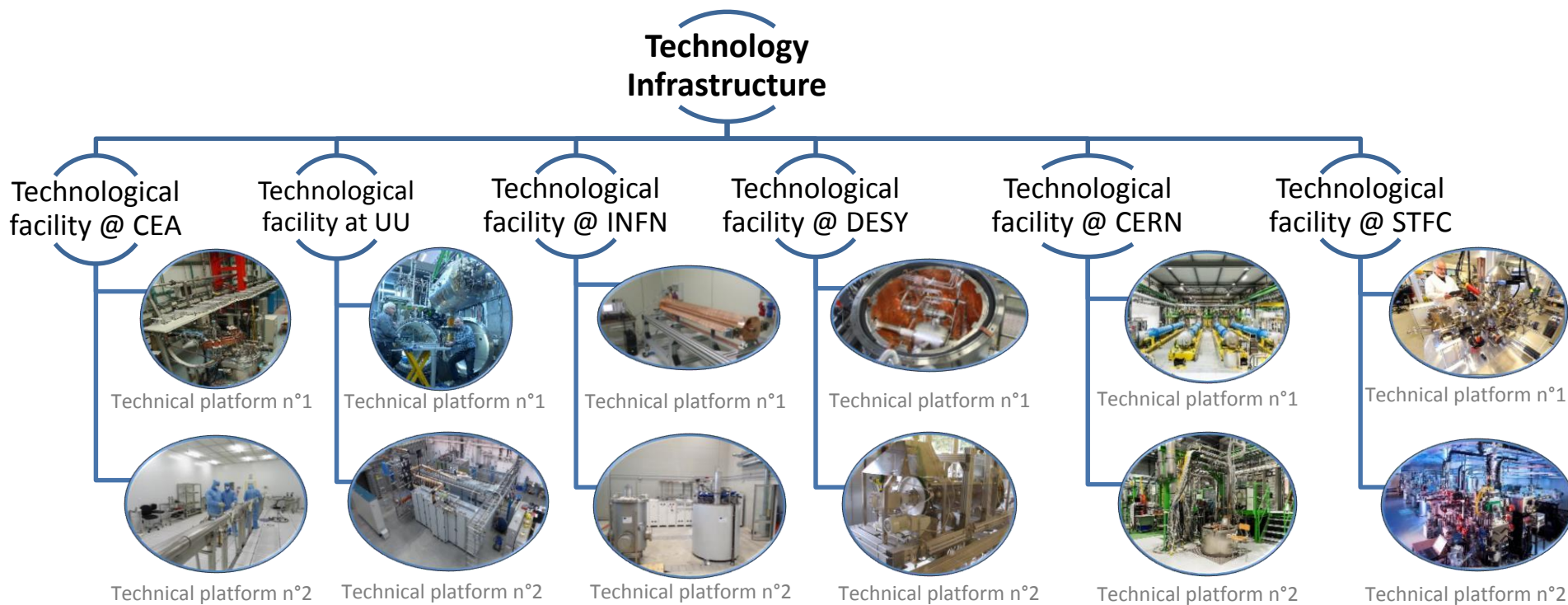


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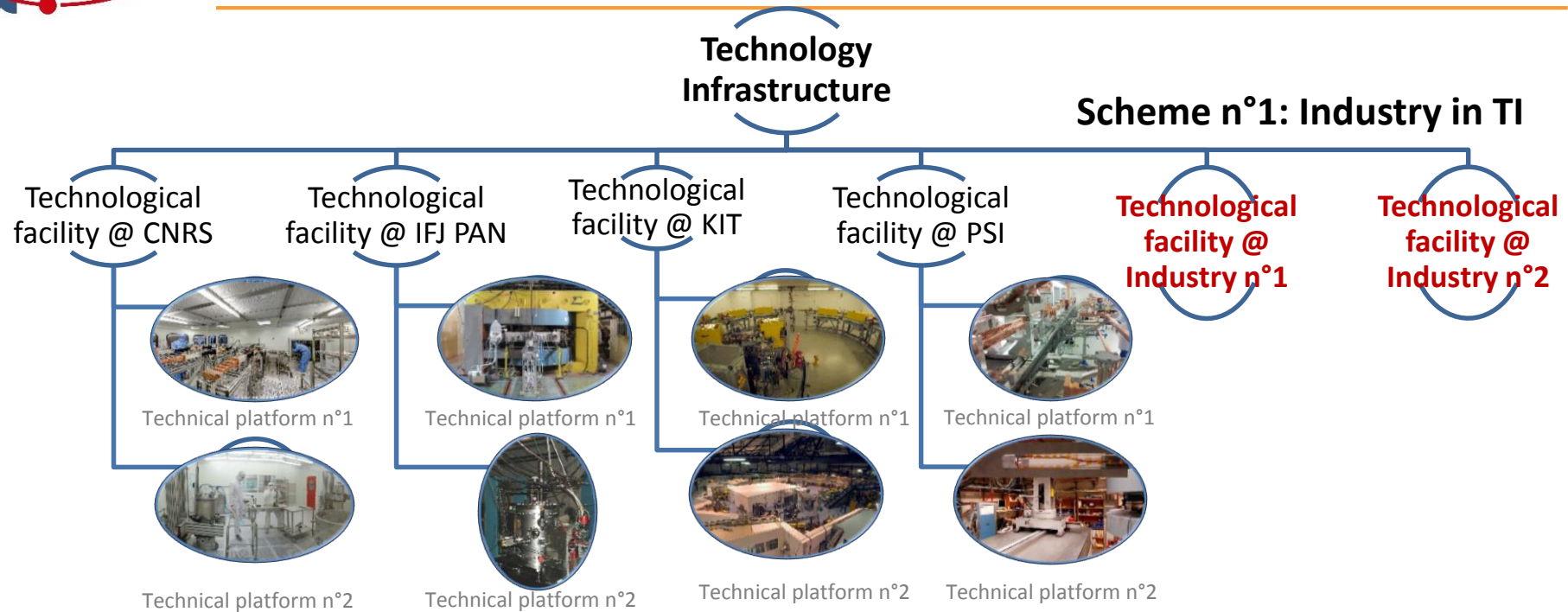


Some 'definitions':

- Technology Infrastructure = a network of 'Technological facilities'
