



# Multi-Disciplinary Knowledge Sharing Platforms

*CERN openlab Technical Workshop 2019*

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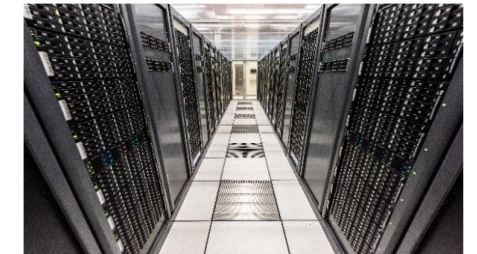
# Three Main Areas of R&D



Increase **data centre performance** with hardware accelerators (FPGAs, GPUs, ..) optimized software



**Scale out capacity** with public clouds, HPC, new architectures



**Change the computing paradigms** with new technologies like Machine Learning, Deep Learning, Advanced Data Analytics, Quantum Computing



# IP Management, Open\*

- The basic principle of any CERN openlab collaboration is openness
- We assume shared (or at least very fair) IP of results among project members
  - More specific IP agreements can be discussed with the CERN KT Office
- Within the respect of limited confidentiality agreements and short embargo periods, we expect the results of the projects to be released to the scientific communities following open policies



# KNOWLEDGE SHARING

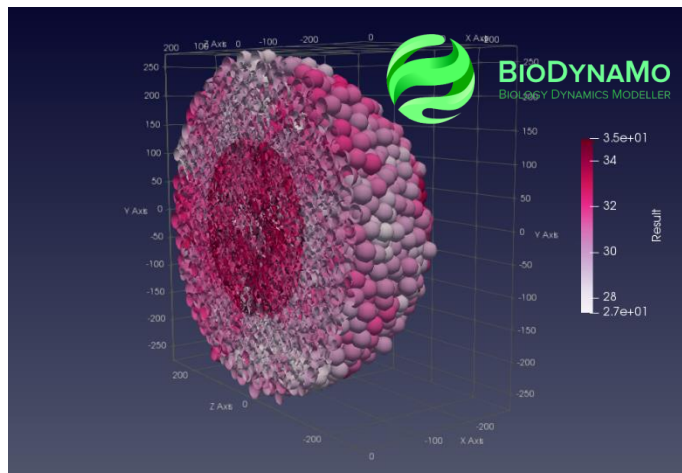
*Working with communities beyond high-energy physics*



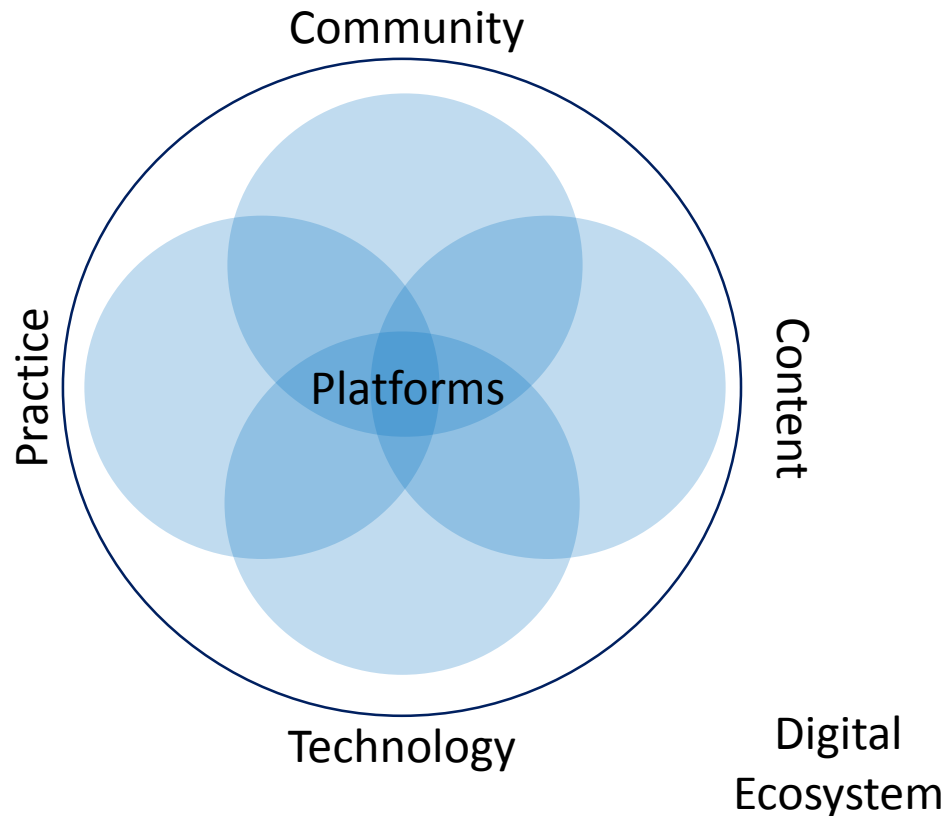
Working closely with CERN KT and external public entities on initiatives aimed at transferring tools, skills, and knowledge from the high-energy physics community to other research fields and vice versa.



