IP aspects in collaborations
CERN TT case studies

Jean-Marie Le Goff/CERN
IAEA/INPRO Dialog forum on International Collaborations on Innovation to Support Globally Sustainable Nuclear Energy Systems
IAEA, Vienna November 18-21, 2014
CERN
where the scientific knowledge and the technology
are transferred to industry and society

Research & Discovery

Technology & Innovation

Training

Collaboration
Content

- Context for collaboration
- Impact on industry
- Case studies at CERN
### R&D in the academia/industry context

#### Research: Open science

- **Publication of discoveries & R&D results**
  - Scientific recognition
  - Value in copyrights

- **R&D to meet scientific programme objectives**
  - Long-term
  - Best possible solution within budgetary constrains

- **R&D results: Technology**
  - IP rights to use internally

- **Highly collaborative**
  - Memorandum of Understanding (MoU)

- **Unclear IP situation**
  - Joint ownership of R&D results
  - Complex dissemination

- **Funding**
  - Public
  - Quality of research program

#### Industry: In/out sourcing technology

- **Protection of innovations & know-how**
  - Required to facilitate industrial dissemination
  - Value in IP rights (patents, etc.)

- **R&D to increase market share**
  - Short-term
  - Best cost-effective solution

- **R&D results: Products (prototypes)**
  - IP rights to manufacture

- **Highly competitive**
  - Licence and/or partnership agreement

- **Clear IP situation**
  - Clear ownership of R&D results
  - Dissemination based on manufacturing

- **Financing**
  - Private with public support (EU, National funds)
  - Product market potential
Procurement as a source of innovation & Technology

- Large fundamental research apparatus are not directly available from industry
- CERN’s purchasing requirements into 3 categories:
  - **Standard industrial products**
  - **New high-tech products requiring a conceptual design phase**
    - → **Innovation/IP vested in CERN**
  - **Non-standard products which can be produced with existing manufacturing techniques and/or technologies**
    - → **Innovation/IP vested in industry**
- Long and Intensive R&D and Prototyping required
  - Source of innovation
  - Source of new technologies
  - Existing technologies pushed to the limits
  - Creation of know-how
- Although developed for the purpose of fundamental research, many technology developments and know-how have strong impact to society
1911: discovery of superconductivity

Heike Kamerlingh Onnes

Impact of industry-academia collaborations to boost innovation

1955: SC magnet manufacturing for research
2008: LHC

Superconductivity as a key technology from small electronics to large magnet applications

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Impact of LHC developments on Health

Detector & electronic technologies

- Readout electronics
- Photo detectors
- Calorimeter
- Gaseous detectors
- Solid State detectors

Solid State detectors
- Microstrip
- Pixel
- A-Si:H

Gaseous detectors
- MWPC
- FGLD

Calorimeter
- Scintillating crystals
- Scintillating fibers

Photo detectors
- MWPC
- FGLD
- GEM

Examples

What the LHC needs

- Radiation hard, fast and high precision measurement of:
  - Energy
  - Momentum
  - Time

Solid State detectors

Readout electronics

- HPTDC timing
- Discriminators

Photo detectors

- Single photon counting
- Pixel
- HPDs

Calorimeter

- Scintillating crystals
- Scintillating fibers

Gaseous detectors

- MWPC
- FGLD
- GEM

Solid State detectors

- Microstrip
- Pixel
- A-Si:H

Examples

- PET
- CT
- X-Ray
- SPECT
- MRI

Applications in Medical and Molecular Imaging:

Performance

- High sensitivity for small tumor detection
- High specificity to avoid unnecessary biopsies and wrong diagnostics
- Ultra fast Signal Analysis
- High Spatial Resolution
- Flexibility in use
- Low cost
- High technology
- Low price
- Compacted

IAEA/INPRO Dialog Forum on International Collaborations
on Innovation,
IAEA, Vienna November 17-21, 2014

Courtesy: H. Hillemanns/CERN
Content

• Research context
• IP aspects
• Case studies at CERN
ORGANISATION EUROPÉENE POUR LA RECHERCHE NUCLÉAIRE

CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

**Action to be taken** | **Voting Procedure**
---|---
For Information | FINANCE COMMITTEE
| 320th Meeting
| 17 March 2010
| -

POLICY ON THE MANAGEMENT OF INTELLECTUAL PROPERTY IN TECHNOLOGY TRANSFER ACTIVITIES AT CERN
## Content

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TT and related IP management

Section #2: IP generated through CERN’s Scientific program

R&D in the framework of CERN’s scientific programme

- IP disclosure, ownership and protection

Section #3: TT through TT partnerships

- Collaborative R&D
- Contract research
- Service and consultancy

- IP identification, ownership, protection and access right

Section #4: TT through exploitation

Licensing
Spin-off companies

Research & development
Technology transfer
Intellectual Property management

B. Denis
11th June 2010
Dissemination models

• Commercialisation of CERN IP
  • Licensing
  • Service and consultancy
• TT R&D projects (collaborative R&D)
  • Collaboration with other institutes
  • Partnership with industry
Content