- Technological facilities = a cluster of 'Technical platforms'



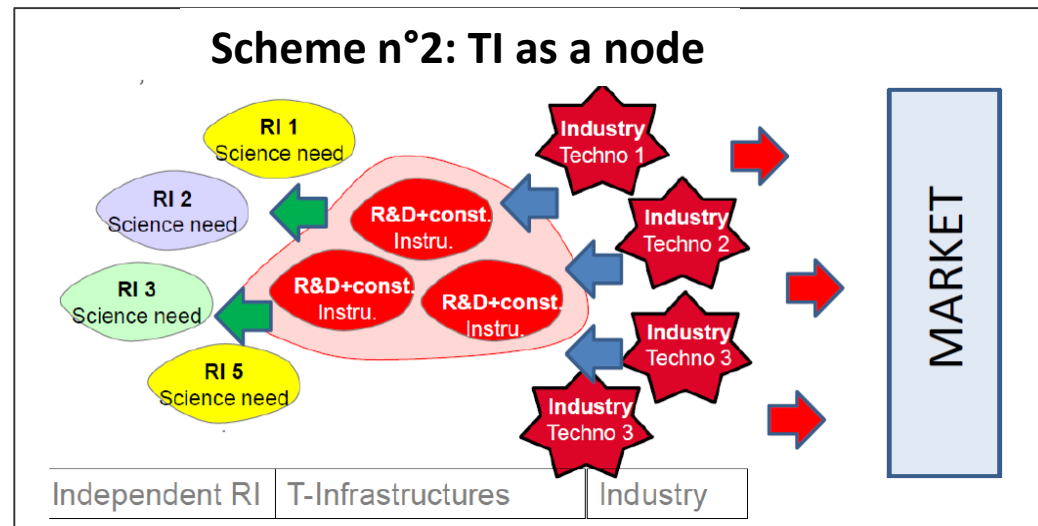
AMICI Co-Innovation @ Technology Infrastructure



AMICI aims at inviting and promoting the use of its Technical Platforms by Industry.


