



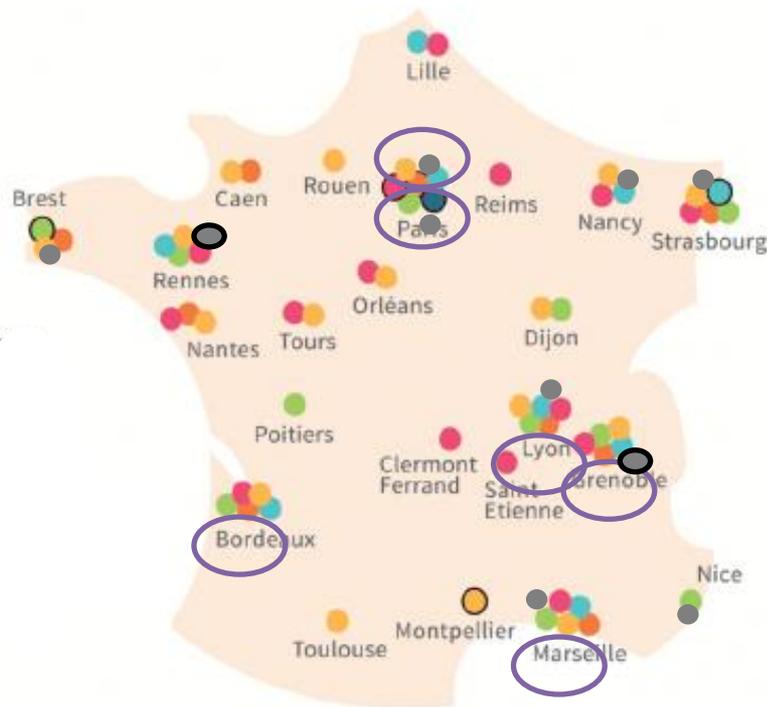
France Life Imaging

MID-TERM Evaluation
June 2016

I. FRANCE LIFE IMAGING NETWORK (1/3)



Launched in 2012, FLI includes 25 imaging facilities linked to ~ 100 research laboratories and units well- known in in vivo imaging



- Laboratories involved in molecular imaging agents
- Laboratories involved in instrumentation and innovative technologies
- Laboratories involved in interventional imaging
- Laboratories involved in image processing
- Laboratories involved in training actions
- National management
- Imaging facilities
- IAM : information analysis and management



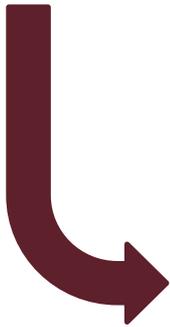
Assigned Objectives

- ✓ To propose a harmonized network including the set-up of a unique national access through a web portal (to guarantee robustness, reproducibility, and high scientific value added of service activities, progressive set up of a business plan)
- ✓ To offer an optimized training for students in imaging and to coordinate training courses for continued education
- ✓ To develop networking approaches in 4 core scientific activities to face the technical challenges in imaging more efficiently
- ✓ To make strategic and complementary investments to improve the national offer in all imaging modalities. A total of 26M€ will be invested to acquire new imaging systems (+15% of the existing FLI installed based) or upgrades (5% of the existing FLI installed based is concerned)
- ✓ To implement solutions for information analysis and data management



37, 000 k€ granted

- 26,762 k€ given for 2012-2015
- **24,937 k€ spent**



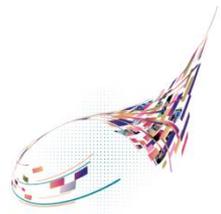
- Acquisition of 49 pieces of heavy state-of-the art equipment on the 52 planned,
- Recruitment of 117 person.month for the management at both national and regional levels (
- Recruitment of 358 person.month for data analysis and processing solutions (458 person.month planned)
- 18 networking events to build a strong community committed in in-vivo imaging in France
- 10 new trainings and the training of 1160 professionals
- Award of 35 starting grants to 40 laboratories to foster collaborations and exchanges of know-hows to boost the French competitiveness
- Five projects submitted to H2020 European calls since 2014 and the current set-up and support to 3 proposals to the 2017 H2020 *Innovative Training Network* call.



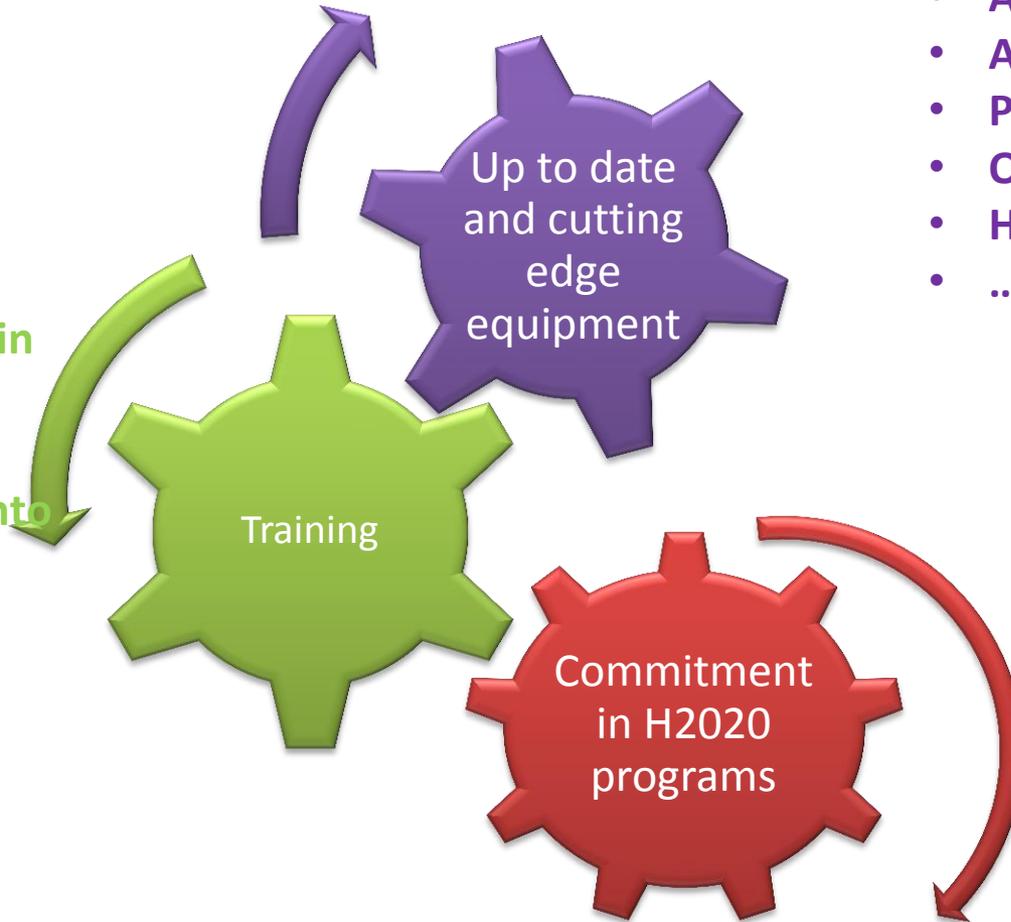
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Involvement in European Research

II. INVOLVEMENT IN H2020 programs (1/2)



Training the professional in the spirit of reinforcing integration into European landscape



49 pieces of equipment:

- A spectral CT
- A PET – ultrafast US
- PET-MR
- Optoacoustic US
- HiFU,
- ...

- 7 submissions to european H2020 calls since 2014
- Preparation of 3 submissions to ITN calls
- Involvement in EMIDS (European Molecular Imaging Doctoral School) with the enrolment of 3 students

II. H2020 CALLS : 7 submissions (2/2)



Funded (6.4 M€) **Spectral CT Scanner – SPCCT (UCB Lyon 1 leading the project)**

Creatis

Erasmus

ENS DE LYON



WP starting grants

- ✓ ERC Consolidator 2015 – CRMBM Marseille - NeuroSpin Paris Sud
- ✓ FET Open 2015 – CRMBM – NeuroSpin – Institut Fresnel
- ✓ FET open 2016 – CRMBM – NeuroSpin – **Institut Fresnel (leader)**

via IAM node - travel & consulting costs

- ✓ EINFRA-2015-1 Participation to the HIRAM grant application
- ✓ EINFRA-22-2016 ‘User-driven e-infrastructure innovation’ (**leading the submission**)

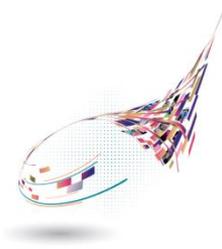
via WP4, and FLI preclinical platforms

- ✓ INFRAIA-02-2017 ERAMMIT Starting community on Molecular Imaging Technologies (**leading the virtual software WP, and the french preclinical platforms offer**)

Strengthening of H2020 projects implementation:

- ✓ via WP Training - travel & consulting costs : 3 ITN-2017 (leaders CEA / Paris VII /Paris V)

