

#CSIC Challenges in Science in the 21st Century

A short reflection based on the analysis of research ecosystems



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CNIC Ph Day



CNIC ISCIII

November 22nd 2019 @MADRID

Disclaimer: all statements presented are based in the personal experience as researcher and do not state any institutional position



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Understanding the research ecosystem

Who eats whom (what is the biomass? money? knowledge!)

SCIENCE IS IN THE BUSINESS CORE IN OUR CENTURY !

Science is no longer only the main interest of scientists...

GOVERNMENT AND PUBLIC ADMINISTRATION

PRIVATE AND PUBLIC COMPANIES

PUBLIC RESEARCH FUNDING & PERFORMING ORGANIZATIONS

-research (academic system)

-libraries and repositories

-technology transfer offices

-students

-citizens

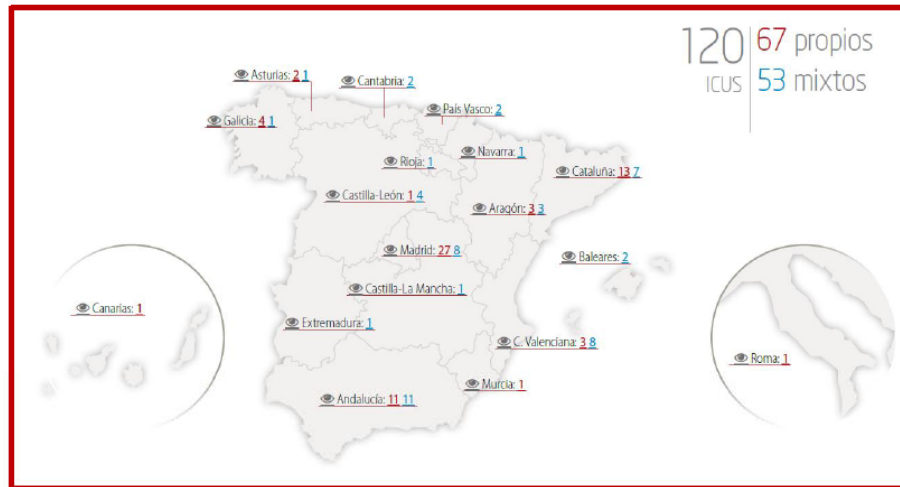
SOCIETY

*“Publishing journals as a **profit-maximizing business** is certainly as legitimate as it is for other **distributors of digital content based on intellectual property protections**. The research enterprise and its stakeholders are responsible for the future of scholarly communication”
From “**Open Science by design**” NASEM*



Consejo Superior de Investigaciones Científicas (CSIC)

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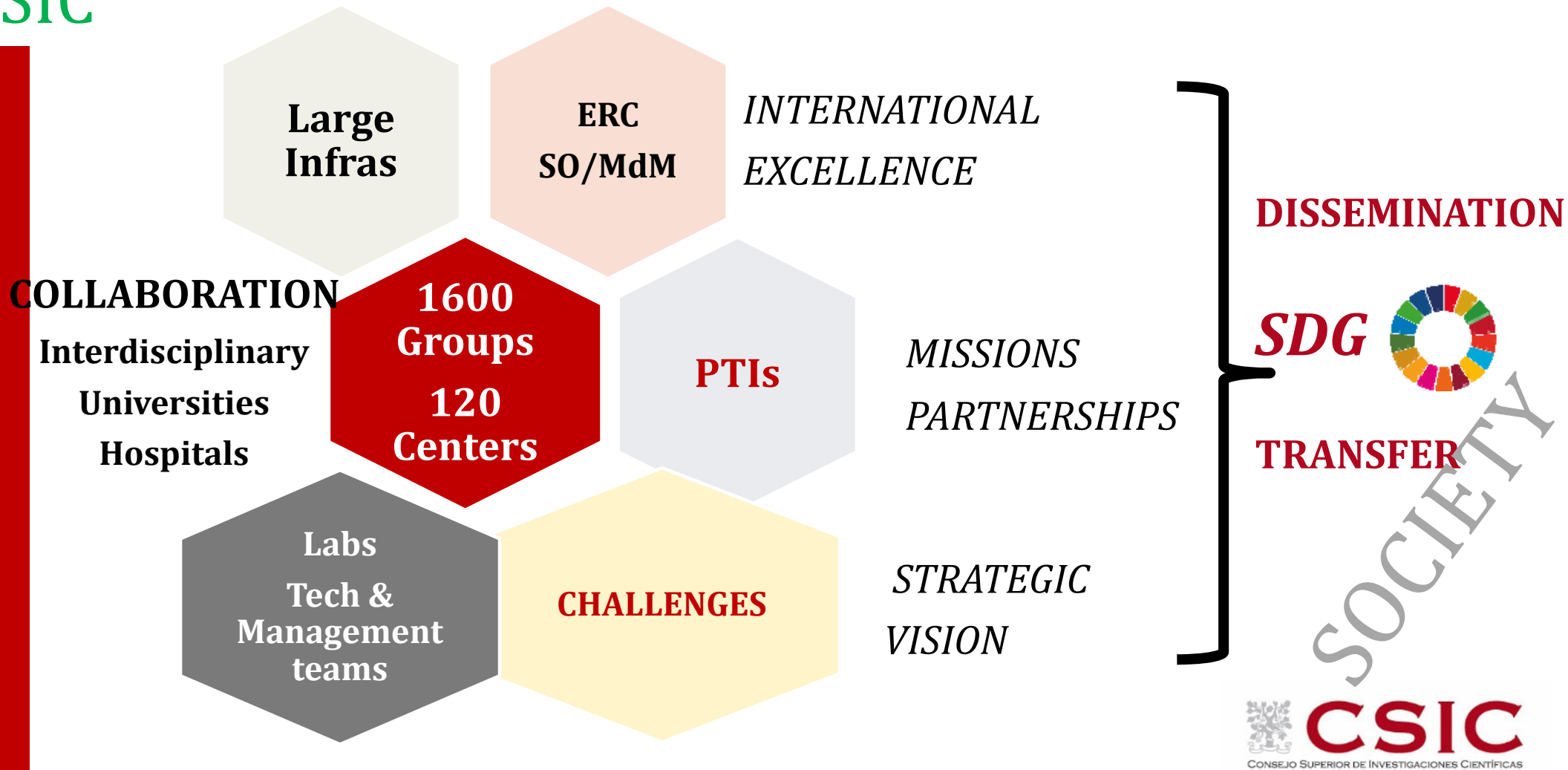
INDICADORES ANUALES: >13.000 artículos / >1.600 contratos / >125 patentes solicitadas