The form of Industry-Academia partnership is under evaluation.

Co-Innovation is favored by the adequation of the TI platforms to high-TRL advanced components.



Main step : <http://eu-amici.eu>

– Developing list and description of AMICI TFs



The screenshot shows a web browser window displaying the AMICI website. The URL in the address bar is eu-amici.eu/technology_infrastructure. The website features a navigation menu with the following items: HOME, ABOUT, EVENTS, TECHNOLOGY INFRASTRUCTURE (highlighted in red), and INDUSTRY INVOLVEMENT. Below the navigation menu, there is a large banner image of industrial equipment with the text "WE SHARE" overlaid. The main heading of the page is "TECHNOLOGY INFRASTRUCTURE". A red sidebar menu is visible on the right side of the page, listing the following items: TECHNOLOGICAL FACILITY @ CEA, TECHNOLOGICAL FACILITY @ CERN, TECHNOLOGICAL FACILITY @ CNRS, TECHNOLOGICAL FACILITY @ DESY, TECHNOLOGICAL FACILITY @ FREIA/UU, TECHNOLOGICAL FACILITY @ IFJ PAN, TECHNOLOGICAL FACILITY @ INFN, TECHNOLOGICAL FACILITY @ KIT, TECHNOLOGICAL FACILITY @ PSI, TECHNOLOGICAL FACILITY @ STFC, and TECHNOLOGICAL FACILITY SEARCH (highlighted in orange). Below the main heading, there is a paragraph of text describing the Technology Infrastructure and a list of bullet points detailing its features.

AMICI

eu-amici.eu/technology_infrastructure

Applications Favoris gérés CEA FNAL LCLS-II Laboratoires Google AMICI icfa.fnal.gov Booking.com Genius Importés depuis IE Banques Journaux ILC UNIX Item Information