Step-out from EuroBioimaging in 2014



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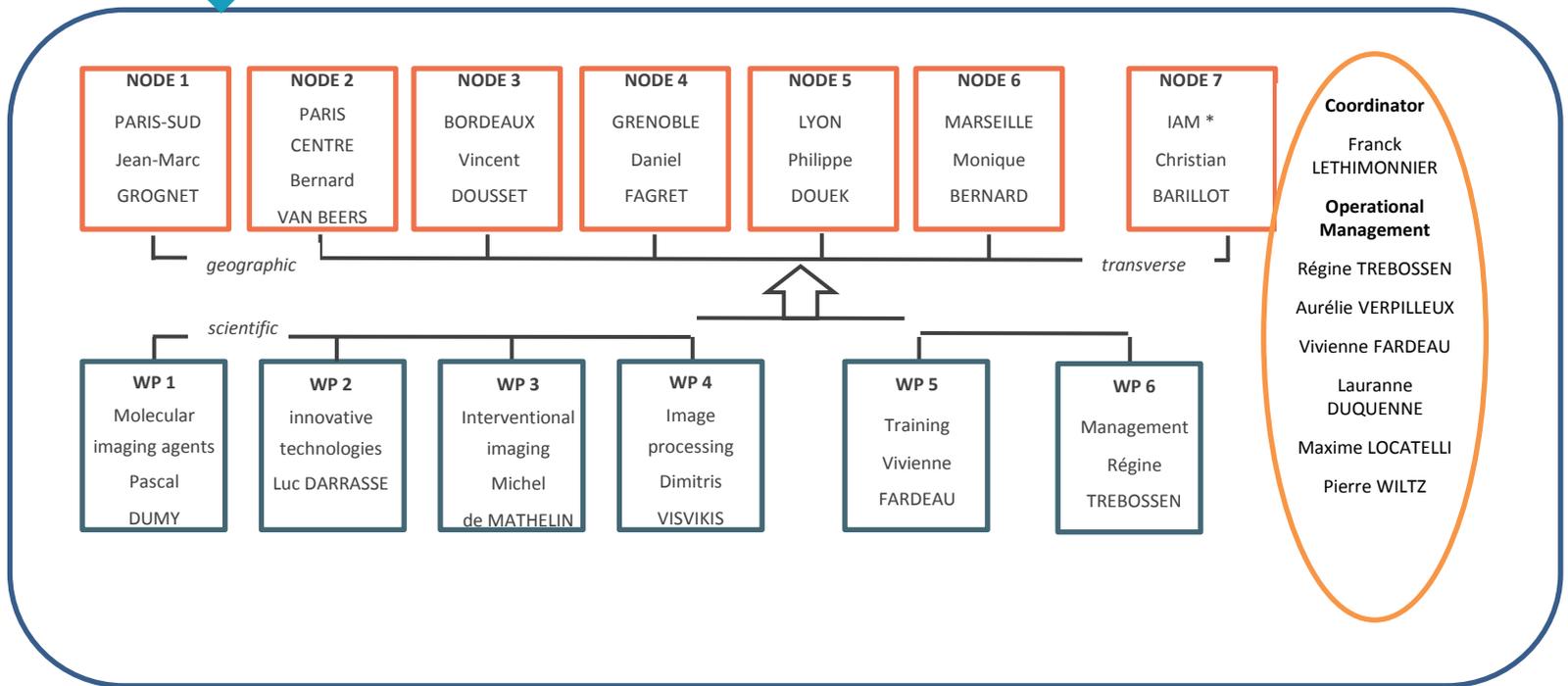
A strong governance

III. A STRONG GOVERNANCE (1/ 5)

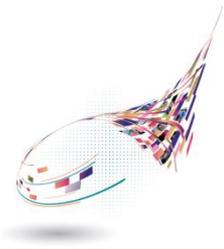


Scientific Advisory Board
 R. Frackowiak, Lausanne, Switzerland
 S. Aime, Turino, Italy
 S. Gambhir, Stanford, USA
 J. Mazziotta, Los Angeles, USA
 O. Speck, Magdeburg, Germany
 D. Townsend, Singapore

25 imaging platforms linked with ~ 100 research laboratories distributed over the France territory and bound by a consortium agreement since March 2014.



III. 1. SERVICE OFFERING



- An easy access through a unique web portal :
 - <https://www.francelifeimaging.fr/en/service-offer/presentation/>
 - Online form to submit requests of services or collaborations
 - A synthetic description of the service offering (French and English versions)
- A detailed service offering booklet mapping of the expertise and equipment in French
- Harmonized operating accounts
- Harmonized quality management across centers



The imaging platforms share the same following quality policy

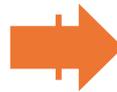
- To offer reliable and advanced systems with a large panel of imaging modalities and expertise in the national context of FLI
- To carry out projects on the devices under the supervision of an identified and trained staff, committed in a scientific and technological continuing watch
- To carry out the project in accordance with the good laboratory practices
- To contribute to activities and animation of the infrastructure by organizing training and scientific events
- To provide a main access point for collaborations and services via the website of the infrastructure: www.francelifeimaging.fr.

For the platforms wishing for high quality standards, FLI offered to support ISO 9001 and NFX50-900 certifications (CRMBM, Marseille and Institut de Myologie, Paris)



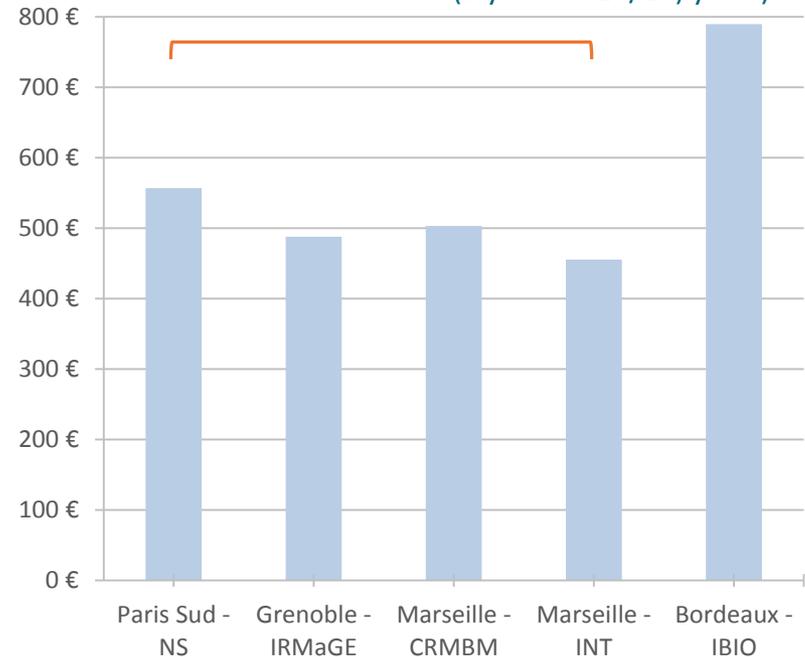
A three-stage method:

1. A common methodology for Operating Account (OA) has been agreed by the platforms
2. The platforms implemented OA, allowing the calculation of the full cost for each modality or activity
3. Pricing practices were discussed and harmonized for type and nature of possible collaboration



Differences between facilities -
impact of the depreciation time
differences on the cost

- * Higher MRI system price
- * Shorter Depreciation period (5 years vs 10/15 years)



III. 1. SERVICE OFFERING :

Expertise in Oncology, Neurology, and Neurosciences, and cardio-metabolism



ONCOLOGY

- Therapeutic ultrasound
- Tumor targeting
- Tumor characterisation
- Image guided surgery

CARDIO-METABOLISM

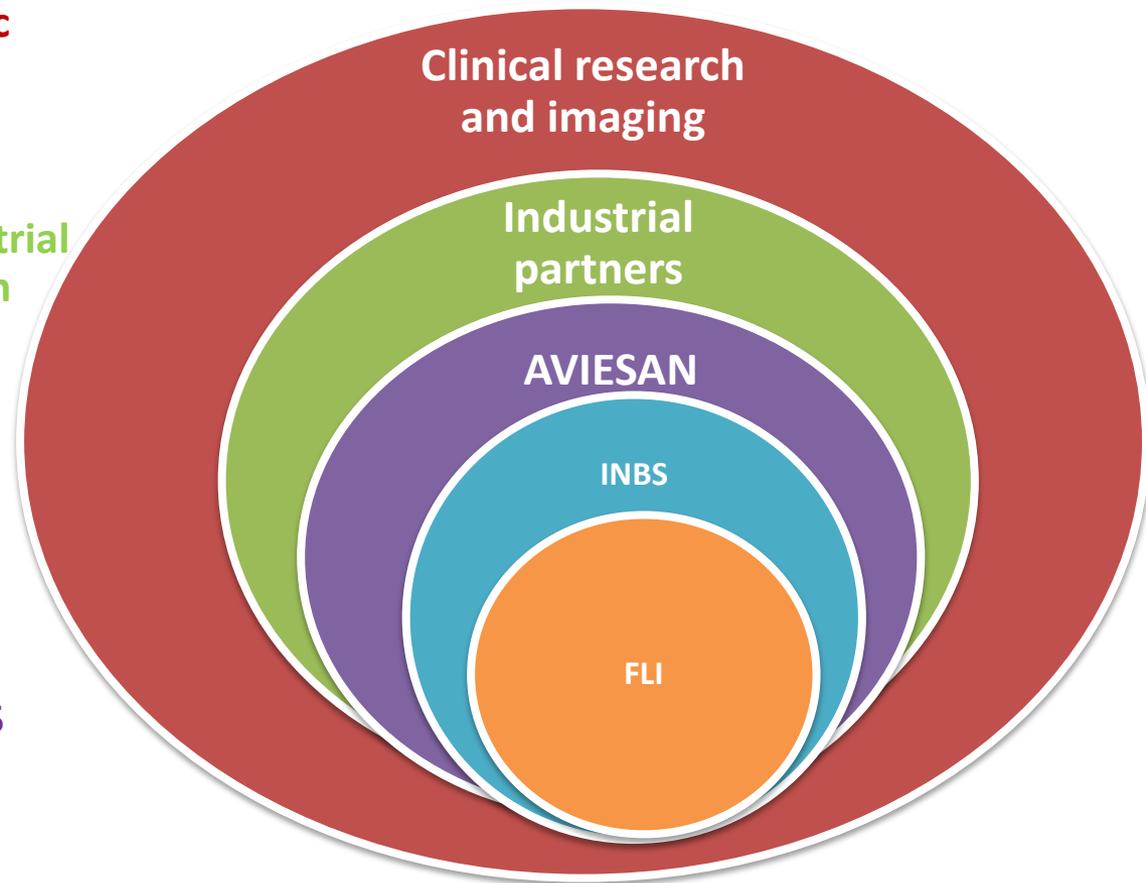
- Cardiovascular disorders
- Cardioprotection
- Rythmology
- Atherosclerosis
- Metabolism

NEUROSCIENCES

- Neurodegenerative disorders
- Cognitive neurosciences
- Stroke
- Neurosurgery
- Neuro-oncology



- **Bring the communities of academic research, radiologists and nuclear physicians closer**
 - FORCeimaging
- **Networking actions with the industrial partners: a close collaboration with MEDICEN competitiveness cluster:**
 - Imaging and therapeutic Ultrasounds community structuration
 - Optical imaging
- **3 industrial partnerships (Sanofi, Bruker, Philips)**
- **Great coherence with the ITMO TS from the Life Science and Health Alliance - Aviesan**
- **Joint actions with other INBS**
 - FBI – IFB
 - IDMIT





FLI contribution

- Context of the creation of FORCEimaging
 - ✓ Medical imaging takes more and more part in clinical research
 - ✓ Data management and analysis is critical
 - ✓ The quality of the acquired data may not be as high as expected for clinical research partly due to insufficient human resources at hospitals



