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D 6.2 – List of recommended criteria for infrastructures for radiation protection research

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Abstract

Activities: The meetings and working groups of the WP6 members have contributed to producing "Recommended Criteria" for Infrastructures. These criteria are described here and have been implemented for use in a database containing all the infrastructures. The database has been named AIR²D²: Access to Infrastructures for Radiation protection Research Documented Database, and is accessible online via www.concert-infrastructures.eu. This database is a communication and information tool which will serve as a portal to help researchers to easily identify suitable infrastructures, as described by owners under the recommended criteria. To increase the visibility of infrastructures, a new bulletin, published approximately 10 months a year named AIR²: Access to Infrastructures for Radiation protection Research, has been implemented. It highlights three infrastructures in each issue. The contents of the bulletin will be used to create a web handbook at the end at the project.

Introduction

The members of WP6 took the decision to change "Recommended Infrastructures" to "Recommended Criteria". The work has been organized into several steps. Firstly, the establishment of a list of recommended criteria, secondly, the database design for all Infrastructures, called AIR²D², which is based on an "ongoing process", and thirdly, the process of highlighting various infrastructures through the bulletin AIR², with the publication of 10 issues per year, to produce a web handbook at the end of the project.

Recommended Criteria

Based on the activities of the three working groups, each of which was tasked to focus on the categories presented in table 1, a list of the "Recommended Criteria" has been produced (tables 2, 3 and 4). These criteria are divided into two categories: common criteria and technical criteria. Only one criterion has been considered as mandatory, i.e. open access for research activities in the context of CONCERT calls.

Activities of the working groups are still ongoing.

Table 1: Working groups and categories

WG1	WG2	WG3
Exposure platforms	**Databases, Sample banks, Cohorts**	**Analytical platforms, Models, Tools**
Lead: Andrzej Wojcik (LTP SU/MELODI) Brit Salbu (LTP NMBU/NRPA) Almudena Real (CIEMAT) Antonella Tabocchini (ISS) Jean-François Bottolier-Depois (IRSN/EURADOS) Jean-Michel Dolo (CEA) María Antonia López (CIEMAT) Elina Pajuste (UL) Nick Beresford (ALLIANCE) Catherine Barnett (ALLIANCE) Boguslaw Michalik (ALLIANCE) Nathalie Vanhoudt (ALLIANCE)	**Lead: Fieke Dekkers (RIVM)** Angelika Bohnstedt (KIT) Laure Sabatier (CEA) Nick Beresford (ALLIANCE) Catherine Barnett (ALLIANCE) Miquel Vidal (ALLIANCE) Almudena Real (CIEMAT) Monika Frenzel (CEA) Laure Piqueret-Stephan (CEA) Balázs G. Madas Dominique Laurier (IRSN)	**Lead: Ulrike Kulka (BfS)** Valeria Hadjidekova (NCRRP) Hans Christian Teien (LTP NMBU/NRPA) Aste Sovik (NRPA) Laure Piqueret-Stephan (CEA) Monika Frenzel (CEA) Almudena Real (CIEMAT) Nick Beresford (ALLIANCE) Catherine Barnett (ALLIANCE) Tatiana Duranova (NERIS)

Table 2: WG1 - Recommended criteria for the category "Exposure platforms" (Acronyms: NORM = Naturally-Occurring Radioactive Materials; Y = yes; N = no)

Common criteria	Technical criteria		
	External exposure facility (closed sources)	**Internal exposure facility (open sources)**	**Contaminated Sites (Observatories)**
• Name of the platform and of the producer/owner if applicable	• Type of source(s): *(radionuclide, X-ray generator, accelerator)*	• Radionuclides, chemical forms and activities (Bq)/activity	• Nature of the contamination in the site (please choose an option):

- Address
- Name and contact details (including email) of the responsible person
- Link to internet site if available
- List of key publications relative to/where the platform was used
- Biological laboratory available (describe)
- Access rules (security, authorization, ethics committee, scientific committee - please describe)
- Image of the facility

- Type of radiation (gamma, X-ray, neutrons, beta, protons, ions)
- Energy, energy range
- Dose range (Gy)
- Dose rate range (Gy)
- Dosimetric quantity used (air kerma, absorbed dose…)
- Possible duration of exposure (min - max)
- Dose rate modulation options (distance, different sources, filters)
- Dose uniformity in a specified volume/distance
- Space available to install the objects to be irradiated
- Type of biological material which can be exposed (cells, animals, plants: specify size and habitat)
- Conditions of exposure (temperature range, light/dark cycle)
- Describe how the dosimetry is performed (dosimeter type, traceability)
- Describe how the dose reference is defined *(in air, in a phantom)*
- Main use of the facility (medical treatment, medical or industrial diagnostics, research, environmental exposure site)

