



Enlarging the particle accelerator market through collaborative R&D, the experience of the Integrating Activities

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Brussels, 6 February 2018

ARIES, the accelerator Integrating Activity

ARIES = Accelerator Research and Innovation for European Science and Society

The 4th **Integrating Activity** for R&D on Particle Accelerators, covering 2017-21.

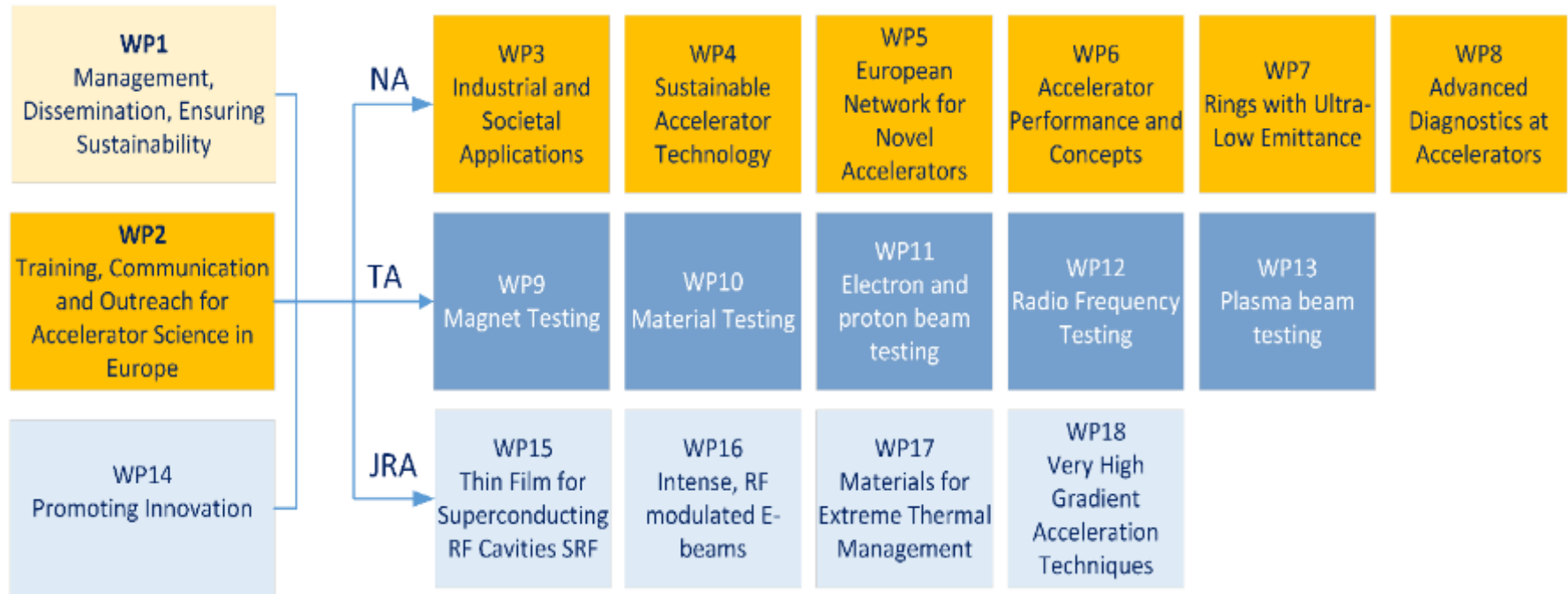
>400 physicists and engineers from 41 partners based in 18 EU countries.

Goal: identify and promote the **technologies** for the particle accelerators of the future, for the needs of **science and of society** (medicine, industry, environment).

Budget of **25 M€** out of which **10 M€** provided by the **European Commission** under the H2020 programme for Research and Innovation – support to Research Infrastructures.



