From CERN knowledge to society

Manuela Cirilli
CERN Knowledge Transfer Group
WHERE THE WEB WAS BORN

In the offices of the computer of the center in CERN, in 1989, the concept of the
Wide Web was developed.

Started in 1994 as a proposal to use HTTP for a number of tasks,
was first divided between an office in the Computer Science
Networking Division (CS). It was eventually turned into a reality,
Computing for Physics Division (CPD).

In 1997 the team led by Tim Berners-Lee was formed.
It was composed of two collaborators, Robert Cailliau and
dle, and a few others. It was
a Computer and Centre Team.

At the end of 1997, Tim Berners-Lee was
Consortium (W3C) with a mandate to
Web to 3.0. The W3C, in collaboration with
the European Communities, the National
Academy of Sciences, the Australian
Academy of Sciences, and the

In 1995 the World Wide Web was
opened to the public. In 1996, the

Photo: CERN
From CERN Technologies ...
This is what we call knowledge transfer

CERN’s unique:
Technologies
Know-how
Infrastructures
A dedicated Knowledge Transfer (KT) Group at CERN

“Places like CERN contribute to the kind of knowledge that not only enriches humanity, but also provides the wellspring of ideas that become the technologies of the future.”

Fabiola Gianotti, Director-General of CERN
Please keep in mind:

CERN is involved in a multitude of international collaborations with other institutes, including on technology developments.

I will highlight this whenever it’s not CERN-only results.
Medical Technologies
From particle accelerators
Hadron Therapy

X rays

Protons

Image courtesy MedAustron
Make them smaller
Explore radically new ideas

Medical Technologies
From particle detectors
Medipix is a family of read-out chips for particle imaging and detection developed by the Medipix Collaborations.
Spectral CT = colour X-rays

9-14 keV
14-23 keV
31-50 keV

S. Procz et al.
Spectral CT = colour X-rays

RGB:
9-50 keV

S. Proczi et al.
Spectral CT = colour X-rays
MARS Bio-scanner now commercial

Notre Dame imaging lab

Slide courtesy of A. Butler, University of Canterbury
The water has been partly cut away to reveal the bone, gold, gadolinium and iodine.

A. Butler, University of Canterbury

compact gas chamber with highly pixelated read out

3D monitoring of therapeutic ion beams
Crystal Clear Collaboration
CERN RD18 Experiment
A long history of contributing to PET developments
Several prototypes over 20+ years:

- PET for small animals
- Organ-dedicated PET (breast, pancreas, prostate)

On-going investigations:

- Improvement of PET time resolution (scintillators, photodetectors, electronics)
- Determination of depth-of-interaction
- Photonic crystals
Medical Technologies

From computing & simulations
FLUKA

fully integrated particle physics
MC simulation package

PRESS RELEASE
STOCKHOLM, SEPTEMBER 10, 2015

RAYSEARCH, CERN AND INFN SIGN LICENSE AGREEMENT IN THE FIELD OF ION BEAM THERAPY

CERN, INFN and RaySearch Laboratories AB (publ) have signed a long-term license agreement allowing RaySearch to utilize the FLUKA Monte Carlo code in its research and development in the field of ion beam therapy.

http://www.raysearchlabs.com/about/press/?year=2015&cisionid=1977472
Design and build a scalable and flexible cloud-based computing platform for rapid simulation of biological tissue development.

Collaboration between CERN, Newcastle University, Innopolis University, Kazan Federal University, and Intel.
Collaboration between CERN and King’s College London

The project is initially making use of sequences from TwinsUK, the largest UK adult twin registry.

GeneROOT
Use ROOT to analyse large genomics datasets
CERN-MEDICIS
First medical isotopes produced

La lutte anti-cancer se prépare au Cern
Aerospace
Timepix: another member of the Medipix family
Timepix on the ISS
Timepix on VZLUSAT-1
Launched June 2017
In 2017

High energy electrons in VESPER for ESA JUICE mission

Mixed-field in CHARM for CNES EyeSat nanosatellite

Heavy ions in SPS North Area for high penetration tests on components for telecommunication and exploration space missions (performed in collaboration with TRAD and IROC companies)
Cultural heritage

#EuropeForCulture

2018 is the European Year for Cultural Heritage
Start-up using Medipix X-ray eyes for cultural heritage
Construction of a compact, transportable accelerator based on the HF-RFQ developed at CERN

With the involvement of INFN-CHNet (Cultural Heritage Network)
TIND: a CERN spin-off providing solutions for library management and data preservation based on the CERN open source software Invenio
And a lot more...
Geant4: from HEP to …