- concentrations that can be used
- Possible pathways of exposure (inhalation, ingestion, injection, skin application, root uptake, atmospheric deposition)
- Possible type of intakes (acute/continuous) and duration of exposure (h/days)
- Samples that can be exposed (cells/animals/plants) and conditions of exposure (Tª, light/dark cycles, green houses, growth chambers, etc.)
- Possibility to perform ex vivo (isolated tissues or organs) and in vitro (cell culture) experiments (specify size and habitat)
- Dosimetric system (if available)
- Speciation
- Available instrumentation for measurement (whole/partial body counter, scintillation counters, semiconductor detectors, bioassay techniques for biological samples, etc)
- Safety class of the facility
- Main application of the facility

Natural radionuclides
Artificial radionuclides
Natural & artificial radionuclides
- Radionuclide(s)/source of exposure
- Activity concentration ranges of radionuclides
- Dominant exposure pathway (i.e. external, inhalation, ingestion…)
- Dose rate range on ground surface
- Type of ecosystem contaminated (i.e. terrestrial, lake, marine, arable/waste land, forest, etc.)
- Compartment of environment contaminated (water, soil, sediments, etc.)
- Total area contaminated
- Species exposed/present (humans, flora, fauna)
- Possibility of bringing animals/plants into the site (and to take them after the experiment)
- Applied/available radiation risk monitoring system
- Existing data concerning exposure/contamination
- Presence of associated contaminations (i.e. heavy metals, hydrocarbons etc.)
- Laboratory/facilities available in the site or nearby (e.g. to process samples)
- Time horizon (term)
- Access to current/historical data
- Export permission – transport of samples from the observatory site to home country (Y/N)
- Formal status of the area of concern, ownership etc. (possibility of using it as an observatory)

Table 3: WG2 - Recommended criteria for the category "Databases, Sample banks, Cohorts"
(Acronyms: GMO = Genetically Modified Organism; FFPE = Formalin-Fixed Paraffin-Embedded;
ICD = International Classification of Diseases; Y = yes; N = no)

Common criteria	Technical criteria		
	Databases	Sample banks	Cohorts
• Name of the infrastructure • Address • Institute • Name and contact details (including email and phone number) of the responsible person • Link to internet site if available • List of key references • Inclusion in STORE? (if yes, please indicate the URL) **Access rules** • Security • Safety level • Authorization • Ethics committee • Scientific and/or selection committee • Local accommodation support	• Database topic, type and number of studies included. • Data type (tables, articles, experiences, cohorts, images…) • Species or samples (if other, specify) • Exposure contexts (medical, accident, experiment) • Availability of information about irradiation (dose, dose rate, whole/partial body exposure, external exposure/internal contamination, radiation quality, acute/protracted…) • Information about dosimetry • Information about end points considered, duration of study, experimental conditions (if relevant)… • Link with a sample bank (Y/N?) (if yes: refer to criteria for sample banks) • Searchable (Y/N) • Exportable (Y/N)	• Type of organism (cells, animal tissue, plant, soil, GMO…) • Sample type (tissue (FFPE/frozen), cells, DNA, RNA, fixed slides …) • Exposure context (medical, accident, experiment…) • Availability of information about irradiation (dose, dose rate, whole/partial body exposure, external exposure/internal contamination, radiation quality, acute/protracted exposure….) • Information about dosimetry • Storage condition (room temperature, -20°C, -80°C, liquid nitrogen…)	• Characteristics of the population (workers, patients, general population, age and gender structure, duration of follow-up, person-years…) • Size of the cohort • Exposure context: (medical, occupational, post-accidental, natural…) • Availability of information about radiation exposure (whole/partial body exposure, external exposure/internal contamination, radiation quality, acute/protracted exposure, method of exposure measurement/ assessment, distribution of age at exposure….) • Information about dosimetry (method of dose estimation, organ doses, equivalent dose) • Information about endpoints (pathologies considered, mortality/ morbidity, histology, ICD classification…) • Additional information (questionnaire, medical treatment, occupational history, confounding factors…) • Ethical and data protection aspects: Related ethical agreements, data confidentiality rules, access conditions, principal investigator contacts • Link with a sample bank (Y/N) (if yes: refer to criteria for sample banks)