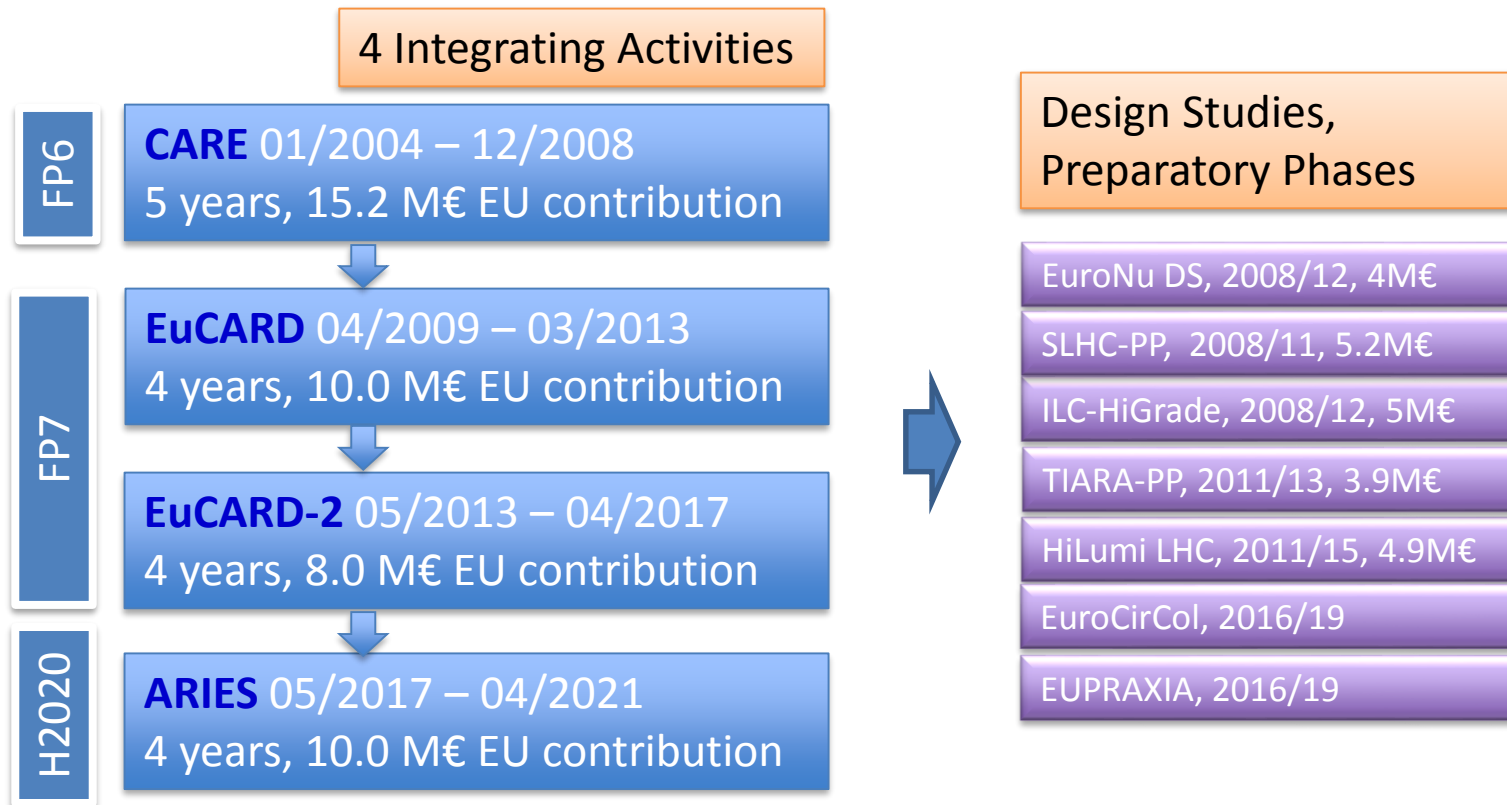
ARIES structure – covering key accelerator topics



18 Workpackages:

8 **Networks** 5 **Transnational Access**, 5 **Joint Research Activities**.

Long series of IA's focused on Research and Innovation



Integrating Activities:

Cross-boundary subjects, not directly followed by large laboratories, with added value coming from collaboration and sharing of resources. May result in new design studies, new projects, new collaborations

A preliminary question

→ What can an Integrating Activity do to enlarge the Particle Accelerator Market?

It can make a lot, acting at three levels:

1. Create a community, around common R&D activities
2. Contribute to creating a market for accelerators
3. Assist the community in going to the market