France Life Imaging

FORCE Imaging

Launch of an action to harmonize MRI data acquisition (anatomical and diffusion) in clinical research centers and in hospitals involved in multicentric cerebral imaging



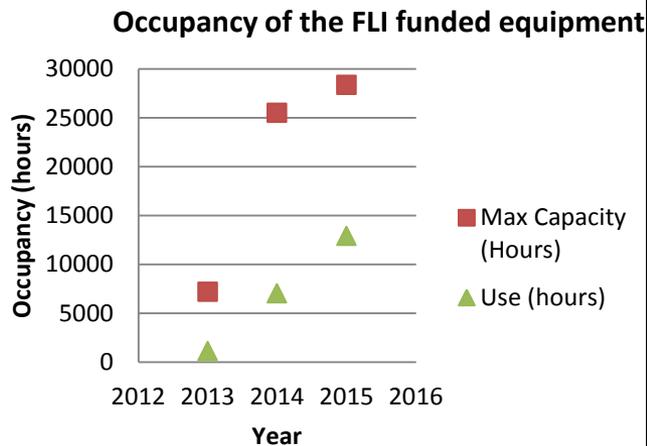
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Impact on the French in-vivo landscape

VI. Impact on the French in vivo imaging landscape



Equipment Investment and update (~30 % of the total)

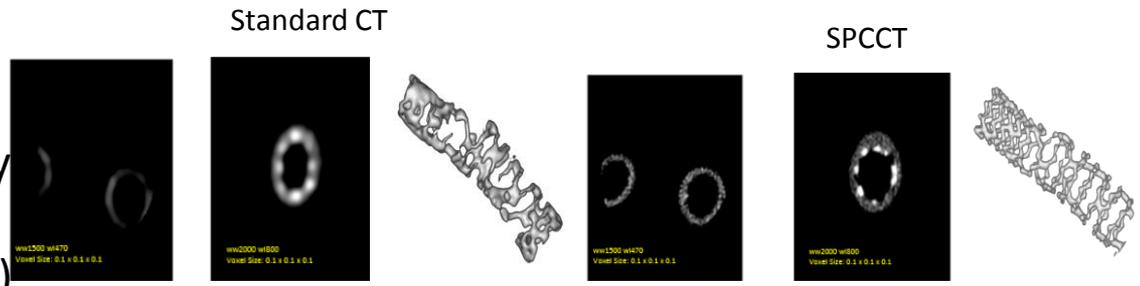


Clinical MR- PET

Spectral CT

PET-Ultrafast ultrasounds

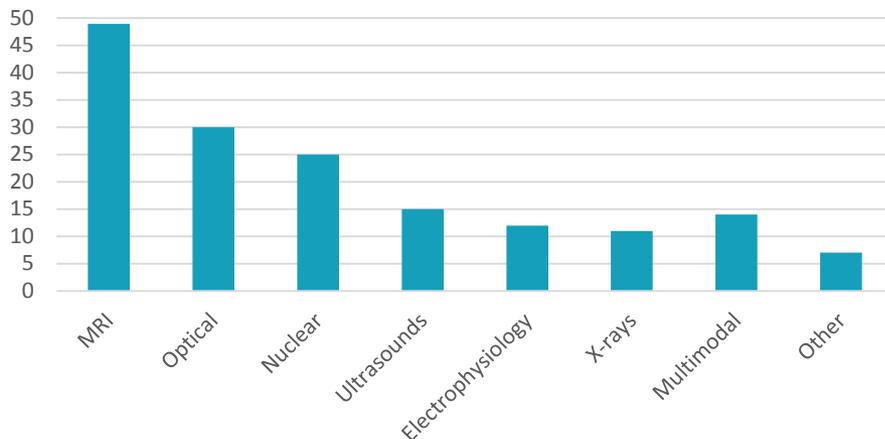
Launch of a medico economic study of MR-PET vs PET-CT scans for lung cancer supported by Direction of Health Organisation (DGOS)



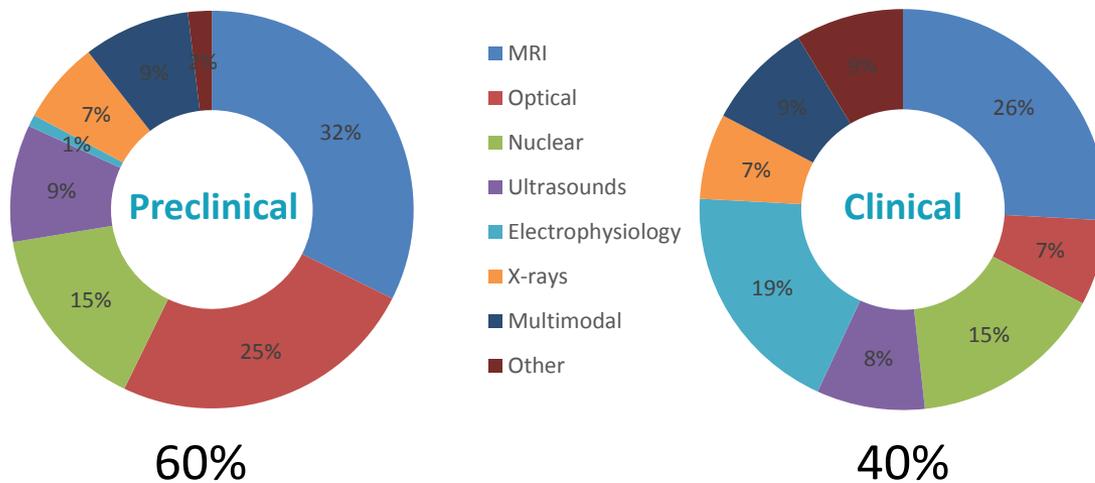
IV. An equipment spanning a wide range of imaging modalities