10.642 Empleados	3.644 Investigadores	1.263 Investigadores en formación	4.472 Personal de apoyo a la investigación	1.263 Gestión
5.220 mujeres	2.285 hombres	654 mujeres	2.445 mujeres	761 mujeres
5.422 hombres	1.360 mujeres	609 hombres	2.027 hombres	502 hombres



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How do we structure our research?



Research Objectives

Two different approaches with economic and social impact:

- **Bottom-Up initiatives:**
 - Ideas proposed by researchers
 - Initially funded in competitive calls
 - European calls (ERC is best example)
 - National programs
 - Local/Internal funding
 - **Promoted and supported for further exploitation by CSIC**
- **Top-Down strategies:**
 - Defined at different level by social/economical requirements
 - Researchers align to thematic proposed
 - Examples: H2020 challenges, National Strategic Actions
 - Exploitation plan is a relevant component in the proposals

KEY POINT: EXPLOITATION OF RESEARCH RESULTS

Connecting with “Global Challenges”

- The challenges of our global society require global solutions that involve different facets and actors:
Science + Technology + Economics + Politics + Social Impact
- Large projects, or groups of projects, are required to address these challenges, with a certain budget, within a certain timeframe.
- *Europe wants to promote this approach in FP9, as analyzed in the High Level Workshop 2018 of Science Europe (May 2018)*

Example: reduce by 2025 plastics going into oceans by 90%.

**PLASTIC-FREE OCEANS ->
CLEAN OCEANS**



“Global Challenges”

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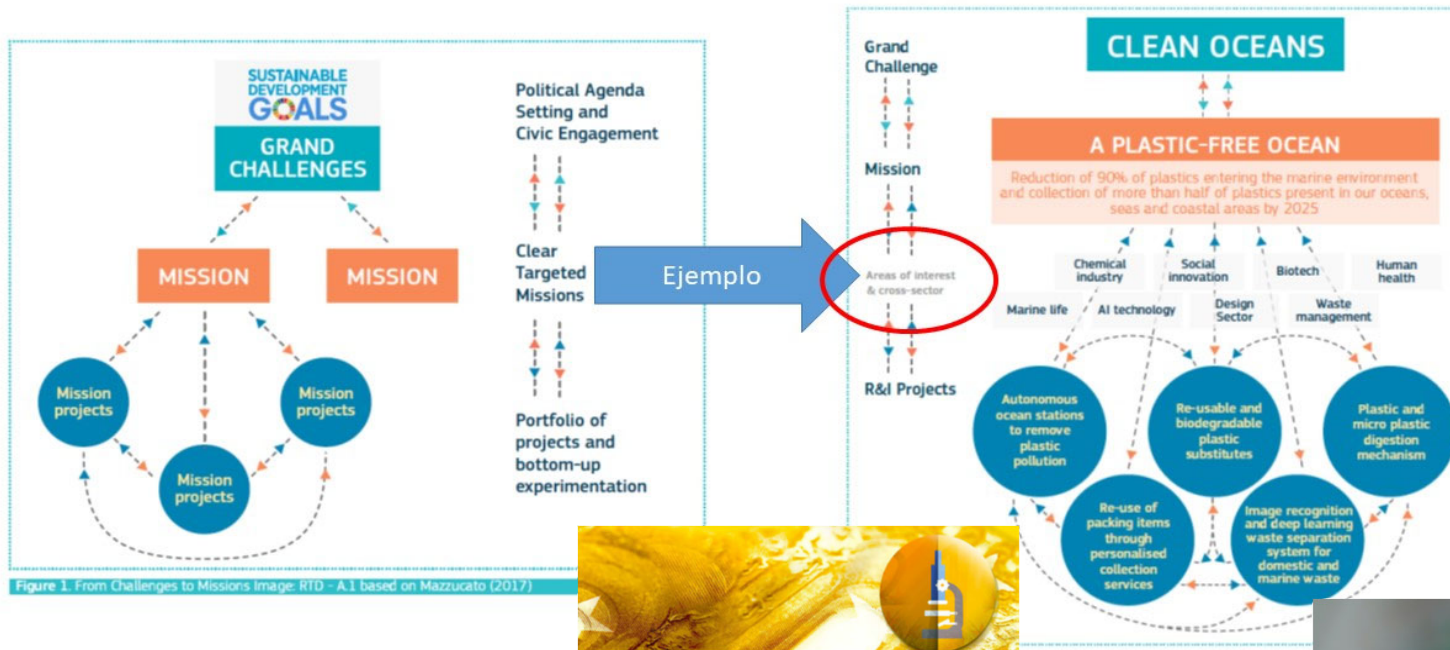


Figure 1. From Challenges to Missions image: RTD - A.1 based on Mazzucato (2017)

PLATAFORMA TEMÁTICA INTERDISCIPLINAR: GESTIÓN DE PLÁSTICOS EN LA SOCIEDAD

- Química de plásticos
- Impacto medioambiental
- Biodegradación
- Uso en alimentación (sustitución en envases)
- Impacto de los micro-plásticos en la salud
- Eliminación automatizada



Adapted from “Mission-Oriented Innovation-Policy...”