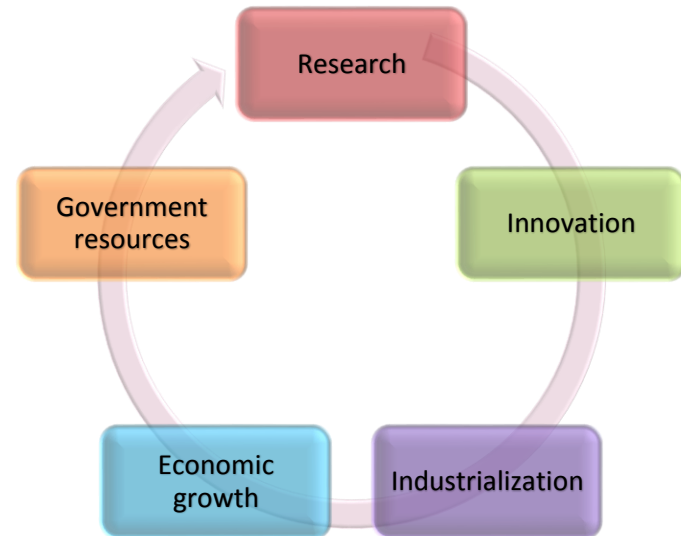
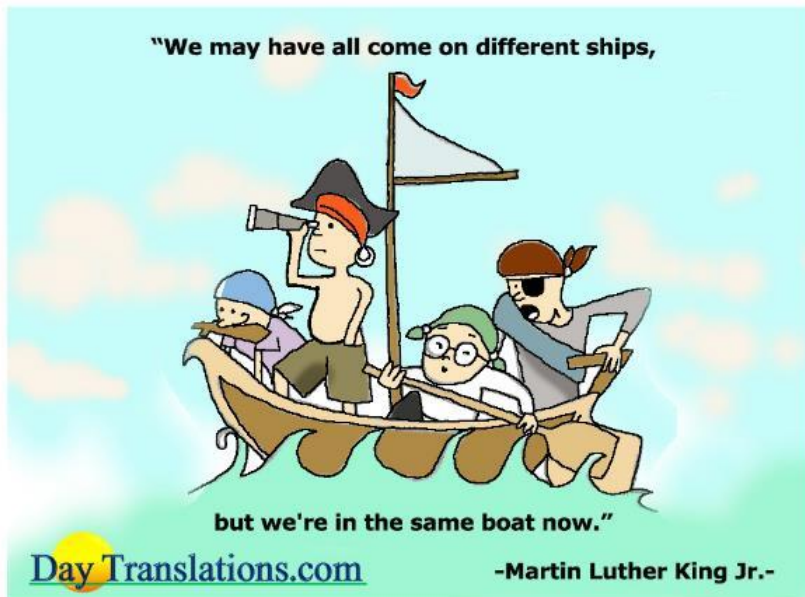


A second key question

→ Why should we do it?

Our main goal is **scientific research** but we understand that we are all part of the same socioeconomic system. It is in our interest to help companies to develop their business around accelerators – and at the same time extend the reach and reputation of accelerator technology.

Companies create economic growth and jobs, which pay taxes, which are used (among the rest...) to pay for scientific research, which in turn can contribute to the development of companies,...

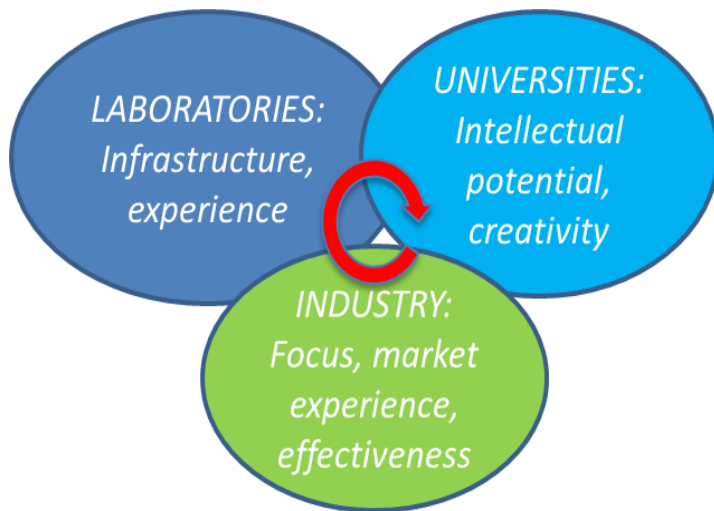


The virtuous circle of scientific innovation

Step 1: Creating a community

The main goal of an IA is to **integrate**, to build bridges and to create connections. Accelerator IA's went already a long way to integrate:

- Laboratories with universities.
- Partners from different European countries.
- Different accelerator communities sharing common technologies.