…space applications

…radiobiology

…medical applications

A vast users’ community
http://www.geant4.org/geant4/applications
Easy-peasy?
8 November 1895: Röntgen discovers X-rays
28 December 1895: Röntgen publishes his discovery
11 January 1896: first clinical use of X-rays
Nobel Prize in Physics 1952: Felix Bloch, Edward M. Purcell

Nobel Prize in Medicine 2003: Sir Peter Mansfield, Paul C. Lauterbur

From NMR to MRI
CERN, 1970s
Doing KT at CERN
CERN’s mission: Basic research
SCIENCE
TECHNOLOGY
TRAINING
COOPERATION
Collaboration
Openness
An international organization

**Member States:** Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Slovak Republic, Spain, Sweden, Switzerland and United Kingdom

**Associate Members in the Pre-Stage to Membership:** Cyprus, Serbia, Slovenia

**Associate Member States:** India, Lithuania, Pakistan, Turkey, Ukraine

**Applications for Membership or Associate Membership:** Brazil, Croatia

**Observers to Council:** Japan, Russia, United States of America; European Union, JINR and UNESCO
CERN KT Group’s Mission

**Maximise** the technological and knowledge return to society in particular through Member States industry

**Promote** CERN as a centre of excellence for technology and innovation

**Demonstrate** the importance and impact of fundamental research investments

Key concepts: Dissemination and Impact
How we do it

- Intellectual Property Management
- Licence, service & consultancy agreements
- Open Hardware Licence & Open Source Software
- R&D Collaborations
- Knowledge Transfer in EC co-funded projects
- Knowledge Networks (Links with Member States Institutional Relations)
- Knowledge Exchange (KT events & Seminars)

- CERN Knowledge Transfer Fund
- CERN Medical Applications Budget
- Formal & practical training in business, entrepreneurship & KT
- Financial, legal, business & intellectual property support
- Entrepreneurship
- Business Incubation Centres
- Start-ups & Spin-offs
The most asked question...

...do you take patents??
Intellectual Property (IP)

IP ≠ patents

IP enables CERN to claim being at the origin of a novel technology

CERN will only consider patenting where it might help mitigate the financial risks of investing further in the development of a technology

CERN’s patent portfolio currently comprises 34 patent families, a number significantly lower than organisations of a similar size.

Patents come at a cost!

CERN know-how is also available through collaboration and consultancy agreements
CERN Open Hardware Licence

Launched in 2011

Created to govern the use, copying, modification and distribution of hardware design documentation, and the manufacture and distribution of products
Money’s not everything, but...
<table>
<thead>
<tr>
<th>CERN Knowledge Transfer Fund</th>
<th>CERN Medical Applications Budget</th>
<th>For CERN scientists</th>
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<tbody>
<tr>
<td>41 projects funded since 2011</td>
<td>25 projects funded since 2014</td>
<td>“Bridging the gap between research and industry, so that society can benefit.”</td>
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<tr>
<td>15-220 kCHF range of funding received per project</td>
<td>64 kCHF average received per project</td>
<td></td>
</tr>
<tr>
<td>8 CERN departments and units funded since 2011</td>
<td>7 CERN departments and units funded since 2014</td>
<td></td>
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KT Fund: a successful example

Prototype of a hand-held radiation survey meter operable in high magnetic fields

The KT Fund allowed to further develop its functionality and scale-up for manufacture. Successfully licensed to a company from a Member State, now an off-the-shelf product.
Push or pull?
“How can machine learning improve vaccine production?”

CERN - Sanofi
Finding the (right!) partners
CERN BICs

CERN Network of 9 Member State Business Incubation Centres of CERN Technologies
Building a culture of entrepreneurship
And even if you don’t care about applications...
Medipix Cycle of Innovation - enhanced by Knowledge Transfer

- **HEP requirements**
  - Vertex tracking@LHC (e.g. VELOpix)
  - Hybrid pixels (e.g. Alice SPD)

- **New technologies/approaches**
  - Triggerless readout (e.g. Timepix/Timepix3)
  - R&D (funded by Collaboration / KT partners)

- **Other scientific fields/applications**
  - Synchrotrons/biology/medicine/industry (e.g. Medipix2/Medipix3)

- **R&D (funded by HEP)**

KT/Collaboration

Courtesy Michael Campbell
Want to know more?
Visit http://kt.cern
Sign-up to our newsletter
http://kt.cern/newsletter
Contact us at kt@cern.ch
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