Available equipment



Preclinical and clinical imaging equipment

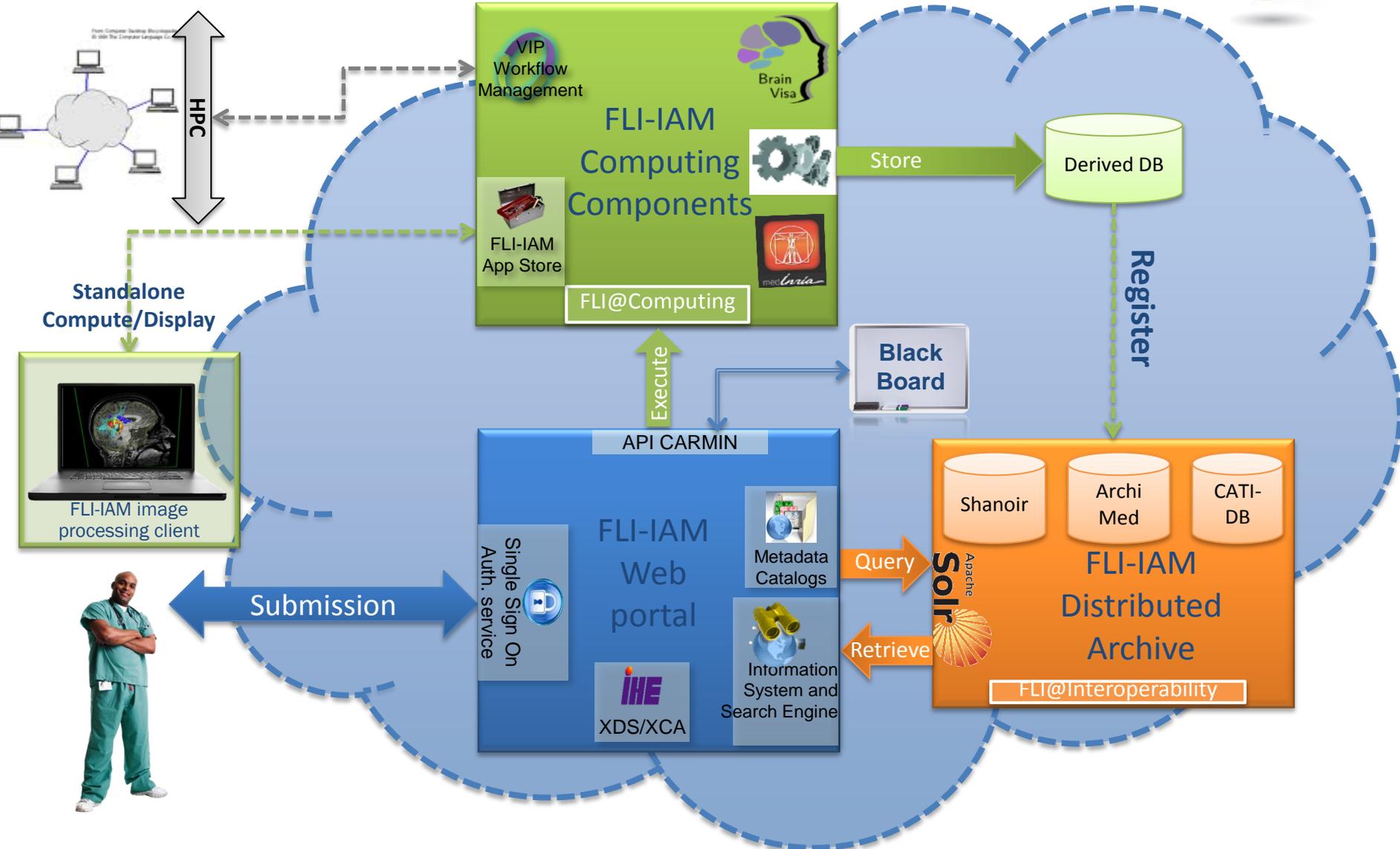




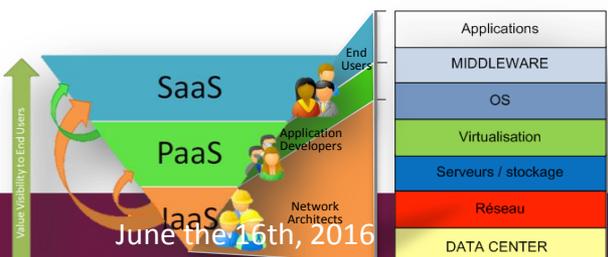
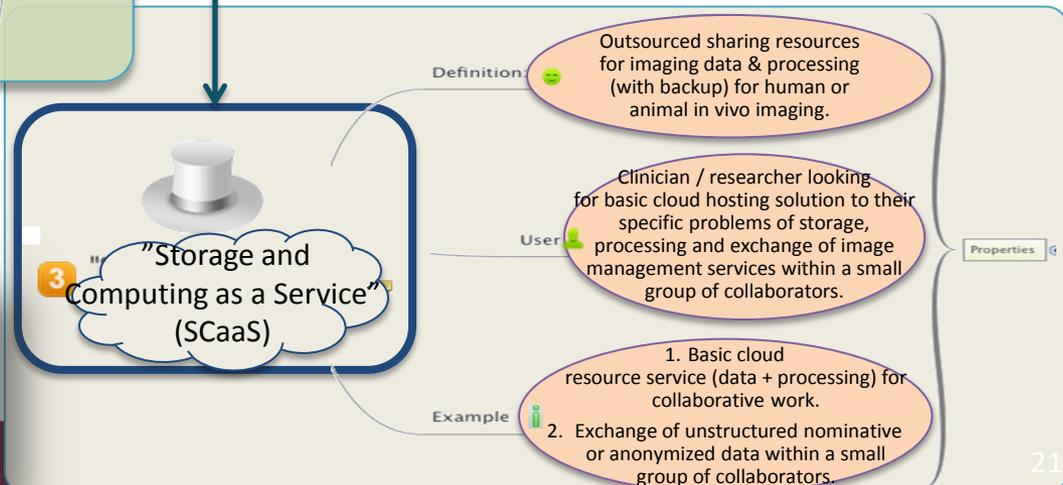
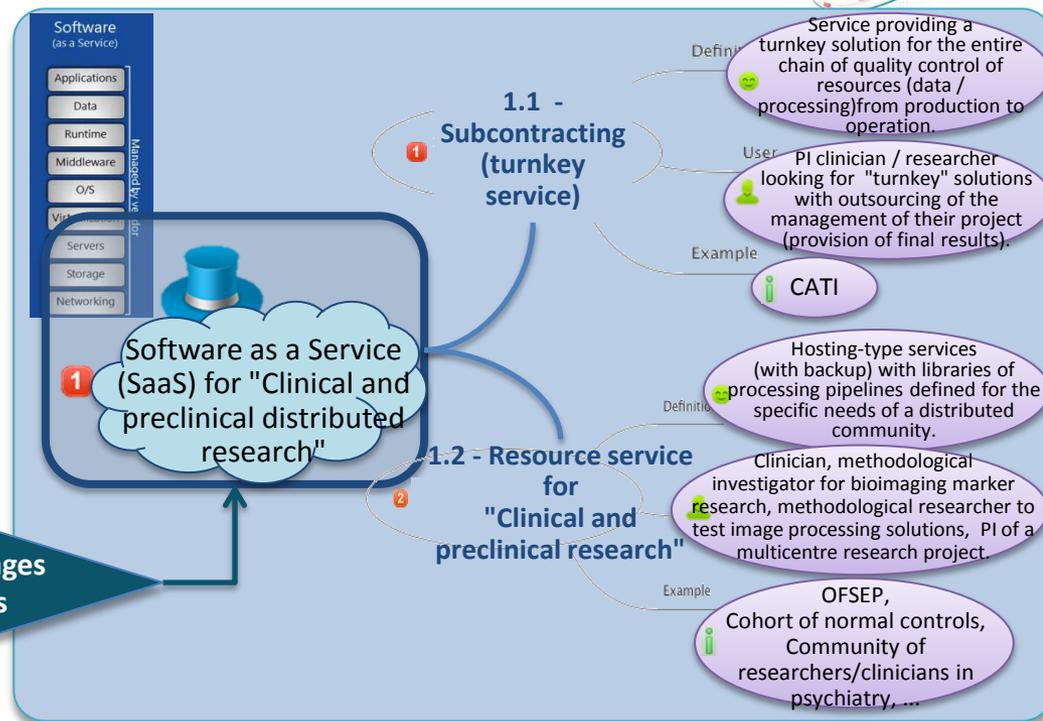
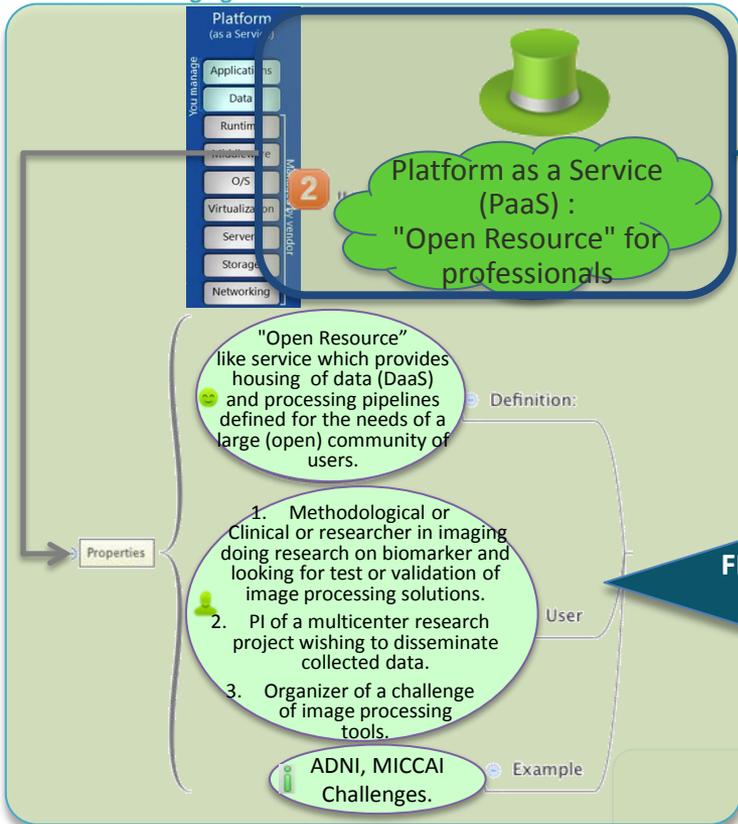
FLI-IAM : a two-Stages process

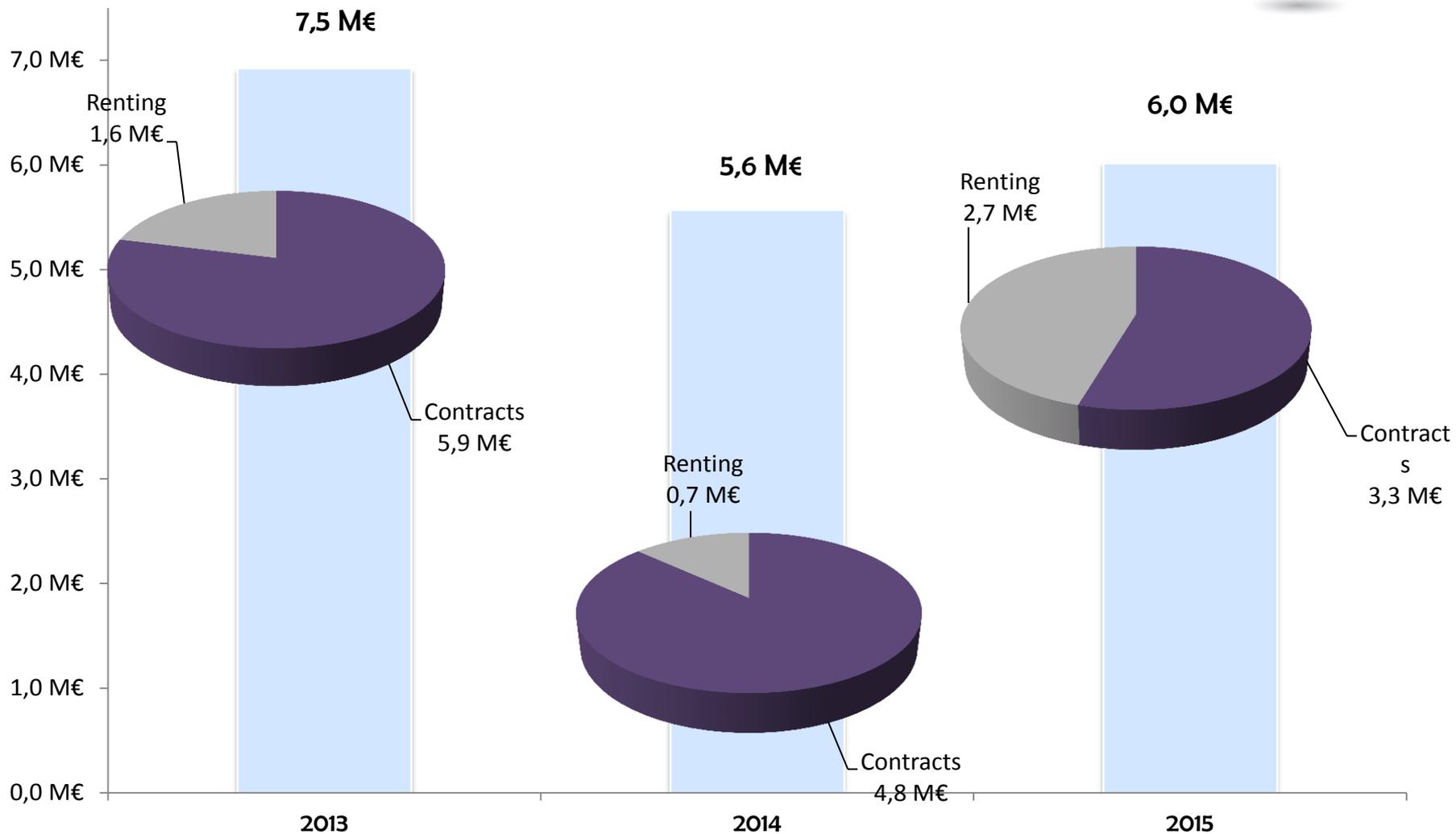
- **Initial stage (2013-2017):**
 - Set up of the infrastructure including specification of the needs of the various categories of users, the definition of the roadmap for the development and operation of the infrastructure
 - Pilot phase on a limited number of in vivo imaging application domains for clinical and preclinical research
 - Set up of the service offer
 - Challenge MICCAI 2016
- **Operational stage (2017 and onward):**
 - Open call to select public/private management and exploitation providers of the developed infrastructure (including SME)
 - Extend the infrastructure to broaden the range of clinical and preclinical research application domains
 - Extend the range of software integration by providing open interoperability standards with conformance statements