Aligned with the officially approved knowledge transfer strategies for the benefit of other research fields like medical applications



# PLATFORMS AS ENABLERS OF LARGE-SCALE COLLABORATIONS



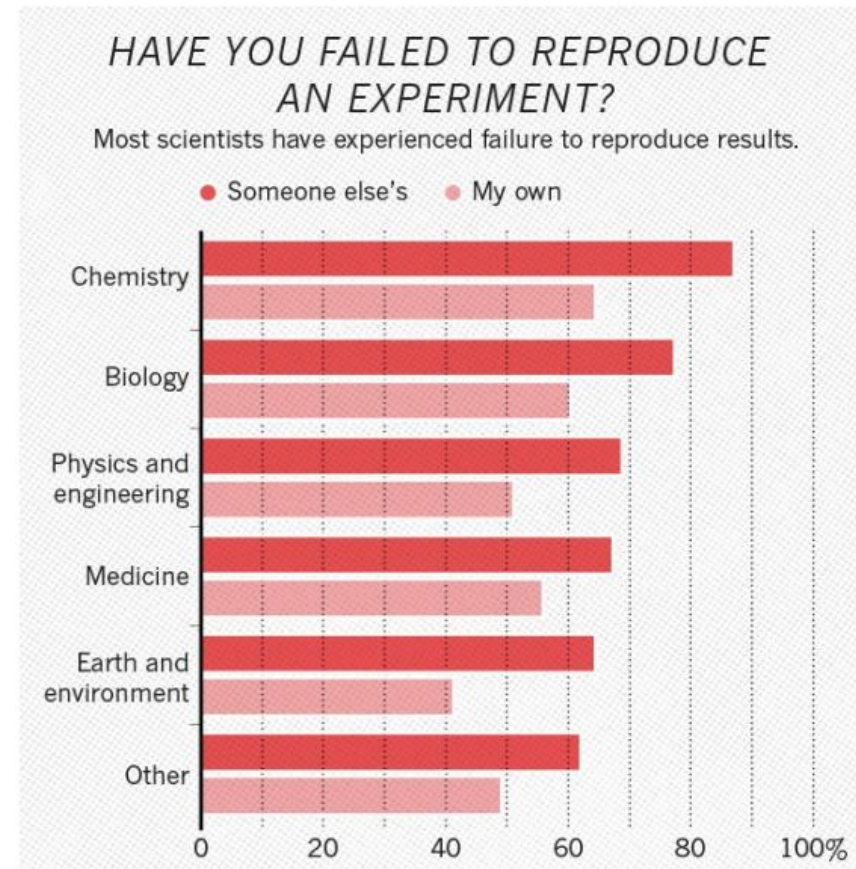
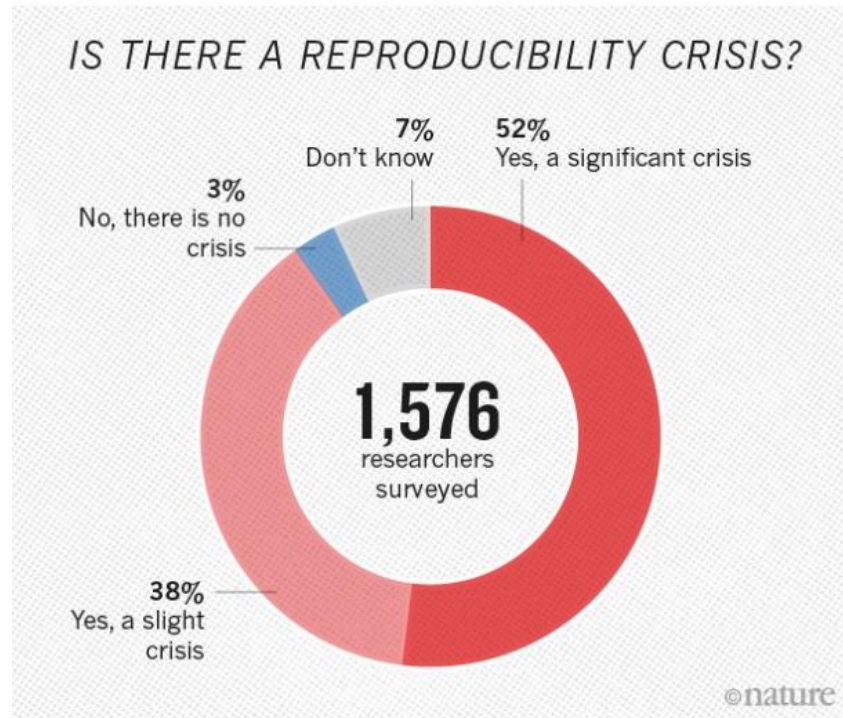
As scale grows, a sound digital ecosystem is generated by four main elements and a way for those elements to interact on common terms