- Research context
- IP aspects
- Case studies at CERN
Case study: Solar collectors

An ultra-high vacuum technology for an efficient solar thermal solution

- Technology history
  - 1996: NEG patent filed by CERN; Inventor: C. Benvenuti
  - Tests of a prototype of an evacuable solar collector at CERN during 10 years
  - 2004: Solar collector patent filed by CERN; Inventor: C. Benvenuti
    - Main feature: Panels can reach an operating temperature as high as 350 deg. C, even at latitudes above the 45th parallel.
    - Ideal for heating and cooling, for a large majority of industrial processes and for electricity production

- Transfer process
  - 2005: R&D partnership with industry for the development of a pre-industrial demonstrator
  - 2009: First prototype production line in operation (ES)
  - 2010: Pilot industrial installation (CH)
  - 2011: Commercialisation (ES, BE, NL)

- Slow market penetration; Customers require demonstrators to adopt the solar collector technology

The expertise of the inventor has been instrumental to the success of the transfer

- A company from the car parts industry built the first production line
Case study: GEM

Gas Electron Multipliers (GEM) is a “typical” Particle Physics technology

- Novel approach for tracking charged particles with high position resolution; Possibility of manufacturing large area devices
  - First patent filed in 1997, inventor: F. Sauli
- GEM has opened up a new line of R&D: Micro Pattern Gaseous detectors (MPGD) including
  - Detection of charged particles, neutrons and photons
    - GEM, ThickGEM, MicroMegas, MicroBulk
    - Patents from other labs (CEA, IN2P3 and CERN)
  - Electronics and readout systems
- The MPGD collaboration (RD-51, → 81 institutes) addresses the R&D issues of the particle and nuclear physics community
  - IT, FR, GR, PT, DE, HU, BE, GB, SP, CH, US, RU, KO, JP, IN, ME, CN, IS, CA

No large scale commercial exploitation is in place; GEMs are manufactured for R&D needs only

- 7 commercial agreements (SE, PL, DE, FR, NL, JP)
- 53 R&D agreements → Strong indication of the interest of the research community

Important application potential in various domains such as beam monitoring and security

- Ex: Spherical GEM for X-ray diffraction and material science

HEPTech Network: Tangible efforts to demonstrate the applicability of the MPGD technologies outside PP

- First target: Security
  - Large area X-ray and neutron scanner for rapid air cargo screening at affordable manufacturing and operational costs
  - Muon tomography for the detection of illicit nuclear material
RD 51 – R&D Collaboration for Micro-Pattern Gas Detectors

Context

• Large number of participants, Institutes and Universities
• Program of work defined through areas of common interest
• Early-stage technology
• Funding scheme

Contractual framework

• **Memorandum of Understanding**
• General Conditions Applicable to Experiments performed at CERN

→ **Consequences:** Each TT case will require its own set of contractual arrangements
**RD 51 – IP principles**

*Simple scheme, direction set by the General Conditions*

*High level principles, a few ground rules:*

- Emphasis on:
  - Identification of needed IP, with any applicable restrictions
  - Access to the identified IP for the research program, and safeguarding this access

- Ownership of Foreground IP

- Any exploitation of Foreground IP left for a separate agreement

- Publication and acknowledgement

**TT Case: Scalable Readout system (CERN, IFIN-HH (RO), Uni Valencia (SP))**

- IP exploitation agreement
  - Joint ownership, CERN sole licensor of project results

- Licences to industry (new IP included in the licence at the same conditions)
  - For procuring the experiments (royalty free)
  - For commercial purposes → Part of the revenues to the collaboration to compensate investments
Case study: Medipix

**R&D collaboration to develop and exploit a multi purpose pixel photon counting chip**

- CERN is responsible for the designs
- Member institutions share the exploitation in various domains and conduct dedicated developments
  - FR, DE, GB, CH, NL, SE, CZ, FI, NZ, US

**Direct exploitation**

- X-ray diffraction measurements for material research (NL)
- X-ray scanners for small animal and mammography (NZ)
- Gamma-ray detectors for nuclear power plants decommissioning (FR)
- (R&D) Readout chip for particle tracking detectors based on MPGD technologies (NL)
- (R&D) Readout chip for fast and position sensitive photodetection for life science (GB)

**Developments of derived chips**

- Using Medipix expertise: Dosepix: Joint R&D with industry for dosimetry applications (BE, DE)
- Using the Medipix technology: Timepix: Joint R&D to extract timestamps & energy information from Medipix
  - For Particle Physics and industrial applications

**Application potential (Medipix, Dosepix and Timepix)**

- Electron microscopy, gas detectors, neutron imaging, nuclear power plant decommissioning, adaptive optics, dosimetry in space and Particle Physics (LHCb Velo: Precision vertex locator)
Collaborations – Partnerships and licences of Medipix technologies

**Medipix2 collaboration (17 institutes)**

- Development of an ASIC with a high spatial, high contrast resolving CMOS pixel read-out chip working in single photon counting mode.