Mariana Mazzucato (2017)

Proposal: **Thematic Interdisciplinary Platforms (PTI)** [Plataformas Temáticas Interdisciplinares]

- Joining the knowledge of experts groups in CSIC with other groups in **companies**, administration, social agents, Universities and other public institutions.
- Solving well defined challenges, in concrete terms, with clear milestones
- Proposals:
 - TOP-DOWN: topic, challenge, involved groups, range and competition
 - BOTTOM-UP: ditto + solutions
 - VARIABLE GEOMETRY (NO ~~“ONE SIZE FITS ALL”~~)
- Extending the **COMPLETE LIFE CYCLE IN R & D + I (PROJECTS)**
 - PROSPECTIVE (integrating as much as possible all stakeholders)
 - PROPUSALS, SELECTION AND DEFINITION OF PROJECTS
 - PLANNING, EXECUTION AND CONTROL
 - COORDINATION AND GLOBAL MONITORING
 - EXPLOTATION AT ALL LEVELS
 - FEEDBACK TO A NEW CYCLE

Proposal: **Thematic Interdisciplinary Platforms (PTI)** [Plataformas Temáticas Interdisciplinarias]

- **COMPREHENSIVE APPROACH TO THE R & D + i LIFE CYCLE**
 - Integrating **Use Cases and Panoramas**
- **JOIN, FROM START, ALL INVOLVED GOUPS IN THE TEAM**
 - Since the prospective phase, in the design and implementation plan
 - Involving them in the monitoring of the Platform
- **PROMOTE THE COLLABORATION AMONG GROUPS**
 - From different research areas within CSIC, complementary
 - With groups from other institutions and Universities
 - **Establishing and Ecosystem with well defined ROLES and INTERESTS**
- **INCREASING THE IMPACT**
 - Size and scope of the initiative (larger than any “group” within CSIC)
 - Visibility (OBJECTIVE: UP TO 8 PLATAFORMS / YEAR)
- **MISSION APPROACH: ADVANCING TO SOLVE A CHALLENGE**
 - Monitoring in phases, re-adjusting by default, etc.
 - **LEADERSHIP AND AMBITION: IMPACT**

CURRENT PLATFORMS

<https://wiki.corp.csic.es/pti-global/>

- **PTI1-QTEP**
- **PTI2-SUSPLAST**
- **PTI3-FLOWBAT-2021**
- **PTI4-MOBIL2030**
- PTI5-SOILBIO
- **PTI6-XYLELLA**
- PTI7-ORIQUIBIO
- **PTI8-MEDHIS**
- PTI9-ALWAYS-UP
- PTI10-SYNTHCELL
- PTI11-ECOBIODIV
- PTI12-SOSECOCIR
- **PTI13-CLIMA**
- **PTI14-CSICPOLAR**
- PTI15-AG2BIO
- PTI16-NEUROPERCEP
- PTI17-RADDET
- **PTI18-VULCAN**
- PTI19-TELEDETECT
- **PTI20-PAIS**
- PTI21-INSTRAV
- PTI22-CONTAMINANTS
- PTI23-RED TIDES
- **PTI24-SUSTAINABLE FISHING**
- **PTI25-BLUE-BRAIN**
- PTI 26 PICAP
- PTI 27 SUSTAINABLE FORESTS
- PTI 28 ES-CIENCIA
- PTI-29 PHYTOPHARMACOLOGY
- PTI-30 NANOMEDICINE
- PTI-31 MARINE OBSERVATION

#

 <p>1 ERADICACIÓN DE LA POBREZA</p>	Área: Desplazamiento rural (30). Transversal – 5, 10, 15, 27	 <p>9 INDUSTRIA, INNOVACIÓN E INFRAESTRUCTURA</p>	Área: Quantum Tech (1). Transversal – 6, 10, 12, 19, 25
 <p>2 HACER HINCAPIÉ EN EL ALIMENTO</p>	Área: Xylella (6), Synthetic Cells (10). Transversal – 5, 27	 <p>10 REDUCCIÓN DE LAS DESIGUALDADES</p>	Área: Alimentación saludable (9), Desplazamiento rural (30). Transversal – 8, 20
 <p>3 BUENA SALUD Y BIENESTAR</p>	Área: Origen vida (7), Alimentación saludable (9), Neurología (25). Transversal – 4, 13, 18	 <p>11 CIUDADES Y COMUNIDADES SOSTENIBLES</p>	Área: Movilidad urbana 2030 (4). Transversal – 1, 9, 15, 30
 <p>4 EDUCACIÓN DE CALIDAD</p>	Área: Patrimonio abierto (20), Español científico (29). Transversal – 1, 4, 8	 <p>12 CONSUMO RESPONSABLE</p>	Área: Plásticos sostenibles (2), Economía circular (12). Transversal – 24
 <p>5 IGUALDAD DE GÉNERO</p>	Área: Comisión mujeres y ciencia Transversal: TODAS	 <p>13 ACCIÓN POR EL CLIMA</p>	Área: Clima (13), Polos 2050 (14). Transversal – 2, 3, 12, 28
 <p>6 AGUA LIMPIA Y SANEAMIENTO</p>	Área: Agua/Usos sostenibles (15). Transversal – 13	 <p>14 VIDA ACUÁTICA</p>	Área: Teledetección (19), Pesca sostenible(24), Observación oceánica(28). Transversal – 2, 11, 14
 <p>7 ENERGÍA LIMPIA Y ASEQUIBLE</p>	Área: Baterías Redox (3). Transversal – 4	 <p>15 VIDA TERRESTRE</p>	Área: Suelos sostenibles (5), Ecobiodiversidad (11), Vulcanología (18). Transversal – 6, 7, 14, 19, 27, 28
 <p>8 CRECIMIENTO ECONÓMICO</p>	Área: Optimización agraria (27). Transversal – 24, 30	 <p>16 PAZ Y JUSTICIA</p>	Área: Historia, cultura y sociedad mediterránea (8). Transversal – 20
 <p>17 ALIANZAS PARA LOGRAR LOS OBJETIVOS</p>	TODAS PTIs		