In ARIES one step forward, **Integrating industry:**

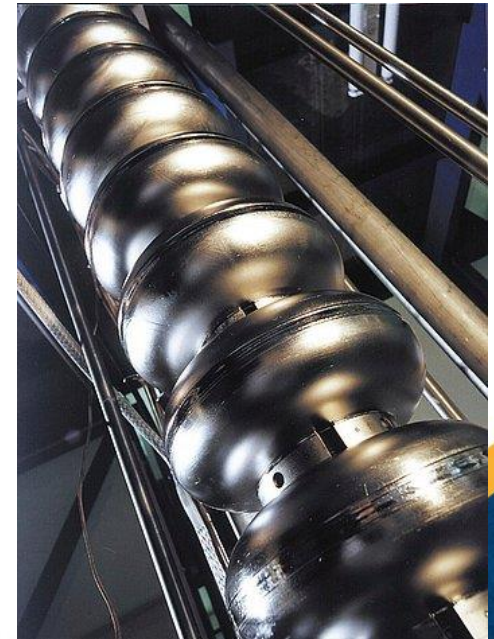
- important industry participation (8 partners),
- an Industry Advisory Board,
- a series of innovation activities with industry.

Seeking a new role for **innovative** companies, not mere supplier, but partners for common R&D objectives.

Long-term goal: create a common language and a common working ground between academia and industry to face future challenges and to expand together the market reach of accelerators:
create trust!

Step 2: Creating a market – the potential

- Particle accelerators have a wide potential to expand beyond their present boundaries: they are our **unique tool to access the atomic and subatomic world**.
- Our technological processes are slowly moving from the **chemical dimension** to the **atomic and subatomic dimension**, and only accelerators provide a (controlled) way to access to and interact with this dimension.
- Already now, out of the more than 30'000 accelerators in the world only 1% operate for fundamental research - 95% are used as everyday instruments for **medicine and industry**.



Accelerators from science to society

Particle physics has been from the early times the **technology driver** for the development of particle accelerators: the **quest for new particles** at increasingly higher energies has motivated the development, construction and financing of increasingly large accelerators.

Now the projected **size, cost and energy consumption** of the next generation of large scientific accelerators is slowing down the implementation of new large projects but at the same time is pushing the community to search for **new ideas and technologies**.

At the same time, accelerator projects are booming, with a wide spinoff of accelerator technologies from basic science towards growing domains in **applied sciences** (photon and neutron sources) and in **medicine and industry**.

COLLISION COURSE

Particle physicists around the world are designing colliders that are much larger in size than the Large Hadron Collider at CERN, Europe's particle-physics laboratory.

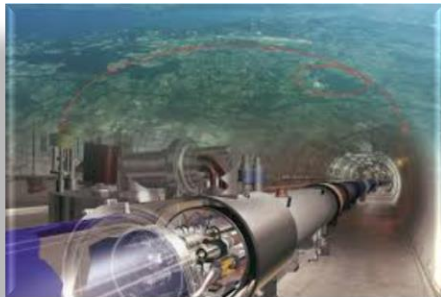
«Nature», July 2014



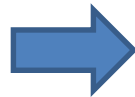
As many as **50** ongoing large accelerator construction or upgrade projects have been listed at the 2017 IPAC Conference (13 America, 11 Asia, 26 Europe)

Accelerators in transition

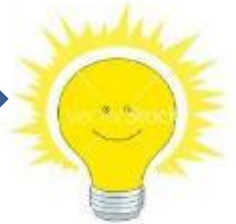
1. Transition to **new technologies** for basic science.
2. Transition from **basic science as technology driver** to a **multiple system** where basic and applied science, medicine and industry drive accelerator development.
3. Transition from a **centralised configuration** based on large laboratories to a **distributed scheme** (**project clusters** of small and large laboratories and industry)



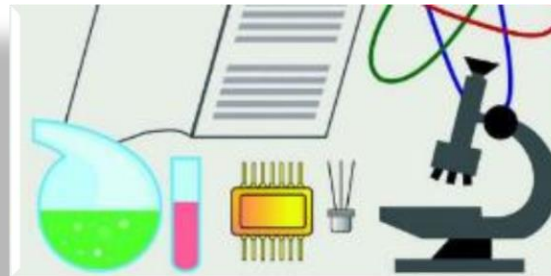
Basic science



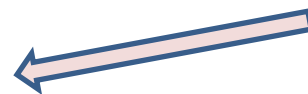
Limitations related to size, cost, energy.



New ideas,
technologies



Applied science (photon
and neutron sources)



Societal
applications
(medicine,
industry,
environment,
etc.)