Table 4: WG3 - Recommended criteria for the category "Analytical platforms, Models & Tools"

Common criteria	Technical criteria	
	Analytical platforms	**Models & Tools**
• Name of the infrastructure • Address • Institute • Name and contact details (including email and phone number) of the responsible person • Link to internet site if available • List of key references **Access rules** • Security • Safety level • Authorization • Ethics committee • Scientific and/or selection committee • Local accommodation support	• Analytical platform type: (e.g. dosimetric analysis, genomics, comparative genomics, sequencing, SNP-arrays, next generation sequencing, transcriptomics, epigenomics, micro RNAs, methylation arrays, proteomics, phosphoproteomics, metabolomics, exosoms, small molecules…) • Techniques applied (if non-omics analytical platform, please describe technical equipment) • Analysed samples / material (cells, blood, human/non-human biota, soil, water…) • Possibility to use archived material? (If yes, please describe kind of archived material) • Capacity (week / month) • Operational readiness • Timeframe to obtain a result • Training proposed **Data treatment:** • Data evaluation by statistician and/or bioinformatician? • Data production and management • Modelling included • Quality **Quality Management & Quality Control:** • Control of welfare parameters / key influencing factors (if not following standard toxicity tests)	• Area (check box: radioecology, toxicology, dosimetry, radiobiology, epidemiology emergency response, post-accident management, other: please specify (with text box)) • Purpose • Input data type and format • Output data type and format • Hypothesis and constraints (validity of the model, model assumptions/limitations …) • Free access? • Webpage link to download **Support/help:** • Level of expertise required • Expert required/available? • Training available on the software

AIR²D²- Access to Infrastructures for Radiation protection Research Documented Database – A communication and dissemination tool gathering data on open infrastructures related to radiation protection research

One of the major aims of WP6 was to gather information on all the infrastructures involved in radiation protection research and assemble this into a single database. The term "infrastructure" currently includes exposure platforms (irradiation facilities for external exposure, internal contamination, and contaminated sites), databases, sample banks, cohorts, analytical platforms (omics or non- omics), and models & tools. All these types of infrastructures have been grouped respectively into 3 categories: (i) Exposure platforms, (ii) Databases, Sample Banks, Cohorts, (iii) Analytical platforms, Models & Tools (see figures 1 and 2).

This database is named AIR²D² for Access to Infrastructures for Radiation protection Research Documented Database and is accessible online via www.concert-infrastructures.eu and is also available via the CONCERT website: http://www.concert-h2020.eu/en/Concert_info/Access_Infrastructures .
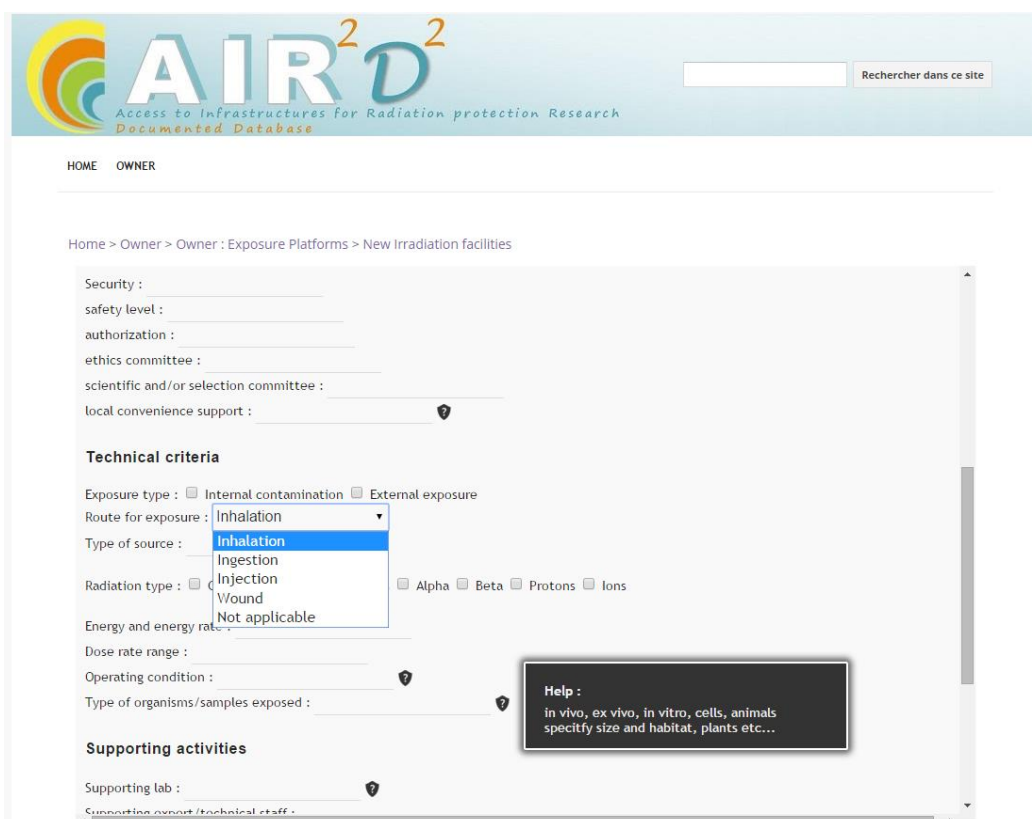