AMICI

HOME ABOUT EVENTS TECHNOLOGY INFRASTRUCTURE INDUSTRY INVOLVEMENT

WE SHARE

TECHNOLOGY INFRASTRUCTURE

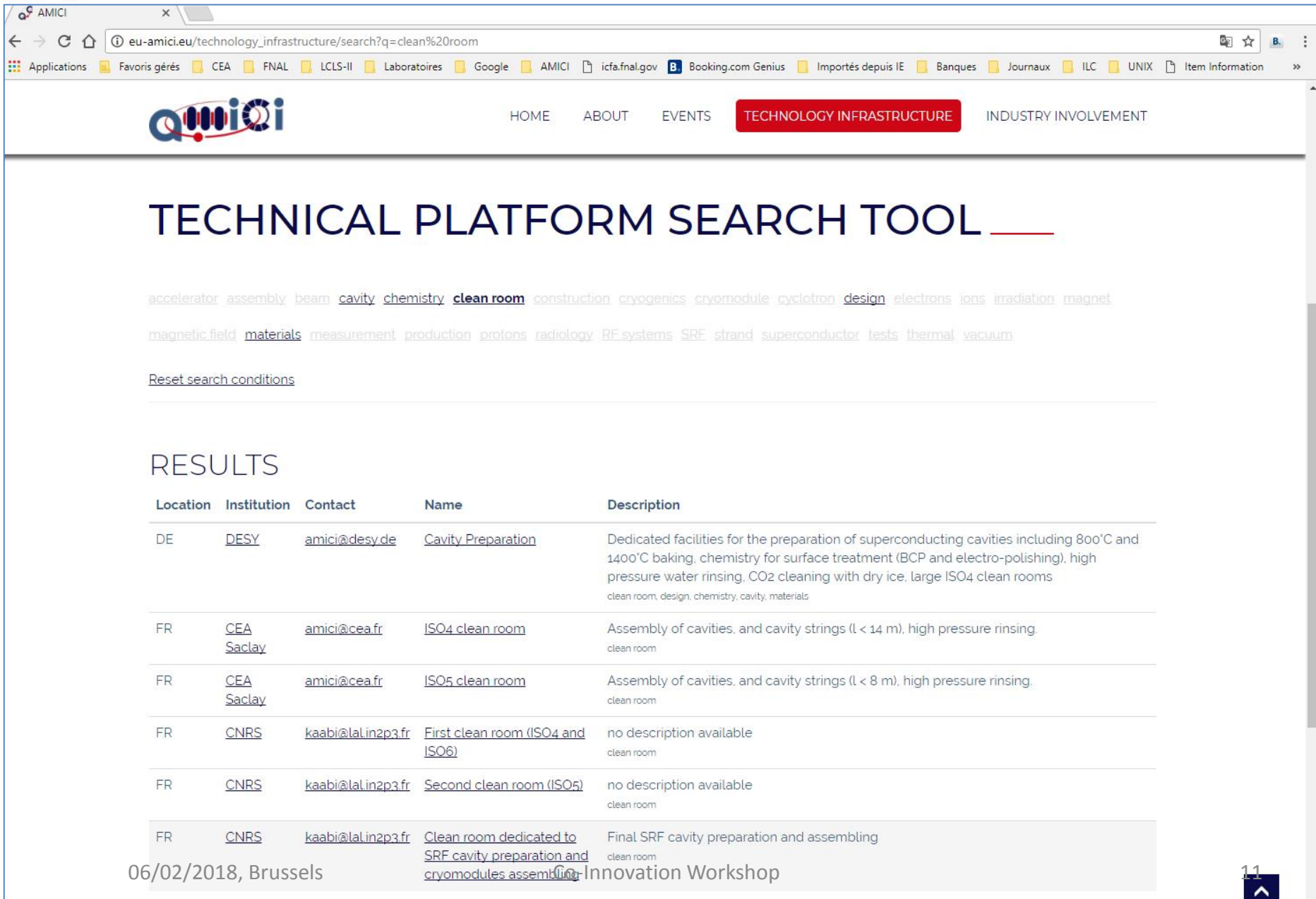
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TECHNOLOGICAL FACILITY @ PSI
TECHNOLOGICAL FACILITY @ STFC
TECHNOLOGICAL FACILITY SEARCH

The large accelerator and SC magnet Technology Infrastructure includes several Technological Facilities, located at European research laboratories that are dedicated to the development of accelerator components and superconducting magnets and available to collaborations with industry partners. It 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-term relationships between laboratories and industry.

06/02/2018, Brussels Co-Innovation Workshop

10



The screenshot shows a web browser window with the URL `eu-amici.eu/technology_infrastructure/search?q=clean%20room`. The page features a navigation menu with 'TECHNOLOGY INFRASTRUCTURE' highlighted. Below the navigation is a large heading 'TECHNICAL PLATFORM SEARCH TOOL' followed by a list of search tags including 'clean room', 'cavity', 'chemistry', 'superconductor', etc. A 'Reset search conditions' link is also present. The main content area displays a table of search results.