Platforms are the unifying services at the intersections that enable

- commoditization
- best practices
- aggregation and integration
- share and reuse of data
- reproducibility
- collaborations, etc.



# Reusable and Reproducible?



<https://www.nature.com/news/1-500-scientists-lift-the-lid-on-reproducibility-1.19970>

Half of researchers cannot reproduce their own experimental results

# Smart Knowledge Platforms

- **Common challenge** across many activities: harness the growing amounts of information being produced every second of our lives
- **Convergence** of fast hardware, smart algorithms, and increasingly sophisticated models is getting us closer to practical solutions



## Education

Adaptative, personalized education environments, guiding the students to achieve their learning objectives



## Research

Data Analysis, Preservation, Reproducibility, Knowledge Discovery and Sharing platforms, automating complex tasks, suggesting non-obvious links across disciplines and people



## Industrial/Social

Smart personal assistants informing you about your environment, the use of your personal information, and your rights

# Why CERN?

- Although CERN mission is to support research in the field of High-Energy Physics, it has a long history of proven results in the art of collaborative research
- It is a unique place where ideas and people can “collide” to generate innovation
- It has developed and keeps developing unique technologies that can and have to be made universally available to other research and to industry and society at large
- There are common challenges that can benefit from broader discussions and solutions
- **CERN openlab wants to take part in this successful and valuable mechanism of “giving-and-taking” to everybody’s benefit**



# Reusing analyses

# reana

Reproducible research data analysis platform

## Flexible

Run many computational workflow engines.



## Scalable

Support for remote compute clouds.



## Reusable

Containerise once, reuse elsewhere. Cloud-native.



## Free

Free Software. MIT licence. Made with ❤️ at CERN.



<http://www.reana.io/>

# Medical Applications

- Aligned with the CERN knowledge transfer strategy for the benefit of medical applications established in 2017
  - Centred around the three main areas of Accelerators Technology, Imaging/Sensors, and **Computing**
- Three main areas of interest
  - **Biological simulation:** using ongoing research on code modernization and new ML/DL algorithms, possible links with expertise on radio/hadron-therapy
  - **Medical image analysis, connectome studies, genotype/phenotype mapping:** using ML/DL algorithms being developed for simulation and track reconstruction, new techniques for training models with scarce data, DNN back-tracing and interpretation
  - **System Biology:** large-scale data analysis to find correlation across different medical domains and very heterogeneous datasets, using experience on large-scale distributed systems and ML/DL



LivingLab

# Societal Applications

*Counting shelters in refugee camps*

Scan million pixels satellite photos for disaster relief:

Evolution of refugee camps

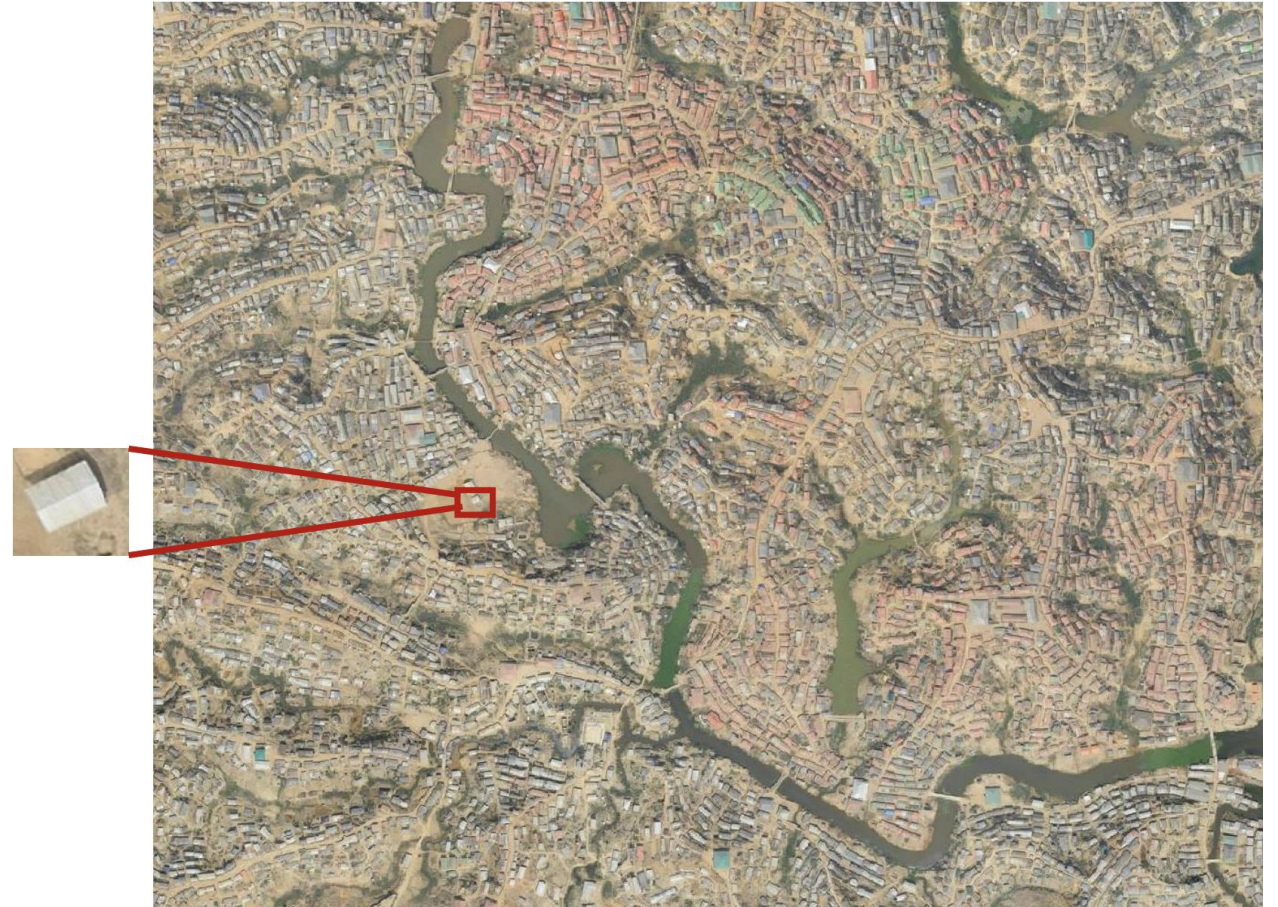
Natural disasters

Buildings damage

High precision is required (> 95%)