Figure 1: AIR²D² home page

Figure 2: Sub-categories of the infrastructure types that appear on the AIR²D² home page

The website offers 2 options: (i) Research Scientists can perform searches to find the infrastructure(s) corresponding to their needs thanks to filters, and (ii) Owners of infrastructures can register and modify their infrastructure(s) at any time. This website is based on Google technology and is easily modifiable. Most parts of the website can be modified by the administrators, but some parts, (e.g. forms for the owner) require modifications using code script in order to avoid filling out a new whole form again. Administrators will learn the code script to allow them to modify the form without having to ask help from a computer expert.

For the launch of the first CONCERT Call, the database was pre-filled with information from existing lists or other supports, in order to avoid a blank database. The existing lists used for completing this database were taken from EURADOS (http://www.eurados-db.npl.co.uk/EURADOS_facilities_query.php) for irradiation facilities, and from DoReMi for irradiation facilities and cohorts. Some infrastructures listed in the deliverable 2.2 of STAR permits to list some of them for our database for irradiation facilities, dosimetric analytical platforms and models but these are not yet integrated into the database. The search for contact points for some of these infrastructures is still in progress. The database will be continually updated.

In order to list all types of infrastructures, it is necessary to combine all existing lists but also to identify other infrastructures not yet listed. Currently, only infrastructures belonging to WP6 members have been prospected but the URL will be circulated widely (see the AIR² section below) in order to invite infrastructure owners to add their infrastructures to the database. Owners can easily create their infrastructure pages within the database, using forms containing help boxes (see figure 3).

Figure 3: Example of a form to be completed by infrastructure owners

Currently, the only restrictive criteria to allow an infrastructure to be included in the database, is that the infrastructure must be open to external partners. The listing of other criteria, termed "recommended criteria" (see above), is still in progress. The WP6 members were divided into 3 Working Groups (WG) to list the recommended criteria: Work Group 1 (WG1), led by Andrzej Wojcik (LTP SU/MELODI) for Exposure platforms criteria (including external exposure facilities, internal exposure facilities and contaminated sites), Work Group 2 (WG2), led by Fieke Dekkers (RIVM) for Databases, Sample Banks and Cohorts, and Work Group 3 (WG3), led by Ulrike Kulka (BfS) for Analytical platforms, Models, Tools (see above).

The AIR²D² database is a communication and dissemination tool and serves as a webportal to guide the researchers in their choice of infrastructures. Its aim is to be, as simple as possible, so it is designed as an easy-to-use tool for researchers as well as for infrastructure owners. Each sub-category is displayed in a dynamic table which includes the recommended criteria (see figure 4).