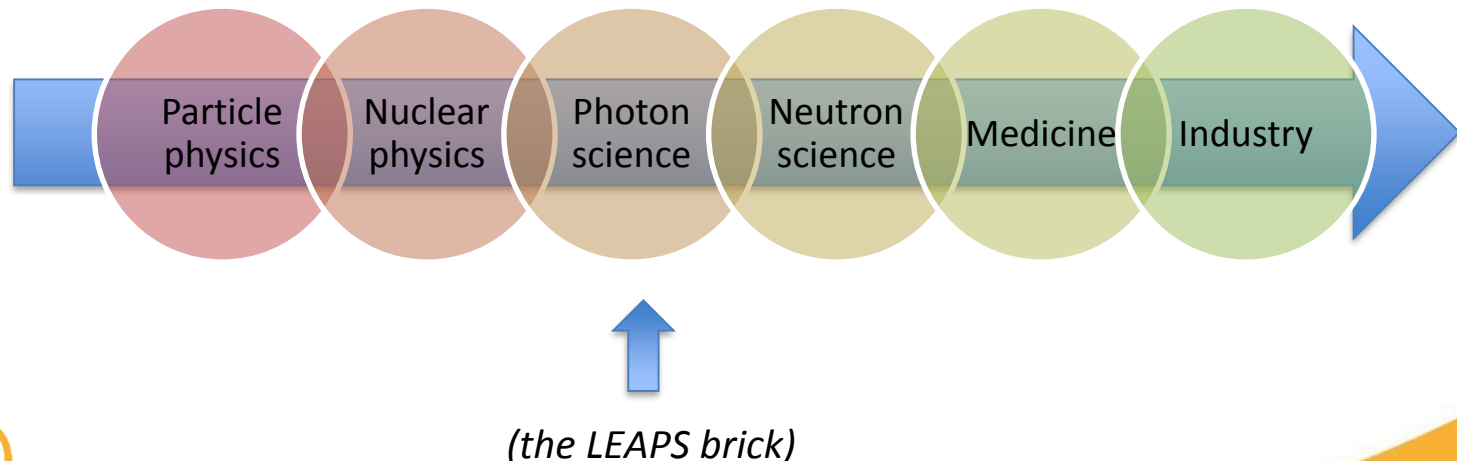
Creating a market – the actions

Huge expansion of accelerators that are becoming industrial.

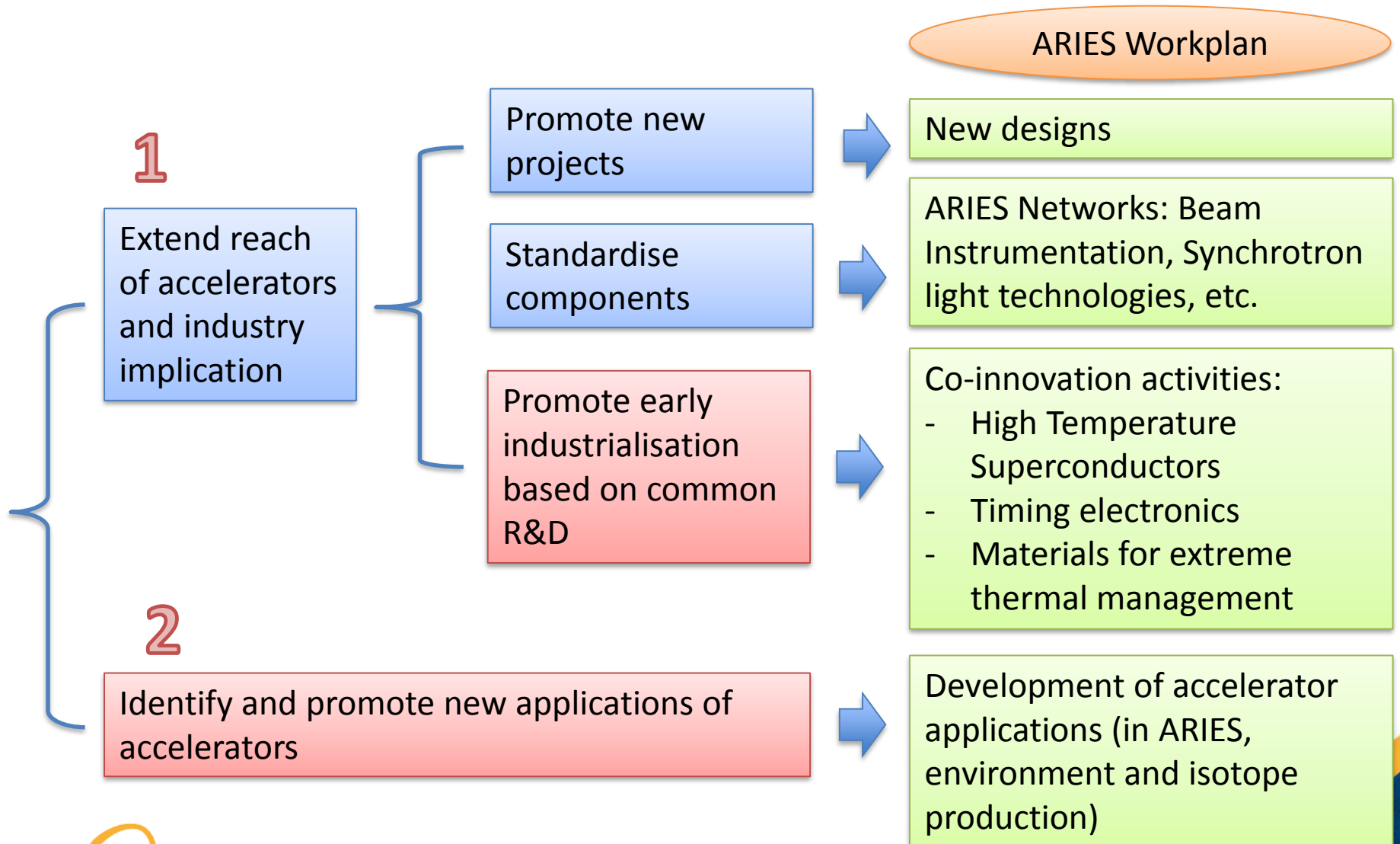
An Integrating Activity like ARIES can drive and power this process by:

1. Developing and testing new ideas (innovation)
 2. In a collaborative environment (synergies and cross-fertilization)
 3. Connecting transversally the accelerator communities
- in collaboration with industry

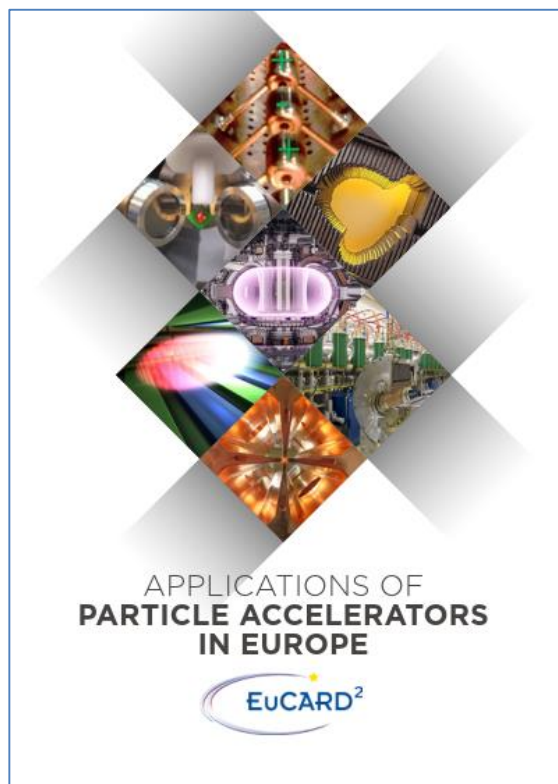
Transversal actions connecting all types of accelerators



Creating a market – the directions



Creating a market – accelerator applications



The document describes current applications of accelerators, achievable improvements, possible new applications and actions necessary to achieve these applications.

Main chapters:

- Health (radiotherapy and radionuclides)
- Industry (analysis, ion implantation, welding, sterilisation, environment, etc.)
- Energy (controlled fission, fusion)
- Security (imaging, nuclear interrogation)
- Photon sources (present and future)
- Neutron sources

“It’s a brave new world of applications!”