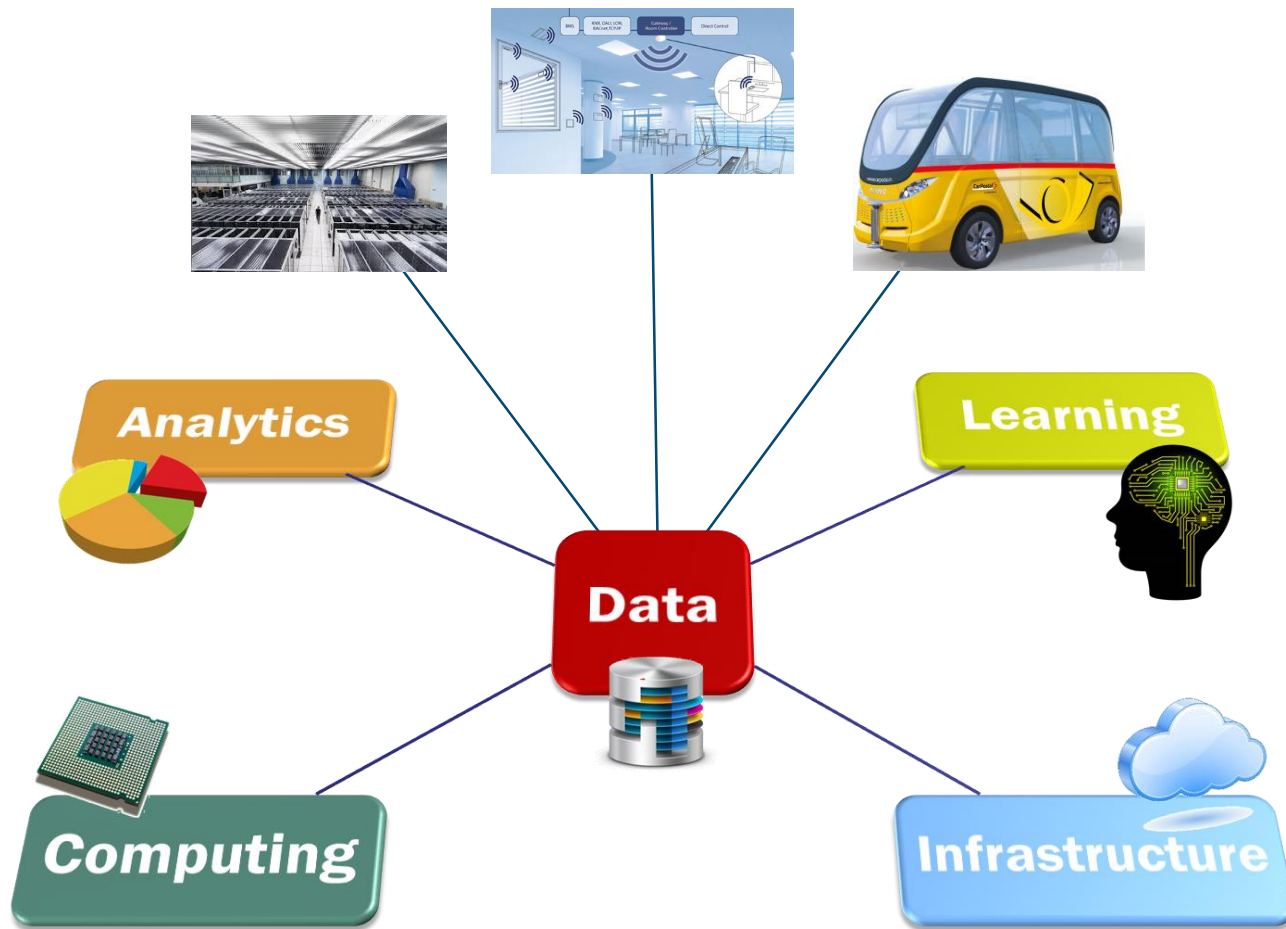
UN decisions depend on this data

Manual scan





# SMART PLATFORMS, IOT, NLP



Understand the potential and impact of technologies such as Internet of Things, fast wireless/mobile communication (5G), large-scale DA/ML, NLP and chatbots

Raise awareness among the community by collecting and aggregating interests and setting up PoC projects

Currently investigating applications for mobility, smart environments, and human-system interfaces

Possible applications in control systems, environmental control, self-help and diagnostics engines, knowledge discovery

# CONTACTS

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**[www.cern.ch/openlab](http://www.cern.ch/openlab)**





# Thanks!

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