Figure 4: Display of the search results in a dynamic table

To further assist researchers in their search for infrastructures, dynamic maps for each sub-category, and filter functions, will be made available (see figure 5).
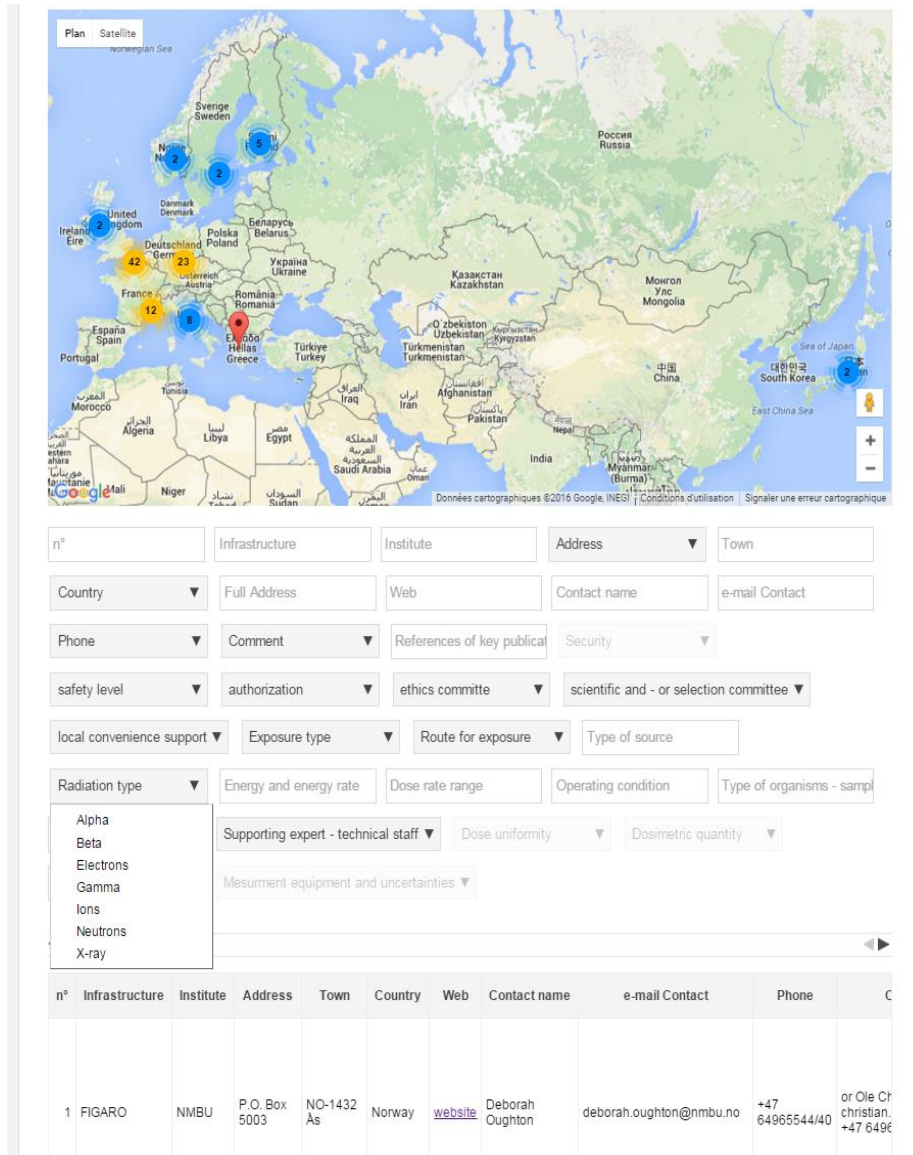
Figure 5: Display of the search results in a dynamic map

A global map with the common criteria (contact, address...) will also be available, giving a global view of all the infrastructures (see figure 6).
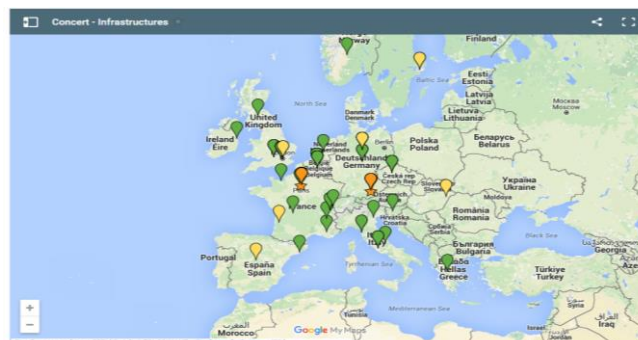

Figure 6: Display of all the infrastructures in a global map

The results of an infrastructure search can be exported into a csv file and can be read in an Excel file. A tutorial to convert exported data into an excel spreadsheet is provided on the website (http://www.concert-infrastructures.eu/export-of-the-data---help) (see figure 7).

Figure 7: Tutorial on how to export and convert the data from an infrastructure search

In the future, it is expected to add additional support of various types to the database, e.g. images, tables, documents, etc., to provide a "documented database". These documents will be available in a cloud folder which will be searchable with Google technology, i.e. to perform word searches within documents such as PDF files.

It is also planned to invite users to leave feedback. These comments will have two major uses. The first is to make available a database which is as complete as possible. The second is to help the researcher who is searching for an infrastructure to find the one most relevant to his/her needs.