IV. IAM COMPUTATIONAL ARCHITECTURE



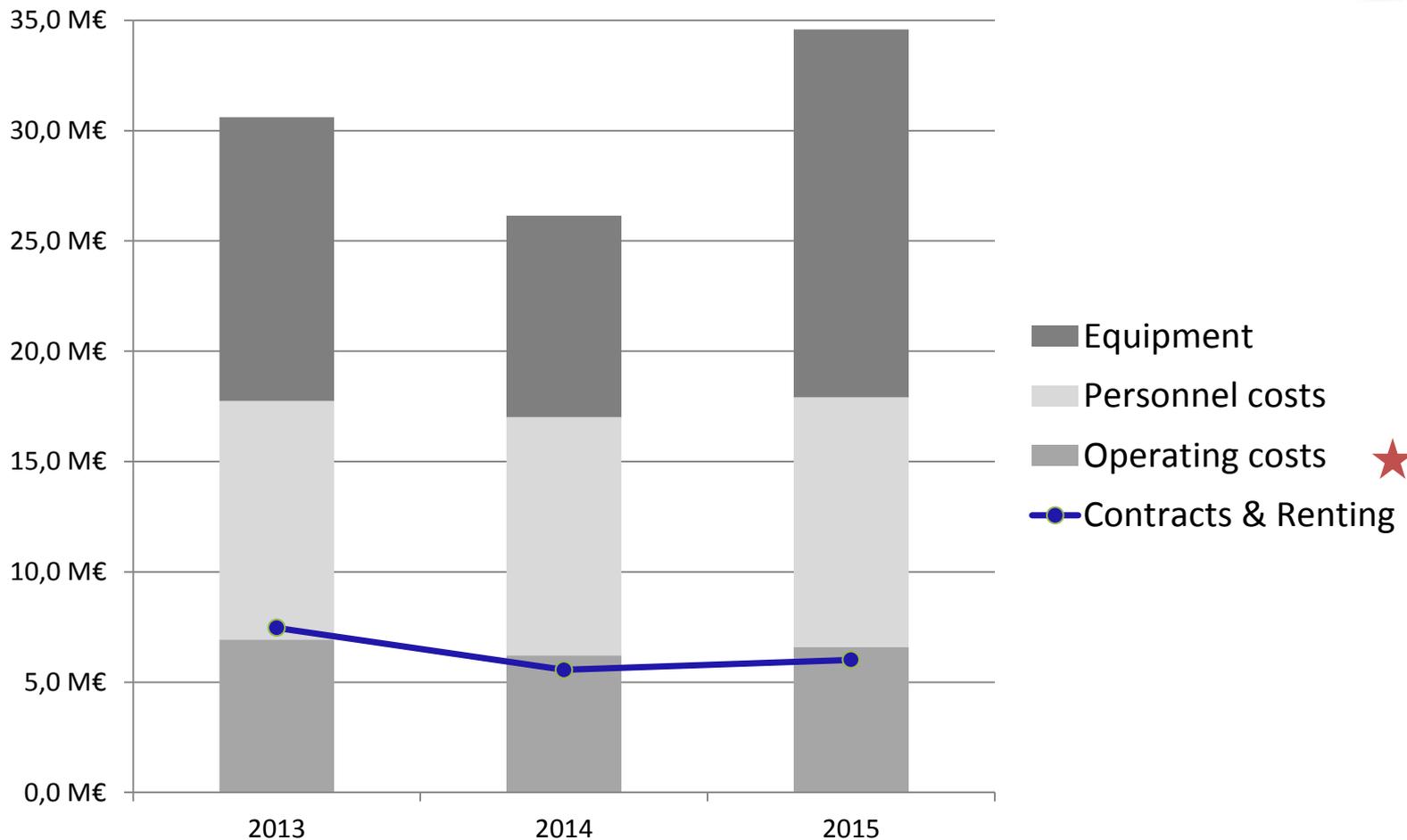
IV. FLI-IAM USAGES SCENARIOS





The income does not include industrial in-kind contribution (on-site industrial staff)

IV. PLATFORMS - EXTERNAL PROJECT INCOME and EXPENSES



★ The platforms recruited 5 persons for operating the imaging systems, and 1 for administrative and financial monitoring of FLI

IV. Projects and partnerships



Many industrial partnerships hosted within the FLI facilities

The following logos are displayed around the map of France:

- GE Healthcare
- AMGEN
- PHILIPS
- Lundbeck
- BRACCO
- Neurolix
- SANOFI
- ERYTECH Pharma
- mellitech
- VISUALSONICS FUJIFILM
- BIOMARIN
- Guerbet | Contrast for Life
- Physiogenex THE METABOLIC DISEASES EXPERTS
- VARIAN medical systems
- intrasense®
- gsk
- INTEGRAGEN Clinical Genomics Experts
- Axillum Robotics Vous assiste pour vos gestes techniques
- BIOSPACE LAB
- SIEMENS
- TRASIS
- LFB L'ENGAGEMENT ÉTHIQUE
- Biogen
- nano+ Value-Added Nanotechnology
- MERCK
- Janssen
- fluoptics Fluorescence imaging for surgery
- BRUKER
- Advanced Accelerator Applications
- Avid Radiopharmaceuticals A wholly owned subsidiary of IDL and Company
- Image Guided Therapy
- NOVARTIS
- medDay PHARMACEUTICALS
- ImmuSmol
- noscira
- Roche
- Lilly
- aTyr Pharma
- Roche
- DANONE
- AstraZeneca
- L'ORÉAL
- SERVIER
- APOSENSE
- SeattleGenetics
- Iba



FLI has the objective of setting up ambitious partnerships with big pharmaceutical companies, and Healthcare product companies

- Agreement with the pharmaceutical company SANOFI : to access to the equipments and the expertise of the imaging platforms.
 - 2 on-going projects so far (i) an expertise in Parkinson's disease imaging and animal models; (ii) molecular imaging using MRI.
 - A Project based on ultrasound imaging under discussions.
- Bruker is a partner of FLI since the beginning of the project. Five small animal MRI scanners sold. Indirect support of methodological R&D on small animal MRI platforms by discounting the servicing
- Philips: partner of FLI for the development of new features of the spectral X-rays scanner especially for molecular imaging in humans through H2020 funded SPC CT project.



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Training professional and students

Research and development activities

Perspectives



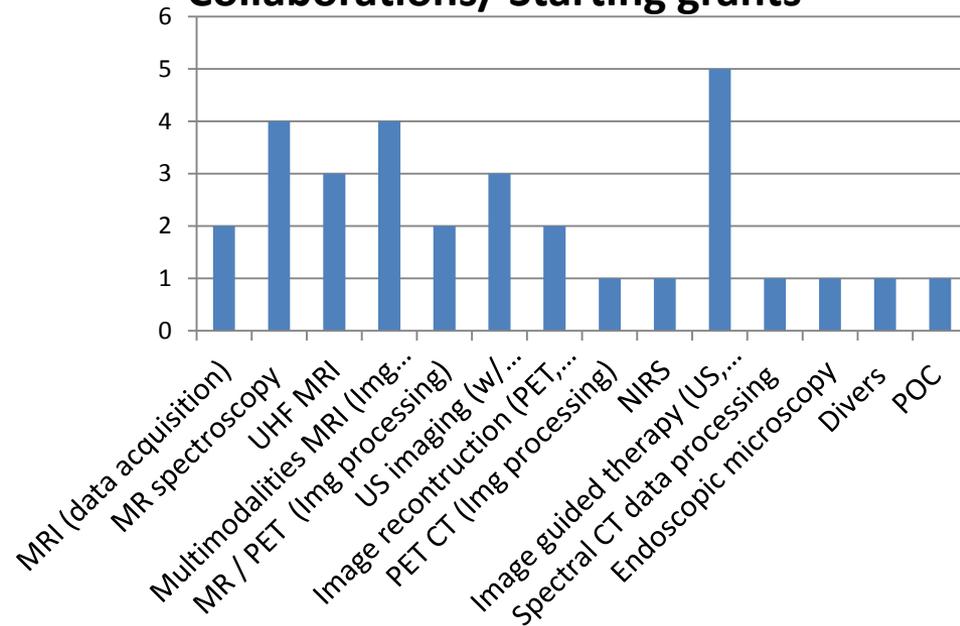
Since July 2012 FLI has contributed to the training of **more than 1 000** students and professionals , including

- ✓ the support of more than **10** training actions;
- ✓ the creation of **12 new trainings**, including **3** sessions for the industry;
- ✓ the attribution of more than **100** individual financial supports;
- ✓ the implementation of the **1st network of French young scientists –FINYS**;
- ✓ the **international** and **academic recognition** of the trainings
 - ECTS awarding and connection with the national and European **doctoral schools** (EMIDS)
 - upcoming submission of 3 **ITN** proposals coordinated by FLI



- Foster collaborations between laboratories with starting grants:
 - 35 exchanges between laboratories financially supported
- 3 projects submitted to H2020 calls :
 - ✓ ERC Consolidator 2015 – CRMBM Marseille - NeuroSpin Paris Sud
 - ✓ FET Open 2015 – CRMBM – NeuroSpin – institut Fresnel
 - ✓ FET Open 2016 – same partners
- At least 2 submissions to the French Research Agency :
 - Ex: Cerebral tumor resection guided by per-op US imaging and a modelling of tissue deformation

Collaborations/ Starting grants



- 9 thematic workshops (state of the art of contrast agents for brain, oncology, cardiometabolism and infectious and inflammatory diseases, Interventional imaging, MR-PET, Spectral CT scanner imaging,



- **2 thematic meetings:**
 - “Ultrasounds for diagnosis and therapeutic approaches”, November 2014 : overview of the expertise and the on going innovative development within the French laboratories, the needs of clinicians and the industrials developments.
 - “In Vivo optical Imaging” organized with the “pole de compétitivité Medicen”, September 2015 : overview of the wide range of applications of in-vivo optical imaging, the strong demand of biologists and clinicians for. An opportunity for 20 small enterprises and imaging platform to highlight their domain of excellence.
- **A national seminar**
 - A 3 days-symposium on in-vivo imaging organized with the 12 societies and organizations encompassing in-vivo imaging in France, February 2016. First one in France. 250 attendees.