- >30 initiatives (12 + 7 approved by CCA y CR)
- > 400 CSIC research groups from 80 centers
- > 50 companies, institutions, social agents

Progressing on:

- Methodology
- **Dissemination**
- Talent Attraction
- Connecting with research career

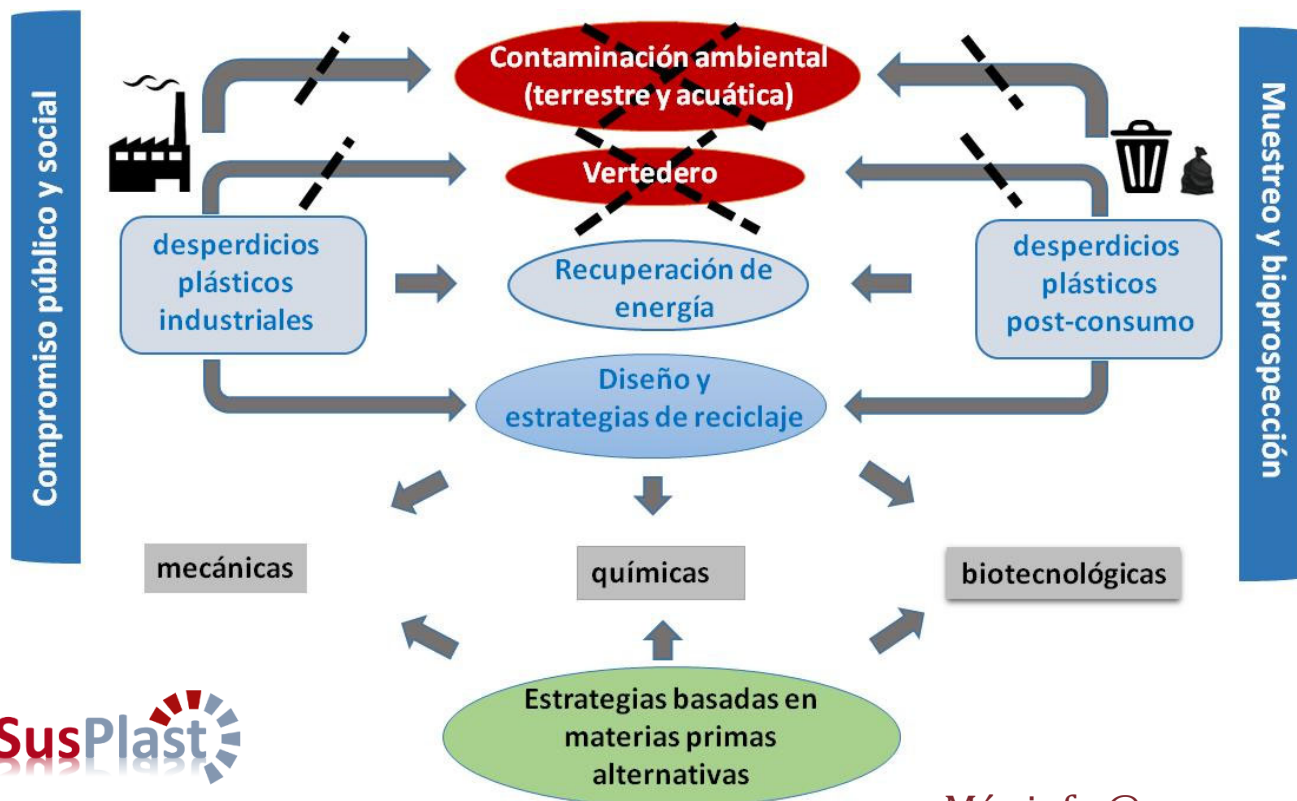
KEY LESSONS (in one slide, *up to now*)

- Interest as an RPO:
 - Collaboration: **YES** but **assure lean governance and lean management**
 - “Self financing” (i.e. >50% return) implies **no restriction for funding**
 - **Interdisciplinarity emerged naturally**
- KEY 1: **Reputed Researcher (+team) as Coordinator**
- KEY 2: **Stakeholders engaged from start**
- KEY 3: **Always open to good ideas, wherever they come from**
 - aligned with Sustainable Development Objectives: Social Impact
- KEY 4: **KEEP IN MIND: 50% WILL FAIL**
- KEY 5: Annual Monitoring, use existing internal
- **FINAL KEY: COMMUNICATION needs MARKETING**

PTI "SusPlast" Interdisciplinary Platform for Sustainable Plastics towards a Circular Economy