Applications of Particle Accelerators in Europe

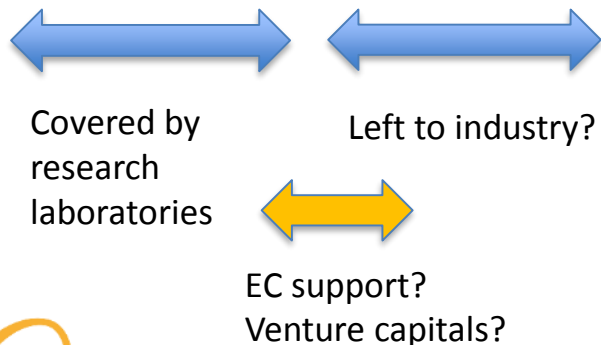
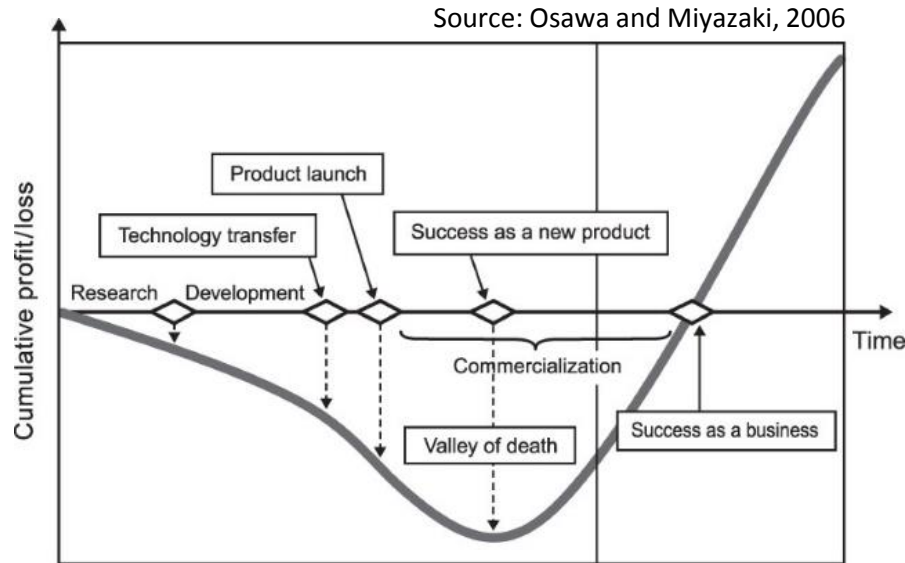
115 page document prepared by the last IA, EuCARD2

Being reprinted, copies can be requested to the Secretariat (Valérie)

Or download at <http://apae.ific.uv.es/apae/>

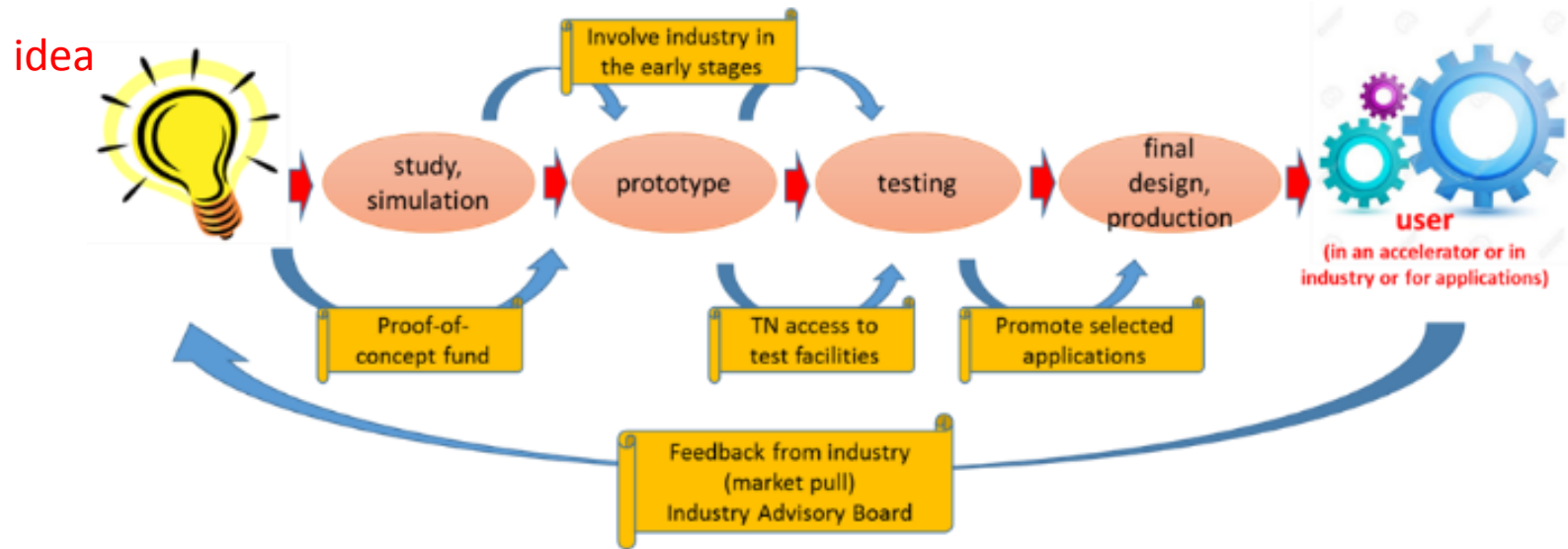
3. From research to society

- Crossing the valley of death



Death Valley, California, October 2017

ARIES Innovation strategy



Support to different stages of the innovation process:

- **Proof-of-concept innovation fund:** for Business Plan preparation, market assessment, demonstration in connection with industry of the technological viability of new ideas.
- **Industrial Advisory Board:** provide business consultation (eg. business plans) and support market assessments (“market pull”).
- **ARIES meets industry events**
- **3 co-innovation programmes with industry** (HTS, materials, standardized timing).