- **Challenges :**
 - To enhance European visibility - application to H2020 calls
 - To conduct the validation of the technological innovations developed in the network and transfer them to clinical practice, an important step in the process of transfer to industrial partners
 - To provide to the largest clinical community , software for information management and analysis integrating the latest innovations, such as the integration of 'omic', biological imaging, and population imaging information
 - To emphasize collaborations with industrial partners, in the technological domain but also in the field of clinical expertise with ambitious partnerships



Thank you for your attention!

Any questions ?





- **Goals**

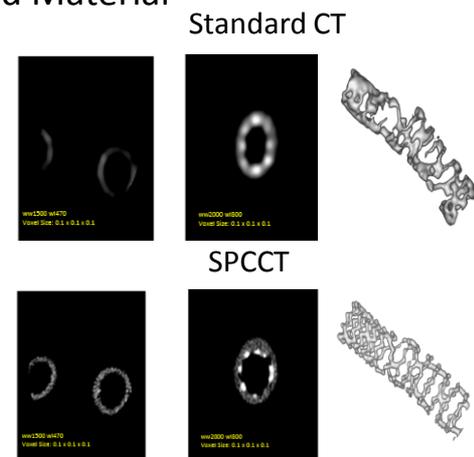
- Develop and validate a widely accessible, new quantitative and analytical imaging technology combining Clinical Spectral Photon Counting CT (SPCCT) and dedicated contrast agents to accurately detect, characterize and monitor neurovascular and cardiovascular disease.

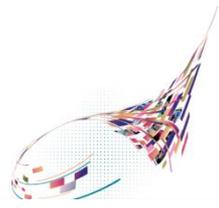
- **Clinical expectations:**

- Improved Spatial Resolution (Reduced Blooming Artifacts, Stents), improved Material Decomposition
- Contrast Specific Images (K-Edge images):
 - Quantitative perfusion
 - Targeted contrast agents

- **Activity**

- Up time 3.5 months
- Over 400 scans
- In-vitro: Anatomical parts and Phantoms
- In-vivo : rodent, rabbit sessions
- Multiple research partnerships and opening of the scanner to external projects





The IAM node consists in developing a versatile software platform made up of several sub-components, which allows inter-connection of hardware facilities and software platforms.

The software development is organized according to the three Working Groups:

- **WG-1 “Interoperability and data management”** aims to specify and implement image data management services allowing:
 - heterogeneous and distributed storage solutions.
 - implementing raw data, derived data and meta-data indexing (e.g. through the use of semantic models or ontologies).
 - supporting the execution of images processing services.
 - Implementation of these concepts onto three initial software platforms (Shanoir, Cati, Archimed) for demonstration and pilot study.
- **WG-2 “Image processing and workflow”** aims to specify and implement pipeline execution services in FLI allowing:
 - The upload, download, sharing and deletion of data files that are not in databases.
 - The invocation and monitoring of pipeline execution.
 - The selection of data from databases for processing –interaction with the data interoperability WG.
 - The download and installation of software packages.
 - The design and deployment of pipelines.
 - The services will be based on the following existing tools : medINRIA (med.inria.fr), BrainVisa (brainvisa.info) and the VIP platform (<http://www.creatis.insa-lyon.fr/vip>).
- **WG-3 “Preclinical imaging”** aims to specify and implement an infrastructure to store and manage preclinical in vivo imaging as well as provide services for image analysis:
 - It addresses the development of a web-oriented management system of preclinical brain imaging data through the extension of existing clinical imaging software architecture (CATI-PA, Shanoir-PA, MediBase).
 - It addresses the development of a catalog of software and processing systems dedicated to data processing of small animals imaging.
 - It aims to promote the use of cohorts in preclinical studies.



Initial Stage

Applications

Standalone apps
(e.g. MedInria, BrainVisa, ...)



FLI-IAM Web Portals
(e.g. ArchiMed, CATI-DB, Shanoir, VIP, ...)



Middleware



Metadata Catalogs



Information System and Search Engine

Workflow Management
(e.g. VIP)



Computing Elements
(eg. MedInria, BrainVisa)



User Interface



Auth. service



IHE
XDS/XCA



Storage
(e.g. ArchiMed, CATI-DB, Shanoir ...)