**PIXcel**

- Xray diffractometer
- Developed and commercialised by a Dutch company
Medipix – R&D for hybrid silicon pixel detectors

**Context**

- ~17 Members, Institutes and Universities
- Very specific work program
- Mature technology with clear commercial exploitation potential
- Interested industry partners at all stages
- Institutional financing

**Issues**

- Different institutional partners around individual chip exploitation

**Contractual framework**

- Collaboration Agreements with a focus on a single technology (chip)
- Exploitation Agreements
- Institutions in collaboration can claim exclusivity on the exploitation of the chip in a specific domain
**IP principles**

**Ownership**
- IP relating directly to individual chips is vested in CERN
- Other IP vested in the party generating it

**Exploitation**
- Each exploitation agreement has to be approved by the Project Monitoring Committee
  - 1 representative per collaboration member
- Rules for redistribution of revenue set out in Collaboration Agreement
MEDIPIX IP organization

Chip (CERN)

Medipix 2

- Core Technology Project Readout
- Core Technology Project Software

Exploitation agreement
Sales agreement
Product agreement

Medipix 3

- Core Technology Project readout
- Core Technology Project Software

Exploitation agreement
Sales agreement
Product agreement

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# MEDIPIX (2, 3) Participation

<table>
<thead>
<tr>
<th></th>
<th>Member Institutes</th>
<th>Third party Institute, Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MEDIPIX (2,3) Collaboration</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Core Technology Project</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Product Agreement</strong></td>
<td>Yes + CERN</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Exploitation Agreement</strong></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Sales Agreement (R&amp;D institutes)</strong></td>
<td>Yes + CERN</td>
<td>No</td>
</tr>
</tbody>
</table>
Case study: Crystal Clear Collaboration

From calorimetry (RD18) to PET applications
Attractive market perspectives for whole body PET/CT’s:
• Generalized use of PET technologies across multiple domains of medical diagnostics
• Attractive opportunities for dedicated PET also in niche markets:
  ▫ Small animal PET’s ([raytest], drug discovery)
  ▫ Mammography, Brain devices

Crystal Clear Collaboration: Small animal PET for in-vivo drug screening
Clear PEM : PET for Mammography

1/8 woman will develop breast cancer during her life
2nd cancer related cause of death for women

Conventional detection techniques (X-ray mammography) are very inefficient, especially in dense breasts (common in women aged under 50 years).
With PEM (Positron Emission Mammography), possibility to detect small tumors (<2mm) and to be able to detect tumors in dense breasts.

The X-Ray mammography picture reveals nothing special, whereas the tumor is clearly visible in the PEM case.
ClearPEM-Sonic:

Objective: detect tumors of 1 to 2 mm

Ultrasound probe
Anatomic imaging

ClearPEM:
Functional imaging

Machine installed in l’hôpital nord à Marseilles

Brussels, May 29 2013
ClearPEM plates:

2 Plates 17.3x15.5x3cm
16 SuperModules of
3072 crystals + 6124 APDs in array

B. Frisch et al., Conference record IEEE NSS/MIC2011

Brussels, May 29 2013
ClearPEM Modules

- 6144 LYSO:Ce crystals in 192 matrices
- Readout with APD arrays on both side for dual readout
- ASICs for fast readout

1 Supermodule : 12 Modules

1 Module =
32 crystals (2x2x20 mm$^3$) + 2 arrays 32APDs

B. Frisch et al., Conference record IEEE NSS/MIC2011
First Images

MRI

Axial view

CLEARPEM

Sagittal view

Full body PET

M. Pizzichemi on behalf of ClearPEmsonic collaboration
CHEF2013 conference, Paris April 2013

Brussels, May 29 2013
Crystal Clear Collaboration

**Context**

- Existing collaboration (2001), ~15 Institutes/Universities
  - resulting from RD-18: Early R&D project for electromagnetic calorimetry at LHC
- Institutional financing, with public funding opportunities

**Issues**

- **Deploy** the expertise developed during LHC R&D phase to benefit other sciences
- **Maximize** the transfer of knowledge to enable the construction of pre-industrial prototypes
  - Expertise in Material sciences (crystal), fast electronics, data acquisition
  - Partnership with medical experts (end-users)
- **Develop** a supporting framework that:
  - Minimize the legal burden when entering new projects
  - Allow the various TT projects to benefit from the results of the generic developments the Collaboration members
  - Handle possibly conflicting interests between academic and industrial stakeholders