María Auxiliadora Prieto,
Biological Research Center (CIB-CSIC)
auxi@cib.csic.es

Reto SusPlast



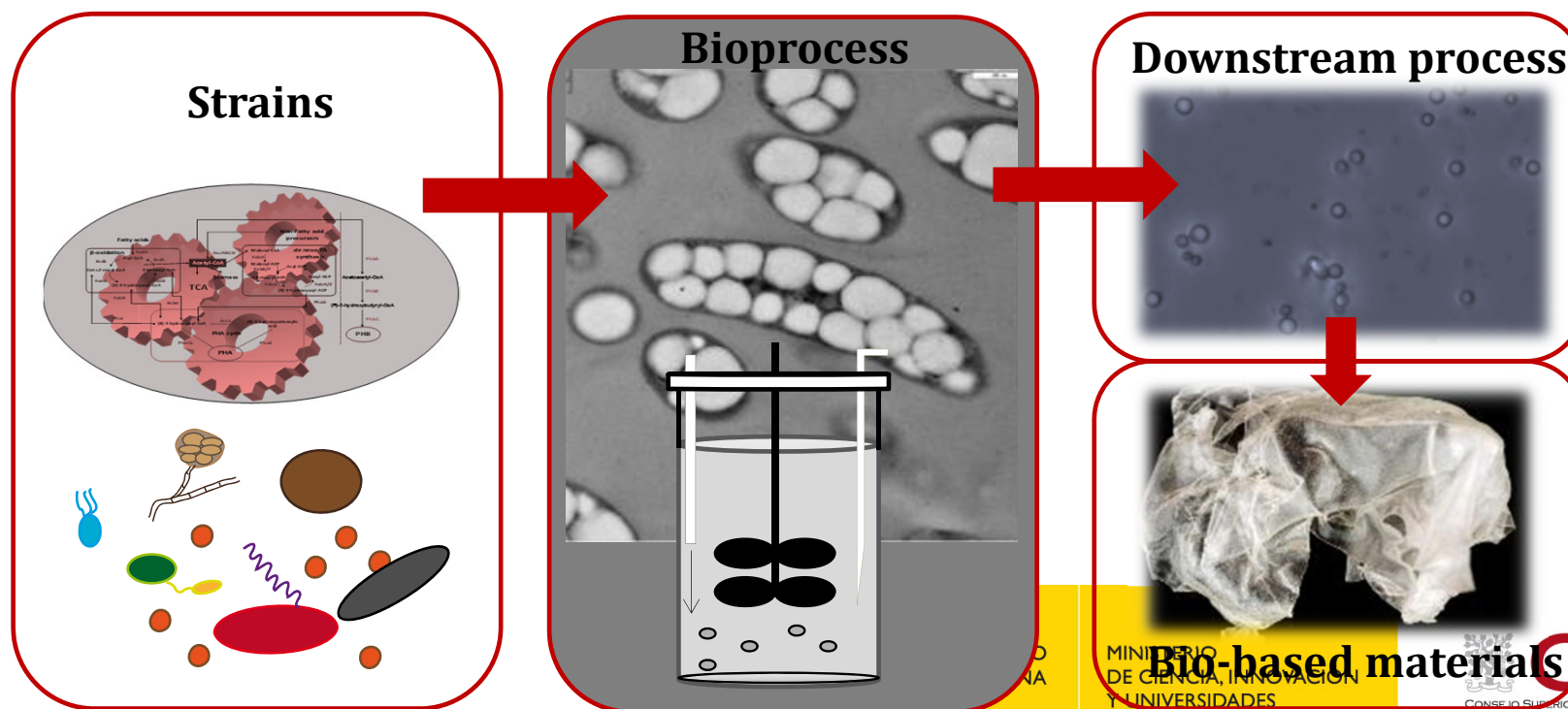
Interdisciplinary Platform for Sustainable Plastics towards a Circular Economy



Más info @ www.susplast-esic.org

Ej. 1: Towards microbial cell factory for bio-based polymer production

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Prieto MA., 2016. Microbial Biotechnology 9: 652-657

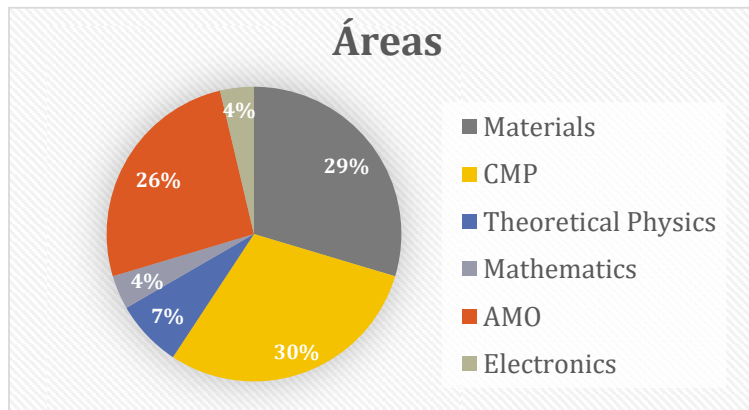
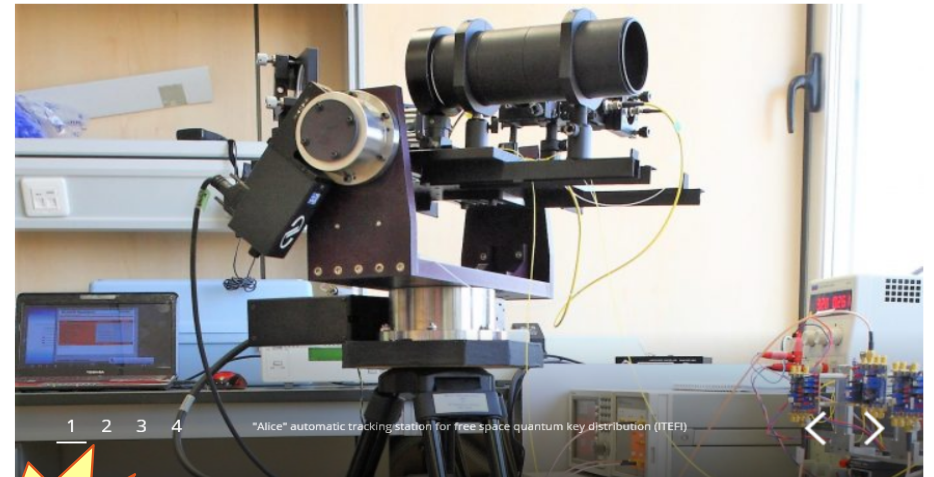
PTI Quantum Technology Platform (QTEP)