Note: all done with only 1.26 MEUR EC contribution, for 4 years

Proof of concept and Industry Advisory Board

Proof of Concept Fund

Selection for **financial support of small projects** at early stage with innovation and technology transfer potential, in view of commercial applications. Should result in a spin-out (seed or venture finance) or licensing opportunity or provide the necessary information to bid for other support. Including **business plan**.



Industry Advisory Board

Committee of 5 members to provide industry opinion regarding the potential of the technologies developed in the project and help defining suitable business plans. Goal: move from a “technology-push” to a “market-pull” approach. (1st meeting here today)

Procedures defined, call open (deadline March 31st)

Activities coordinated by Marcello Losasso, CERN

Several very interesting proposals are in preparation!

Co-innovation: projects and procedures

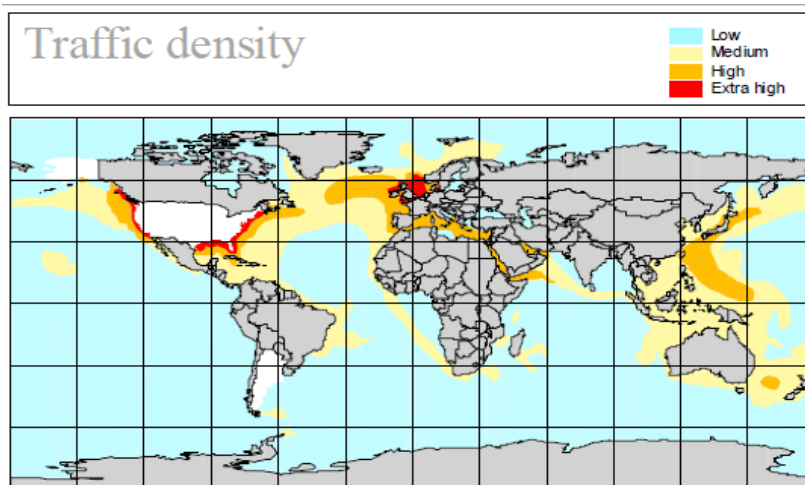
- 3 pilot co-innovation projects in ARIES – minimum 1 academic+1 industry partner:
1. breakthrough in the cost per kAm of industrial **High Temperature Superconductors** (Bruker HTS) – continuation of EuCARD2
 2. production of **materials for extreme thermal management** in accelerators (RHP and BrevettiBizz) - continuation of EuCARD2
 3. production of a **standardized timing** for medical and industrial applications (Cosylab) – new subject related to standardisation and applications.

Key question: How to select projects and companies?

1. Projects must be critical for the workplan, often extending beyond one IA (**long-term R&D objectives**).
2. Selected companies are European leaders in a field, with no (evident) **competition**.
3. Companies must be ready to **co-fund the activity** at a level of **25% to 50% of total cost** including overheads (50% to 75% for scientific partners).
4. Access to results must be **open** – a key requirement.

An example in an early stage (not yet industrial): accelerator treatment of ship exhausts

ARIES group working on environmental applications of accelerators has identified a promising application: **Low-energy electron beams** can break molecular bounds and be used for cleaning of SO_x and NO_x from **exhausts of marine diesel engines**. Maritime traffic is one of the largest contributor to **air pollution** (*the 15 biggest ships pollute as much as all car traffic on earth!*)



ARIES Strategy:

Support the partner holding a patent on this procedure (Institute of Nuclear Chemistry and Technology, Warsaw) by creating a collaboration to test the technology in a marine environment with early contribution of industry (shipyards and shipping companies).

Outlook to the future

In ARIES we have only 3 subjects where we do common R&D (**co-innovation**) between laboratories and industry but our goal for future projects is to have **many more** collaborations of this kind. To achieve this goal we need to:

1. identify topics of common interest
2. define the modalities for the collaboration: co-funding, IP management, exploitation of results, etc.
3. define transparent criteria for the selection of the company and of the partner laboratory.

All these points should be addressed in ARIES, in AMICI and in other forums, in preparation for future initiatives that could possibly receive the support of the European Commission.

Thank you for your attention



**The best way
to predict the future
is to invent it.**

Alan Kay, American computer scientist
Speech given at Xerox PARC (1971)