1. ARIES task

Task: Define the network of technologies and subjects in the R&D accelerator field.

Classifications done by

1. Accelerator Technologies
2. Accelerator Components
3. Accelerator Concepts
4. Accelerator Fields
5. Different strategic interests: generic R&D, technological platforms, specific subjects, ...

The industry, involved on each interest.

2. Key Accelerator Research Areas

The previous work in WP3 and WP2 of TIARA [1,2] identified the areas related with accelerator R&D. These were classified as follows:

1. Accelerator Technologies
2. Accelerator Components
3. Accelerator Concepts
4. Accelerator Fields

3. Key Technical Issues

3.1. Accelerator Technologies [1]

ACCELERATOR TECHNOLOGIES	
Key Accelerator Research Area	**Key Technical Issue**
Electronics and Software	xTCA Standards
	LLRF cost, performance
UHV	Radiation-Induced Outgassing and Secondary Particle Generation
	Low Outgassing Rates to Limit Pumping Times
	Wall Chamber Conductivity and Eddy Currents
RF sources	Energy efficiency
	Solid State Technology RF Sources
Cryogenics	Cryoplant Efficiency Improvements
	Cryogenic Distribution and Cryostat Insulation
Alignment and Stabilization	Laser and Wire Positioning Systems
	Nanometer Level Stabilization
Power converters	Energy storage, energy efficiency, cost
Machine protection	Quench protection, improve reliability
Radiation issues	Determination of Prompt Radiation Levels Component Activation Handling Radiation hard electronics and materials Compact Shielding

3.2. Accelerator components [1]

ACCELERATOR COMPONENTS	
Key Accelerator Research Area	**Key Technical Issue**
Sources and Injectors	High Brightness Photo Injectors High Intensity Heavy Ion Injectors High Intensity Proton Injectors High-polarization electron/positron sources Hollow beams for proton beam collimation RFQ development Beam funneling
RF structures	High Gradient Acceleration at Low RF Breakdown Rates Development and engineering of C-Band and X-Band Structures Consolidation of the Nb Technology for Maximum Yield at Highest Gradients Improvements of the "Low Beta" Cavity Technology CW superconducting radiofrequency Coupler for SRF Cavities at High Average Power Overcoming the Performance Limits of Bulk Niobium Crab cavity Developments RF Structures for 6D Muon Beam Cooling Variable Frequency Resonators for Synchrotrons or FFAG
RF systems	Optimization of RF Systems for high brilliance damping rings X-Band and C-Band RF Systems Precision LLRF control
SC magnets	Material and Technologies for the 20 T Range and Beyond Fast Cycling SC Magnets Engineering Challenges for High Field Magnets Cryogen-free magnet systems High-Field short period undulators High Field Small Magnets using rare-earth pole tips
Conventional NC magnet systems	Compact Magnets Radiation Resistant Magnets Insertion Devices for X-Ray Production and Damping Rings Pulsed Magnets and Kickers Transparent Injection in Top-Up Schemes Fast pulsed quadrupole magnets for beam lines
Diagnostics and instrumentation	Beam Position Monitor Development Beam Size and Emittance Monitor Devices Development Synchronization, fs or sub-fs Beam Intensity and Loss detectors
Targetry	Challenges for High Power Targets for Secondary Particle Production Radiation Damage Phenomena in Target Materials Monte Carlo Particle Transport Codes Validation Collimation Systems Bent Crystal channeling

3.3. Accelerator Concepts [1]

ACCELERATOR CONCEPTS	
Key Accelerator Research Area	**Key Technical Issue**
Accelerator Design	Design for Reliability and Availability
	Beam Losses and Machine Protection at High Beam Power
	Compactness and Simplicity
	Energy Efficiency and Storage
Beam Dynamics	Enhanced Beam Modeling Tools and Experimental Code Validation
	High Luminosity and High Energy Hadron and Lepton Colliders
	Beam Stability and Lifetimes in Circular Accelerators
	Small Emittance Beam Generation and Transport
	Transport of electrons in plasma accelerating structures
	Low Losses in High Intensity Linacs
	High Reliability Operation
	Laser-Beam Interaction for Acceleration and X-Ray Production
	Fast Acceleration for Unstable Particles
	Develop New Seeding Techniques for FELs
	Circularly Polarized X-Ray FELs

FEL processes	Attosecond Pulse Generation
Beam cooling	Electron and Stochastic Cooling for Heavy Ion Beams
	Ionization Cooling
New techniques for high gradient acceleration (laser-plasma etc.)	Self Injection Laser Wake-Field Acceleration
	External Injection in Laser Plasma Waves Below Wave Breaking
	External Injection in Particle Wake-Field Acceleration
	Proton and light Ion Generation with Laser Driven Plasmas
Medical and Industrial Accelerators	Improvement in Dose Delivery for Hadron Therapy
	Image Guided Radiation Therapy
	Cost and Complexity Reduction of Medical Accelerators
	Boron Neutron Capture Therapy
	Production of PET Isotopes and Tracers
	Acceleration Driven Systems for Nuclear Waste Transmutation
	Accelerators for Fusion
	Industrial and Societal Applications
	Environmental Applications
	Accelerators for Detection of Illegal Nuclear Material

3.4. Accelerator Fields [2]

The following field of research or respective communities of scientist involved with accelerator technology are identified:

- Particle Physics
- Nuclear Physics
- 3rd & 4th Generation Light Sources
- Neutron Sources
- Accelerators for Medical Applications
- Accelerator-Driven Nuclear Reactors
- Fusion
- Industry

Field/ community	Identified body
Particle Physics	ECFA, ESPP
Nuclear physics	NuPECC
Light sources (3rd, 4th generation)	LEAPS (EFELC, XFEL, ESRF)
Neutron sources	LENS*
Medical applications	ENLIGHT
	PTCOG
ADSR	(MYRRHA)
Fusion energy	F4E, (IFMIF)
Industry	ARIES, AMICI, FUSUMATECH industry bodies

*League of advanced European Neutron Sources

4. Running Accelerator Projects

TIARA: A consortium with general scope: coordination on accelerator technologies
ARIES: sustainability of R&D
AMICI: sustainability of Technological Platforms
EASITRAIN: training
FUSUMATECH: sustainability of determined aspects of R&D

We cannot ask the industry to make the field sustainable

The co-funding of Member States has deeply analyzed in H2020, with known-results (50-50% acceptable at most).

CE money just for start and consolidate communities is a fallacy.

INFRAINNOV-04 must be useful for implementing a support on the whole picture, R&D, TF, TP.

References:

[1] TIARA Report on R&D Infrastructures. Infrastructure Survey Report. Report WP3-2012-004. 23 February 2012
[2] TIARA Report on Collaboration with Other Bodies. Report WP2.2.2 Identification of Bodies with which collaboration is needed. 2 July 2012