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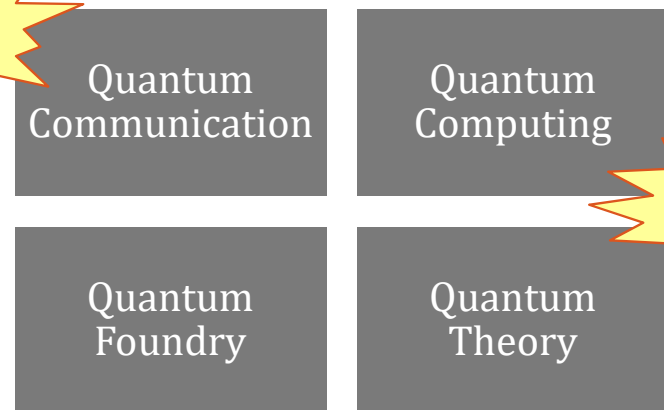
Juan José García Ripoll, *Instituto de Física Fundamental (IFF-CSIC)*
jj.garcia.ripoll@csic.es



QTEP ABOUT RESEARCH NEWS IBM-Q



Euro QCI



IBM-Q

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 CENTRO DE INVESTIGACIONES CIENTÍFICAS

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12+1 STRATEGIC LINES

- BASIS FOR A SUSTAINABLE GLOBALISED SOCIETY
- ORIGIN AND EVOLUTION OF LIFE AND SYNTHETIC BIOLOGY
- GENOME AND EPIGENETICS
- HEALTH CHALLENGES IN BIOMEDICINE
- AGING AND MIND
- RESPONSIBLE PRIMARY PRODUCTION
- IMPACT OF GLOBAL CHANGE
- CLEAN, SAFE AND EFFICIENT ENERGY
- BASIC COMPONENTS OF THE UNIVERSE AND THEIR STRUCTURE
- DIGITIZATION
- ARTIFICIAL INTELLIGENCE, DATA SCIENCE AND ROBOTICS
- EXPLORATION AND COLONIZATION OF SPACE
- OCEANS

Understanding data and AI for research

Application to biology and medicine (examples)



- Successful projects developed on classification of plants and snails using a CNN.
- Some projects being started right now on CNN for medical imaging applications:
 - Mental diseases through nuclear magnetic resonances.
 - Fatty liver: Classification of liver biopsies
 - Brain hemorrhage through TAC images.



Exploiting same AI techniques:
From plants to plankton, to conus, to HEP collisions, to brain...



Ignacio Heredia

Arquitectura
ResNet50

Framework
Python con Lasagne/Theano

Training dataset
PlantNet (6K especies | 250K imágenes)



- **Training dataset**
Colección de imágenes de expertos (68 especies | 1.5K imágenes) que cubren tres regiones diferentes:
 - Región Panámica
 - Región de África del Sur
 - Atlántico Occidental y Mediterráneo
- **Resultados**
Los resultados usando sets de imágenes de Google son prometedores

How to become the BEST expert in plant identification in your country in 10 minutes

Do you think experts understand how they identify "by heart"?

<http://conus.deep.ifca.es/>

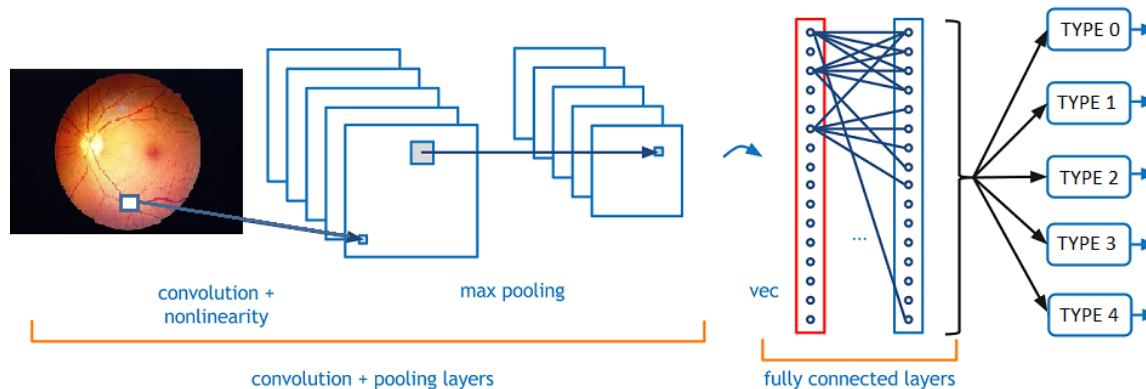
Lara Lloret



Research in Medicine: Joining Data and AI

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- **Retinopathy** is a fast-growing cause of blindness over 400 million people at risk from diabetic retinopathy alone : successfully treated if it is detected early.
- Colour fundus retinal photography is analysed in order to document the presence of disorders and monitor their change over time.
- Specialized medical experts interpret such images and are able to detect the presence and stage of retinal eye disease such as diabetic retinopathy.
- **Deep Learning approach:** automated classification based on color fundus retinal photography images



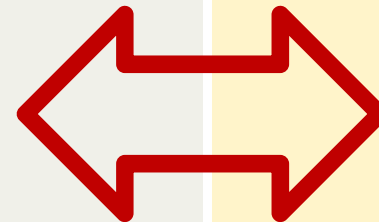
Only an example (but one of those few already accepted) of **medical applications** where AI **should** help for good!