**Contractual framework**

- 3-tier structure put in place
  - Collaboration Agreement
  - Agreements for development of ‘generic’ technologies
  - Agreements for development of specific technologies (applied research) (industry interest)
Crystal Clear Collaboration

- Activities within collaboration under confidentiality
- Disclosure of **Generic Technology results** to Collaboration for research purposes only
- NDA with invited external experts (industry, other institutions)
- Disclosure of information and publications controlled by Collaboration (incl. Patents)
- Industry can claim IP on results generated by **Specific Research Developments** (Applied research)
- Revenues: Sharing model established in **Specific Research Developments** agreement, reviewed at commercialization, industrialization or licensing stage
Ownership:

- Ownership of Background IP not affected
- Ownership of Foreground IP vested in the party(ies) generating the IP
- Ownership of improvements to Background IP considered Foreground IP if developed within CTP or PDP, considered Background IP if developed by CCC member individually

Protection:

Collaboration level

- Strategy for protection

Generic Technology development Project level (CTP)

- IP protection implementation and follow-up as specified in collaboration agreement

Specific Development Project level (PDP)

- Ad-hoc, depending on specific needs of parties in the PDP.
Crystal Clear Collaboration - IP principles

Access:

- Determined prior to conclusion of any agreement
- Access by:
  - CCC members
  - Industrial partners
  - Commercial users
- Access for:
  - CCC
  - CTP (by participants to that Project or to another Project)
  - PDP
  - Product Industrialization
  - Commercial Exploitation

- Each CCC member determines which Background IP it wishes to contribute to the Collaboration;
- Access to Background IP of CCC members for internal research purposes by other CCC members through membership to CCC;
- Access to Foreground IP of CTP for evaluation purposes through membership to CCC;
- Access to Foreground IP of CTP for research and development through joining that CTP, or setting up another CTP, or getting a license;
- Access to Foreground IP of CTP for PDP or commercial exploitation possible if party to that CTP, or by obtaining license;
- Access to Background IP or Foreground IP of PDP only through joining that PDP or obtaining license.
Lessons learned on TT @ LHC

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1. Product development without Generic Technology Project

2. Product development with IP from Generic Technology Project

3. Generic Technology Project

4. Generic Technology Project with results from other GTPs

5. Commercial exploitation of Product Development*

6. Commercial exploitation of Generic Technology Project results†

7. Product Industrialization of Product Development

8. Commercial exploitation of product industrialization‡

9. Prod. Ind. of Generic R&D

10. Product Industrialization of CCC IP

* Product fabrication; † Technology fabrication; ‡ Final product.

18 December 2006

M. Ayass, H. Hillemanns, J.-M. Le Goff
Overview of scenarios with IP flows

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Lessons learned on TT @ LHC
Proposed CCC structure - Clear PEM Sonic and Block detectors

- Licence to Industry for commercial use of pre-existing IP of Collaboration
  - LIP for results of ClearPEM project
  - CCC members for results of ClearPET project
- Partnership Agreement for the development of the ClearPEM-Sonic product
Proposed CCC structure - Brain PET MRI

- Core Technology Project on Block Detectors by subset of CCC members
- Julich institutional lead for PDP with Siemens

Commercial ex.

Ind.

PDP

CTP

Brain PET Project

Block Detectors Project

Brain PET MRI Project

Product Industrialization

Commercial exploitation
## Participation

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<th>Institutes</th>
<th>Industry</th>
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<tr>
<td>Crystal Clear Collaboration</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Core Technology Project*</td>
<td>Yes, if member of the CCC</td>
<td>No</td>
</tr>
<tr>
<td>Product development Project*</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Product industrialization</td>
<td>No</td>
<td>Yes</td>
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* Constraints: CCC must approve the CTP; CCC must be informed of PDP
## Funding

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<th>Institute</th>
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<td>Supports its own costs</td>
<td>Excluded</td>
<td>Supports the Collaboration’s operations</td>
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<tr>
<td>Core Technology Project</td>
<td>Supports own costs and additional costs</td>
<td>Sponsoring (2)</td>
<td>Covers additional costs of institutes</td>
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<tr>
<td>Product Development Project</td>
<td>Supports own costs</td>
<td>Covers costs</td>
<td>Covers costs (1)</td>
</tr>
<tr>
<td>Product industrialization</td>
<td>Excluded</td>
<td>Covers costs</td>
<td>Supports industry</td>
</tr>
</tbody>
</table>

(1) Additional costs for institutes, full costs for industry
(2) For future access through non-exclusive license
Thank you for your attention