Resources

Disk/tape



Clusters



Servers

Operational Stage

Network

Public internet



Academic networks

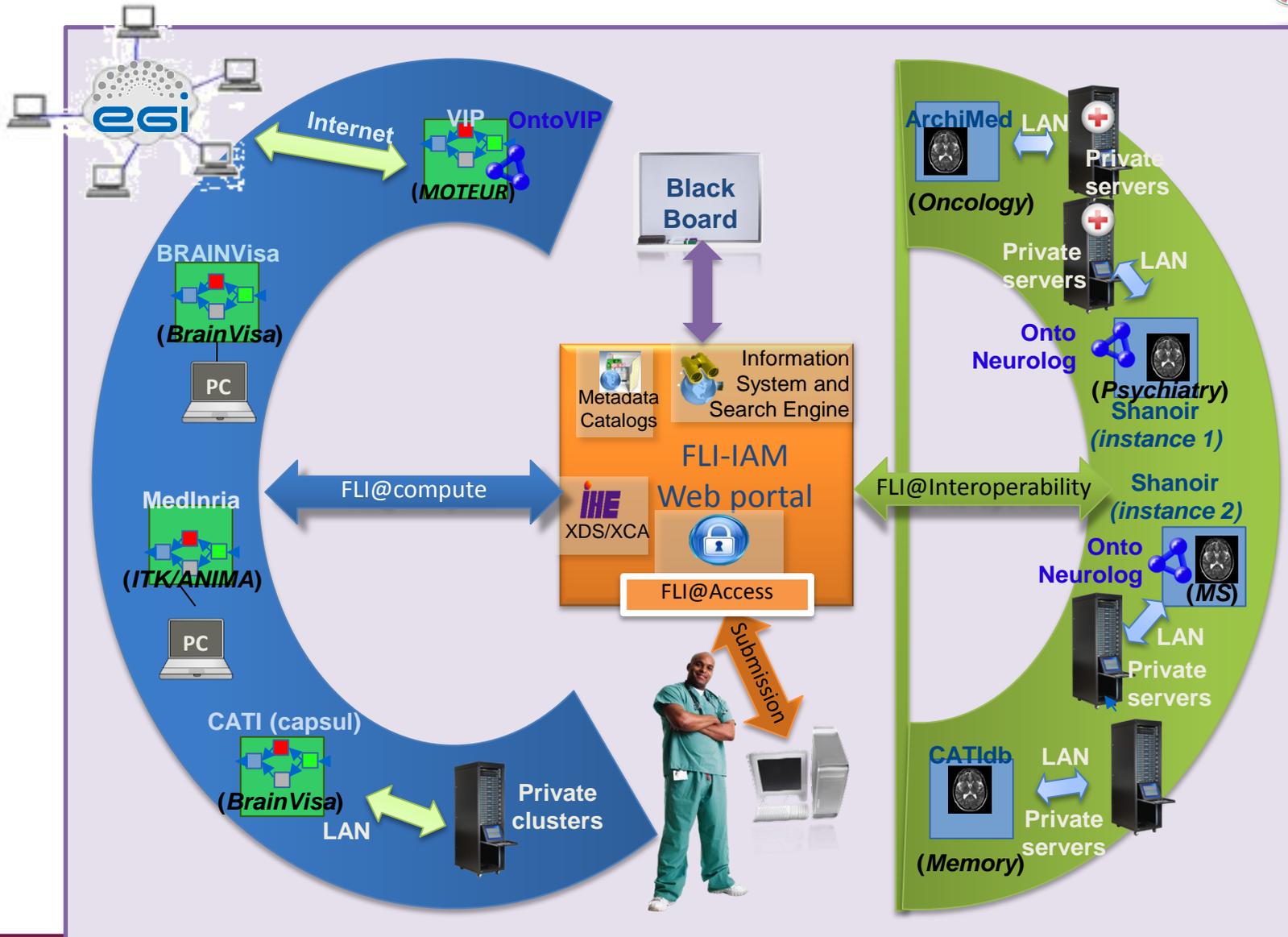


Dedicated links



FLI - IAM Computing/Data Architecture

France Life Imaging

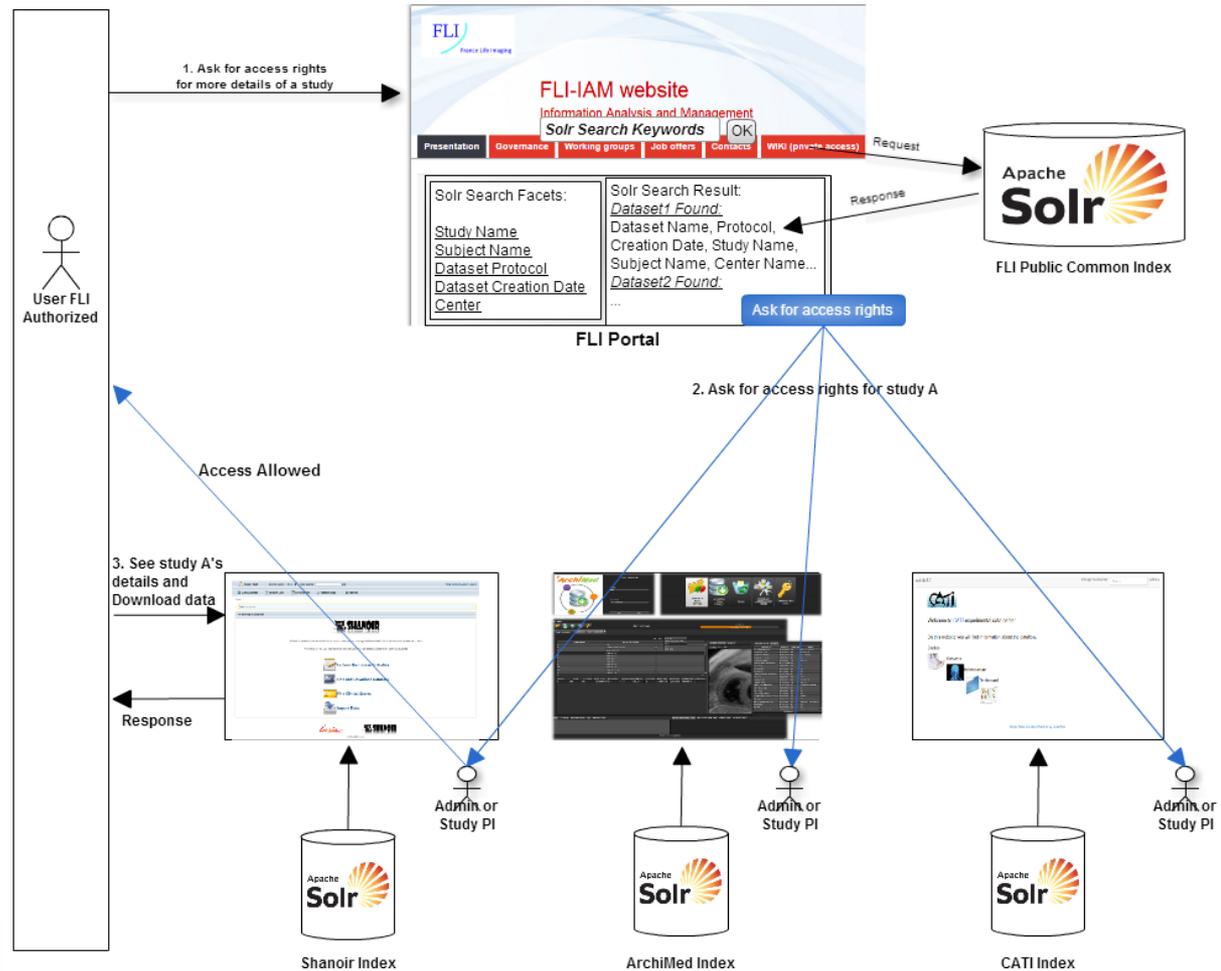


IAM Node: some recent achievements



- **WG-1 “Interoperability and data management”**

Common public meta-data catalogue and integration of them through Apache Solr



IAM Node: some recent achievements



- **WG-2 “Image processing and workflow”**
 - **CARMIN*** is an API for pipeline execution on the web that will allow a greater integration between image data repositories and image processing workflows for both Push and Pull data streams

processes_in_platform	
Return a list of all process available in this platform.	
required role	study manager
→ processes	List of process_id. A process_id is an identifier that is unique among all process identifiers of this platform.

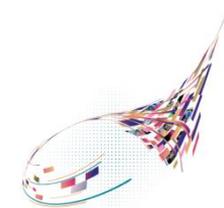
create_user_account	
Create a new user account in the platform.	
required role	platform manager
→ user_id	Login of the new user. No other user can have that user_id on the platform.
→ roles	Initial roles granted to the user.
→ first_name	User first name
→ last_name	User last name
→ email	User email

create_study	
Create a new study.	
required role	platform manager
→ study_id	Name that identify the study. No other study can have that id on the platform. The study_id is reserved for a usage through this API and can have platform specific restriction (e.g. being a valid Python variable name for CATI).
→ name	Name of the study. A free text that will be presented to platform users.
→ manager	The user_id of the user who will be granted the role of manager for this study.
→ description	Free text to describe the study.

set_role_in_study	
Set roles given to a user for a study.	
required role	study manager
→ study_id	Identifier of the study.
→ user_id	Identifier of the user.
→ role	"user", "contributor" OR "manager"

* Common API for Research Medical Imaging Network

T. Glatard et al. « CARMIN: a common web API for remote pipeline execution » *Neuroinformatics 2015*, Frontiers in Neuroinformatics.



- **WG-3 “Preclinical imaging”**

- **Dicomifier:** conversion of Brucker MRI data to Dicom
- **Shanoir-SA:** Extension of Small Animal Imaging to Shanoir system

Administrator: admin Home Online users: [admin]

Stop import process

Home » Choose modality » Select DICOM archive » Series selection » Set the context » Edit Animal Subject

Edit Animal Subject

General

Imaged object category: Animal

Animal Specie: * Rat

Animal Strain: * Wistar

Animal Type: * Please select...

Provider: * Simon

Stabulation Location: * STRASBOURG

Common name: * SEPEMOBC188579

Administrator: admin Home Online users: [admin]

Stop import process

Home » Choose modality » Select DICOM archive » Series selection » Set the context

Successfully created

The subject TESTSIMON has been created.

Research Study

Select an existing research study: Multiple sclerosis - lesion segmentation details

Select an existing study card: MS Study study card (Philips Medical Systems - Achieva 3.0T (MR) 38235 - CHU Pontchaillou) edit details

Nifti converter: dcm2nii_2014-08-04

Single subject: Experimental group of subjects

Select a subject already in the research study Create a new subject

Created subject: Rat 4 TESTSIMON

Please fill the details on the subject: Common name Subject Identifier for this research study Is physically involved

TESTSIMON

MR Examination

Select an existing MR Examination Create a new MR Examination

Research study: * Multiple sclerosis - lesion segmentation details

Subject: * Rat 4 TESTSIMON details

Center: * CHU Pontchaillou details

External examination executive:

Examination executive: * Please select... Create a new investigator...

Examination date: * 2013/09/20 00:00

Comment: * PROTOCOLES*SEP EMOTIONS

Subject weight: 63.0 g

Upload monitored physiological data files: Respiratory Rate Heart Rate SaO2 Temperature

Upload monitored blood gas data files: Add

Metadata from Dicom files	
Tag	Value
Institution Name	IPB
Performing Physician's Name	PB

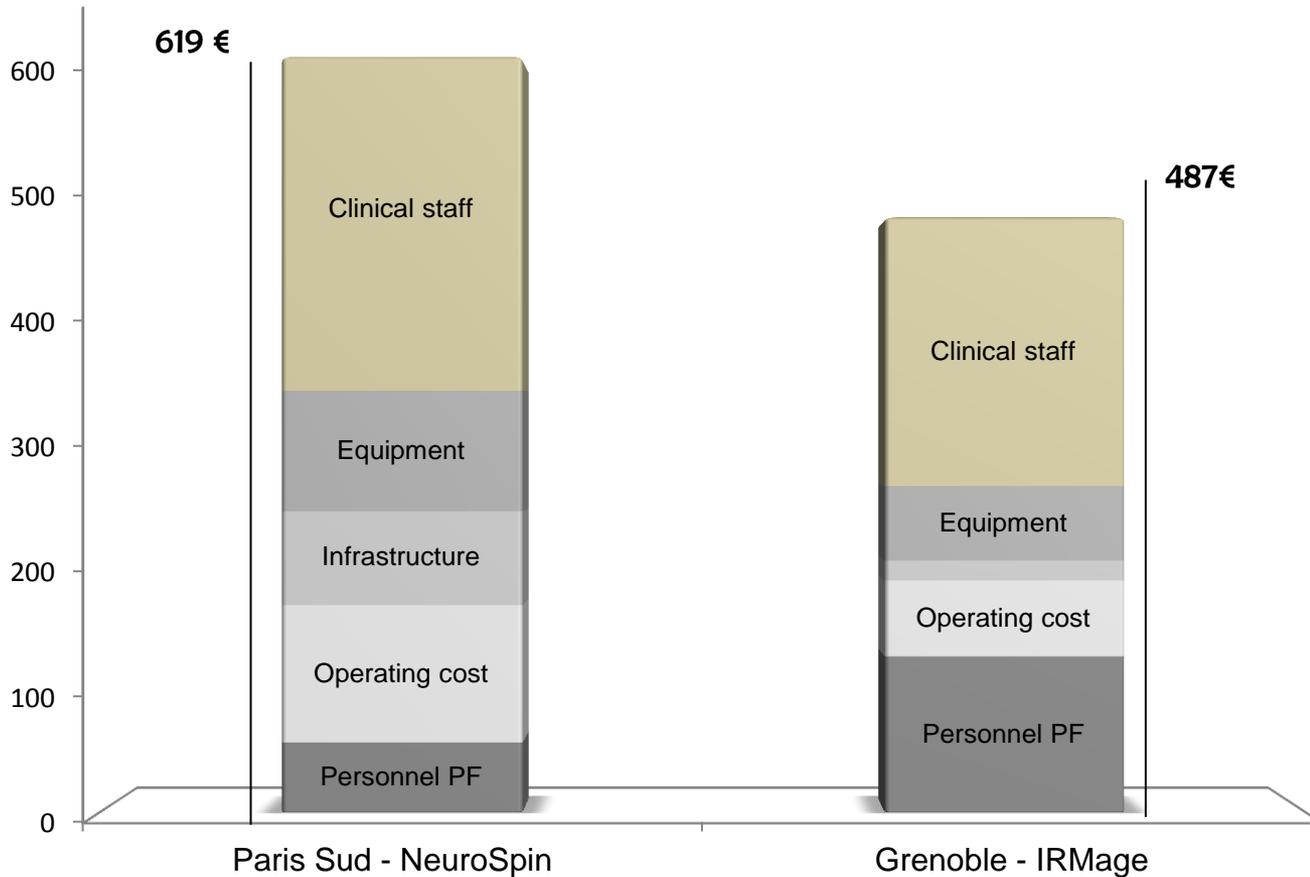
Anesthetic Name: * Gas - Isofl.52.0 % - Xylam.54.0 % Create a new anesthetic...