ECOSYSTEM:

- biomed researchers /
- doctors
- patients
- biomed companies
- authorities
- hospital owners
- assurance companies
- families

A proposal: Joining Data and AI in a public safe environment

- **Donation of Medical/Personal Data**
 - Clinical History
 - Activity, Exercise, Food, Environment
- **Data Safe Haven (+ HPC framework)**
- **Legal Sandbox**
 - Joint (Public-Private) Research proposals
 - Open Research Software Tools (on IA)
 - Joint (Public-Private) Exploitation



ECOSYSTEM:

- biomed researchers /
 - doctors
 - patients
- biomed companies
 - authorities
 - hospital owners
- assurance companies
- families

Many, many technical advances

Ecosystem: **PRIVATE-PUBLIC COLLABORATION ON INTERDISCIPLINARY COMPLEX PROBLEM**

Key factor: **PRIVACY**

Status: **HOW TO PROGRESS?**

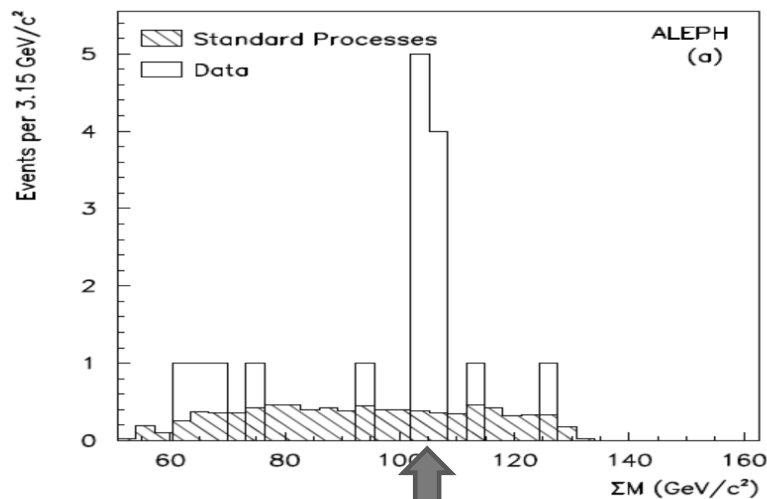
**EXPLOIT MEDICAL DATA ON
“PUBLIC” HPC CLOUD?
(IBM, Amazon, Google, Microsoft...)**

20 years towards open science in particle physics...

#CSIC *in one slide*

2015, LHC, CERN

1995, LEP, CERN



A new particle?

Many, many technical advances
Ecosystem: HEP community
Key factor: **REPUTATION**
Status: **PROGRESSING ADEQUATELY**

opendata

ABOUT SEARCH EDUCATION RESEARCH

Research > CMS

CMS Open Data are available in the same format as used in analysis by CMS physicists. A CMS-specific analysis framework is needed, and it is provided as a Virtual Machine image with the CMS analysis environment. The data can be accessed directly through the VM image. Basic information of the data contents is provided in About CMS and in About CMS Physics Objects. The original data are in primary datasets, i.e., no selection nor identification criteria have been applied (apart from the trigger decision), and these have to be applied in the subsequent analysis step. The 2011 data release includes simulated Monte Carlo datasets, but no simulated datasets are provided for the 2010 release.

VMs Getting started! Software and tools

CMS Primary Datasets

CMS Simulated Datasets

CMS Derived Datasets

CMS OPEN DATA @ IFCA.ES BETA

START YOUR ANALYSIS

nature
physics

Perspective | Open Access | Published: 15 November 2018

Open is not enough

Xiaoli Chen, Sünje Dallmeier-Tiessen, Robin Dasler, Sebastian Feger, Pamfilos Fokianos, Jose Benito Gonzalez, Harri Hirvonsalo, Dinos Kousidis, Artemis Lavasa, Salvatore Mele, Diego Rodriguez Rodriguez, Tibor Šimko, Tim Smith, Ana Trisovic, Anna Trzcinska, Ioannis Tsanaktsidis, Markus Zimmermann, Kyle Cranmer, Lukas Heinrich, Gordon Watts, Michael Hildreth, Lara Lloret Iglesias, Kati Lassila-Perini & Sebastian Neubert

Nature Physics 15, 113–119 (2019) | Download Citation | 9707 Accesses | 5 Citations | 151 Altmetric | Metrics >>