Location	Institution	Contact	Name	Description
DE	DESY	amici@desy.de	Cavity Preparation	Dedicated facilities for the preparation of superconducting cavities including 800°C and 1400°C baking, chemistry for surface treatment (BCP and electro-polishing), high pressure water rinsing, CO2 cleaning with dry ice, large ISO4 clean rooms <small>clean room, design, chemistry, cavity, materials</small>
FR	CEA Saclay	amici@cea.fr	ISO4 clean room	Assembly of cavities, and cavity strings (l < 14 m), high pressure rinsing <small>clean room</small>
FR	CEA Saclay	amici@cea.fr	ISO5 clean room	Assembly of cavities, and cavity strings (l < 8 m), high pressure rinsing. <small>clean room</small>
FR	CNRS	kaabi@lal.in2p3.fr	First clean room (ISO4 and ISO6)	no description available <small>clean room</small>
FR	CNRS	kaabi@lal.in2p3.fr	Second clean room (ISO5)	no description available <small>clean room</small>
FR	CNRS	kaabi@lal.in2p3.fr	Clean room dedicated to SRF cavity preparation and cryomodules assembling	Final SRF cavity preparation and assembling <small>clean room</small>

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

R&D Need	Energy & Environment	Medicine	Industry	Security & Defense	Discovery Science
Reliability	Red	Red	Red	Blue	Red
Beam Power/RF	Red	White	Orange	Red	Red
Beam Transport and Control	Yellow	Red	Blue	Orange	Yellow
Efficiency	Orange	Blue	Orange	Blue	Yellow
Gradient (SRF and other)	Blue	Blue	Yellow	Red	Blue
Reduced Production Costs	Blue	Orange	Red	White	Blue
Simulation	Yellow	Blue	Blue	Orange	Blue
Lasers	Blue	White	White	Orange	Orange
Size	White	Orange	Blue	White	Orange
Superconducting Magnets	White	Yellow	Yellow	Yellow	White
Targetry	Orange	Yellow	White	Blue	White
Particle Sources	Blue	Blue	Blue	Blue	Blue

Color code: increased priority

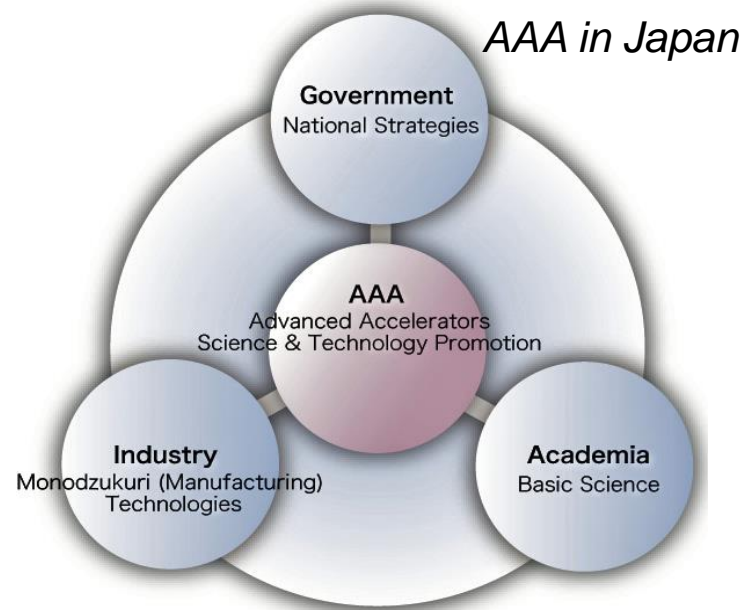
This will be achieved by:

- updating the Key Technological Areas (KTA) of accelerator and superconducting magnet science and technology,
- collecting the scientific roadmaps Research Infrastructures in Europe (ESFRI) and in the global landscape,
- assessing the workload, the capabilities and, when possible, the priorities of the Technology Infrastructure in the different KTAs.

The *Cooperation*-related activities will study 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.

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,
- identifying synergies, complementarities and duplication.



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 Institutes 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.

WP4 will deliver reports identifying specific domains of societal applications and European commercial organisations that have the current capability, and future potential, to innovate and develop solutions in the fields of mature Accelerator technologies (STFC) and Superconducting Magnet technologies (CEA).