Dose: 89.0 ml



- **COFIL FLI-IAM: 1 meeting per month**
- **3 Working Groups (WG): 1 meeting per month, plus joint WG meetings**
- **Active Web site : Recent Events: <https://project.inria.fr/fli/events/>**
- **Development Team**
 - Recruitment: 12 Engineers to date in 9 different sites (*2 more to come*)
 - Hack fests for development team: 1 week twice a year
 - W43-2014: WG1 - V1 of common catalog definition; WG2 - FLIWS development for use cases; WG3 - technical specification of DICOMifier and demo for SFRMBM 2015
 - W17-2014: WG1 - common catalog demo (V1&V2); WG2 - FLIWS ready for GA, data-synchronizer VIP; task force data-flow ; WG3 - portal specification & NIFTI conversion
 - Scrum:
 - Daily Scrum established with all developers from 15:45-16:00
 - Usage of Gantt-Project for planning and progress
 - Demos : JFR 2014, SFRMBM 2014, JFR 2015
 - Hardware Infrastructure: VMs and Shanoir-SA Server in Grenoble
- **Task Forces**
 - **H2020-EINFRA-2015-1**: Participation to the HIRAM grant application (*not financed by EU*)
 - **API CARMIN**: Interoperability between computing and storage resources (INCF Abstract)
 - **FLI-IAM Portal** : Specification of FLI-IAM web portal
 - **Single Sign On (SSO)** : Specification of secure web access to FLI-IAM (Apache shibboleth2 Renater / Local Platform Authenticate-Methods)
 - **Data Flow** : Specification/ Modeling of how data navigate within the infrastructure
 - **MICCAI Challenge** : go/nogo recommendation, workshop organization

WG Operating Account : calcul of the full cost for 1h 3T MRI

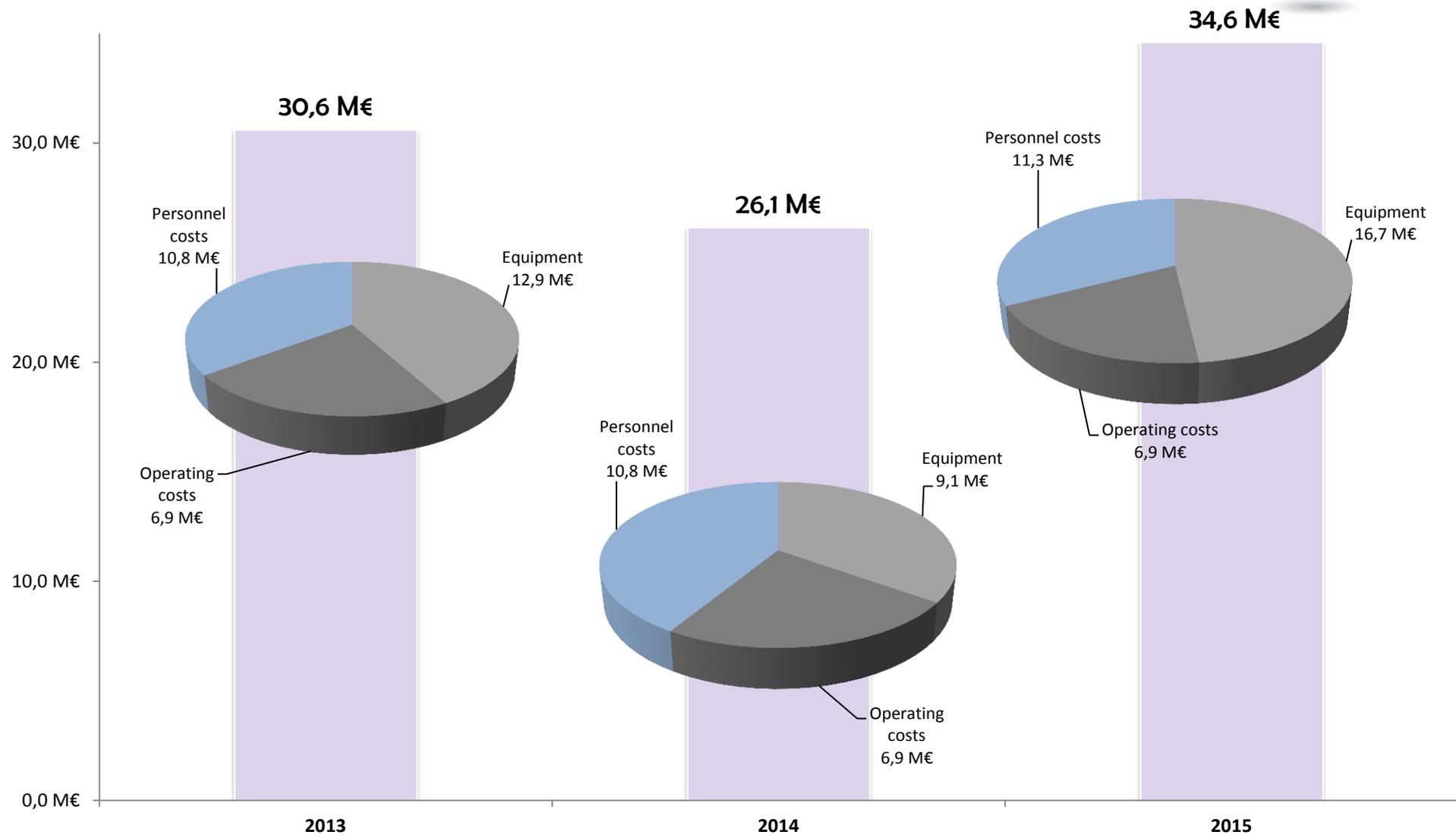


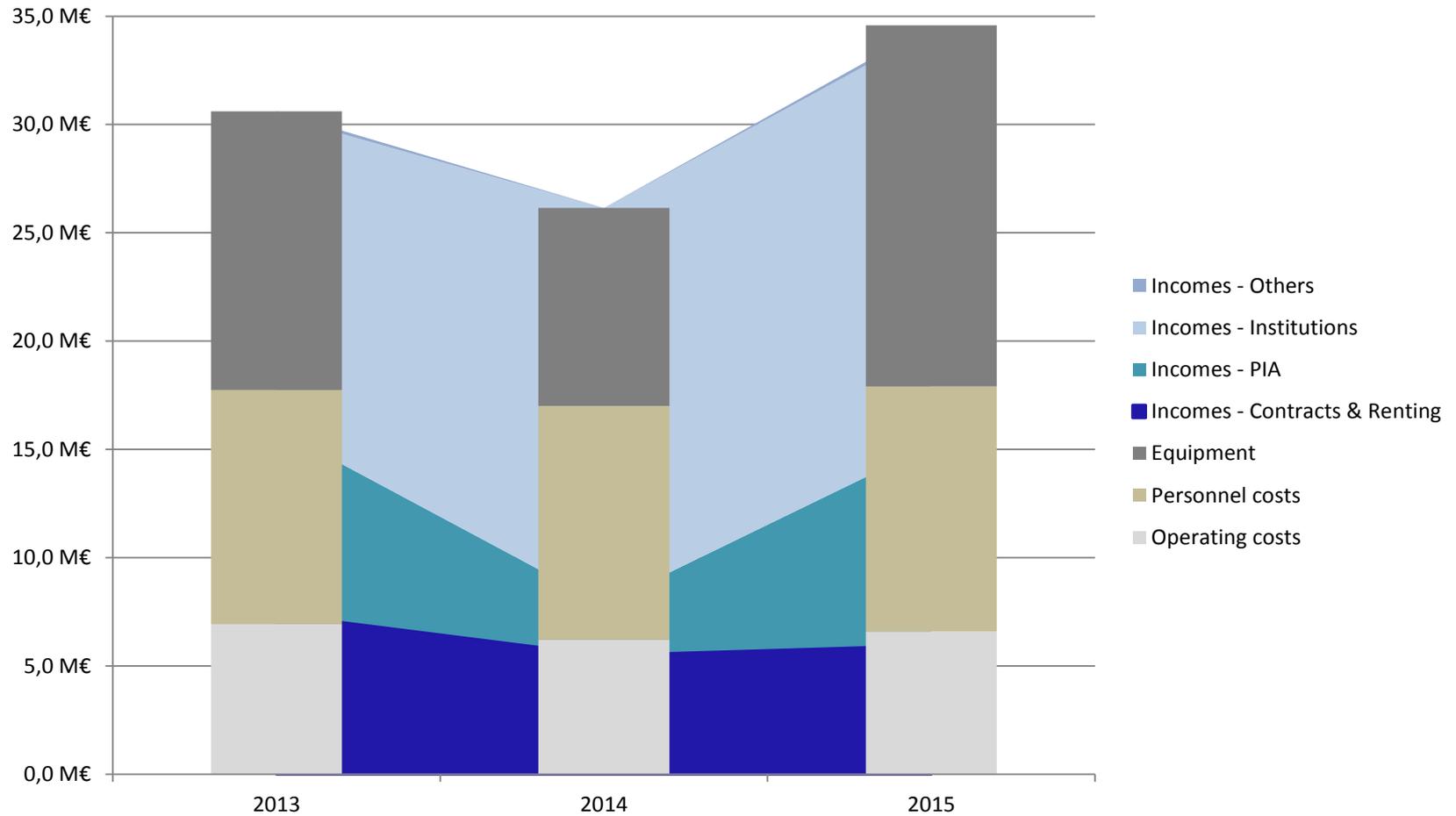
Cost breakdown by item of expenses

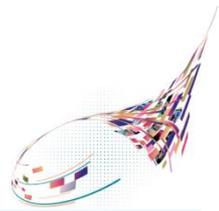
Same method (except for depreciation time) ...

...but cost supported by the PF different

Platforms - Total PF Expenses /year







Objectives

- Ensure a **high level** education in the field of imaging for **students** and **professionals** in both preclinical and clinical fields within, and beyond the FLI consortium
- Reinforce **exchanges** between the members of the French Imaging community
- Ensure the **sustainability, professionalism** and **recognition** of the FLI trainings in **Europe**

Strategy

1. **Management** and **promotion** of the training actions
2. Improvement of **students'** training and **professional integration**
3. Coordination, support and update of the **continuing professional development** (CPD) actions for core-facilities' staff, users and community
4. Embedding of the FLI training actions in the scope of related **European educational programmes**
5. Contribution to an **effective communication** among the partners, the scientific community

III. 3. SERVICE OFFERING :

Leaders and expertise



Neurology and neurosciences

- Neurodegenerative disorders
- Cognitive neurosciences
- Stroke
- Neurosurgery
- Neuro-oncology

CIREN – Sainte Anne Hospital and CENIR, Paris
IMNC – Paris-Saclay University, Orsay
MIRCent – CEA, Fontenay-aux-Roses
NeuroSpin – CEA, Saclay
IMN, GIN –Grenoble - Alpes Univ.

INCIA - GIN - U Inserm U1049, Neurocentre
Magendie, Bordeaux Uni.
Visage -- Rennes
CRNL, team BIORAN and CMO, Fondation
Neurodis, SBRI – Lyon
INMED, INT, CMRBM U7339, Marseille

III. 3 SERVICE OFFERING :

Leaders and expertise



Cardiology and metabolism

- Cardiovascular disorders
- Cardioprotection
- Rythmology
- Atherosclerosis
- Metabolism

Centre de recherche radio thoracique
de Bordeaux

IHU Liryc, Bordeaux

LVTS, Inserm U1148 équipe

Cardiovascular imaging, Paris

PARCC, équipe Imaging of
microcirculation, Georges Pompidou
Hospital, Paris

IMB, UMR 5251, Bordeaux

CarmEn, Lyon

Créatis, Lyon