The database may still be in progress when the first CONCERT Call is launched; however a beta test version is already available after only 6 months of work. The WP6 group expects to have an operational version ready at the end of the call, even if there is still room for improvement by the administrators (some of which are WP6 members) without the help of a computer expert. Thus, if new ideas result from WP6 meetings, it will still be possible to implement these.

AIR² - Access to Infrastructures for Radiation protection Research - A monthly bulletin for dissemination of the information available on Infrastructures related to radiation protection research

In addition to listing all open infrastructures related to radiation protection research, WP6 is committed to increasing their visibility. In order to fulfil this objective, a monthly bulletin featuring infrastructures by category was implemented in October 2015 (with the publication of approximately 10 issues per year). This bulletin is called AIR² for "Access to Infrastructures for Radiation protection Research".

The bulletins comprises 5 pages: The first page carries the editorial of the WP6 leader (Dr Laure Sabatier, CEA) and, from the 2nd issue onwards, also includes a section "The floor to …", in which (for issues 2-7) a CONCERT WP leader discusses the importance of an infrastructure. Subsequently, this section will be broadened to include contributions from leaders of the European platforms MELODI, ALLIANCE, NERIS and EURADOS, as well as CONCERT grantees, POMs and national contact point for infrastructures. A section named "CONCERT CORNER" is also available and contains announcements of some of the future events of the CONCERT project and the latest news for WP6 (see figure 8).

Figure 8: AIR² cover page. Issue No.1 (left) and Issue No.2 (right) with the section "The floor to…"

The next three pages are dedicated to featuring infrastructures: one infrastructure from the category "Exposure platforms" (page 2), one from the category "Databases, Sample banks, Cohorts" (page 3), and one from the category "Analytical platforms, Models & Tools" (page 4). These three pages are constituted in the same way, i.e. with a text featuring the infrastructure, written by its owner, two spaces for images or photographs, a photo of the author, two key references of work involving the

infrastructure, and an ID card containing basic criteria to provide key information at a glance. A little bullet point with a colour code is also used to distinguish the sub-categories to which the infrastructure belongs (see figure 9).

Figure 9: AIR² - Examples of pages 2, 3 and 4 (from left to right)

Page 5 gives a list of the infrastructures published to date and those expected to be featured the next issue. A list of future events relating to radiation protection research and infrastructures is also available with hyperlinks to the events (see figure 10).

Figure 10: AIR²: Page 5 - last page (issue of December)

It was decided to use the colours of the CONCERT logo for the bulletin, with one colour per page, in order to be homogeneous with the CONCERT project.

The issues of the bulletin are circulated via an e-mail distribution list, presently composed of CONCERT, ALLIANCE, MELODI, DoReMi, COMET and OPERRA members, and researchers from the CEA and IRSN. Currently, the global distribution list comprises 459 persons. The bulletin is also sent to the EURADOS members via their Newsletter (circulation of around 900 persons). Anyone who wants to receive the monthly bulletin can send an email request to laure.piqueret-stephan@cea.fr. After distribution, the bulletin is housed on the CONCERT website: http://www.concert-h2020.eu/en/Concert_info/Access_Infrastructures.

It is planned to publish a special issue (once a year) to present infrastructures in a different way (mapping, involved in one association: MELODI, ALLIANCE…).

At the end of the CONCERT project, all the pages featuring the infrastructures (pages 2, 3 and 4 of the bulletin) will be assembled to create a web "handbook", containing all the infrastructures presented in the bulletin during the 5 years of the project.

Conclusions: Links between AIR^{2}D^2 and AIR^2, connections to CONCERT website and future evolutions

As described in the two previous sections, the titles of these two activities (AIR^{2}D^2 and AIR^2) are related in order to increase the visibility and the use of the infrastructures. Published 10 times a year with 3 infrastructures in each issue, WP6 aims to provide a web handbook with around 150 infrastructures highlighted in AIR^2. These highlighted infrastructures will also be re-used in connection with their corresponding referenced line in AIR^{2}D^2, which will allow the potential for each owner and each researcher to have an exchange of information with rich text rather than short descriptive answers for criteria. Finally the last type of shared information will be the comments provided by the infrastructures' users. These three types of information constitute a complementary basis comprising various approaches which will help to guarantee more objective information on an identified infrastructure to initiate contact between potential partners and increase opportunities to build a research project together.

The database is built as a continuous open system and for easy implementation by owners and WP6 team administrators, and also, if so decided in the future, by users. The database will be directly accessible via the CONCERT website.