To enable this goal a broad range of European commercial organisations will be surveyed, including both large companies and SMEs, to establish their current capability, and future potential, to innovate and develop technology solutions in the field of mature Accelerator technologies. their appetite for commercial innovation

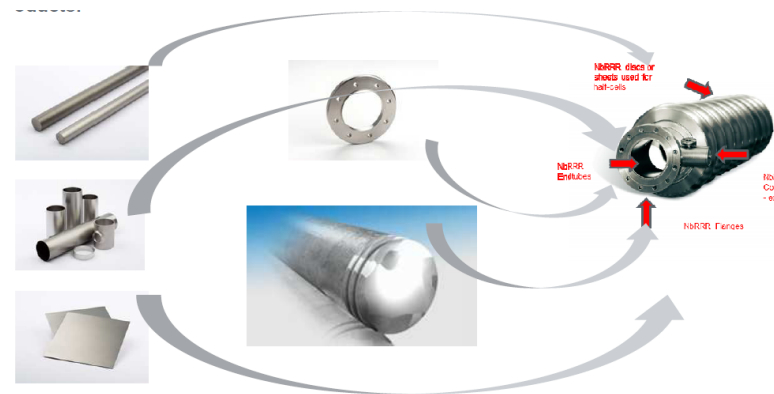
In addition the survey will provide insight into the domains of societal applications and potential market sizes beyond Research Infrastructures.

A review of previous research programmes and surveys in this area will be performed and used to inform this survey and its findings, and to avoid any unnecessary duplication. These will include TIARA, EUCARD2 Applications for Particle Accelerators in Europe, IAEA Applications of Electron Beams and DoE Accelerators for America's Future.

Delivery of these Market Surveys is expected in June 2019

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 elsewhere.

(Courtesy A. Spaniol)



This will be achieved by fostering collaboration initiatives and opportunities between Industry and the TI that include: research and development of key technology prototypes at high Technology Readiness Level, test and verification of industrial products, professional training and apprenticeship, certification studies and training (e.g. vacuum, cleanliness, welding, etc.), harmonization and standardization studies (e.g. cryogenics, material, etc.).

WP5.4: Industrialization/Prototyping

- Industry has naturally more appetite for **Commercial Innovation business** than Research Institutes.
- The size of the market is a key parameter (water purification, cargo scanning, medical treatment), hardly met by the construction of new Research Infrastructure (RI).
- However, industrialization of new Research Infrastructures is key to accessing to medium TRL's, and increase their readiness.
- For Commercial Innovation based on RI components (magnetic, RF, or instrumentation devices, etc...), industry needs to enter earlier into the design and prototyping phases products, as part of technology transfer, to **develop in-house expertise**.
- **Subsidiarity** principle: to which TRL should Institutes provide 'build on specifications' is a newly discussed question ?

WP5.4: Industrialization/Prototyping

Industry is reluctant to operate on TI platforms: we have to understand their reasons and offer enticements, such as:

- Cutting edge and qualified equipment
- In chain integration, from R&D to verification
- Scientific and Technical expertise (human factor)
- Training, communicating, stimulating (human factor)
- Coordination within TI (organic factor)
- Networking with Universities and Schools (community node factor)

Opportunities for Co-Innovation activities depend on the availability of all the above services, regarding:

- access,
- operating costs,
- maintenance,
- intellectual property
- personnel availability
- competition rules (SBIR vs. PCP attractiveness)

No opportunities should be missed: if one of these parameters is missing or failing at some Technological Facility, or because other impediments occurred during the negotiations with the Institute, **the usage of other platforms should be proposed.**

This is the reason why the Technology Infrastructure capacity should be reinforced by providing it with an **organic constitution** allowing, at some level, for organized relationships, dynamical planning and strategy coordination (cf. AMICI WP3).

AMICI is only a first step towards a European **Technology Infrastructure**

AMICI partners are working on defining statuses and rules of the future **European TI**

The case for **European TI** requires the understanding and the support from EC and from Industry