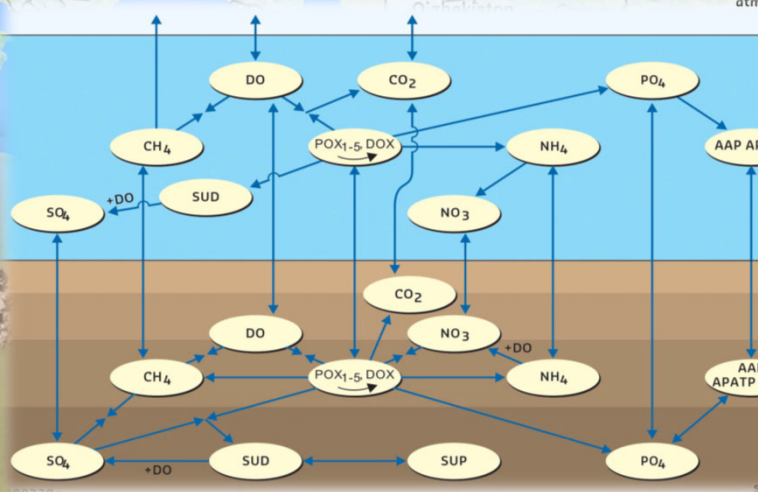
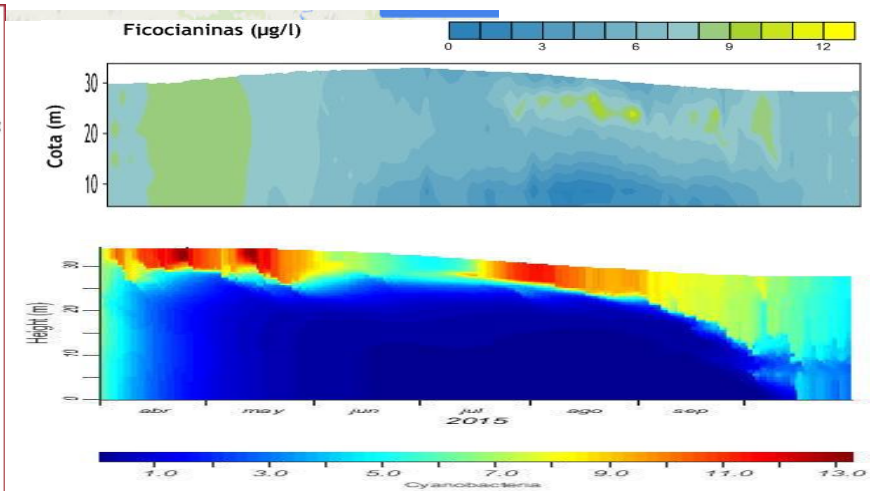
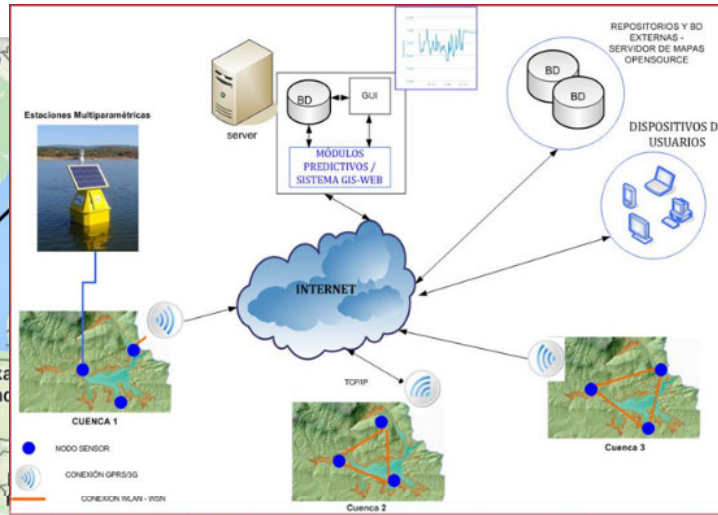
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12 years project on Eutrophication coordinated by an SME

Ecohydros, SPAIN

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Cuerda del Pozo
Watershed (Soria, SPAIN)



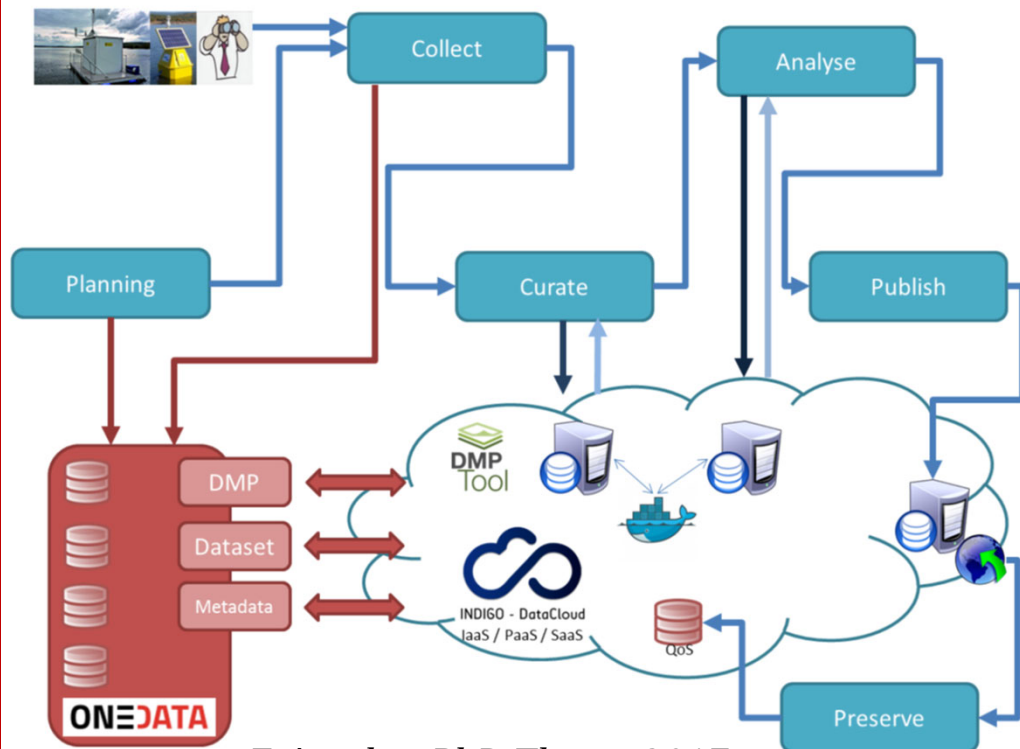
Many, many technical advances
Ecosystem: **PRIVATE-PUBLIC COLLABORATION**
ON INTERDISCIPLINARY COMPLEX PROBLEM
Key factor: **BUSINESS MODEL**
Status: **PROGRESSING ADEQUATELY?**

**EXPLOIT SENTINEL DATA ON
GOOGLE EARTH?**

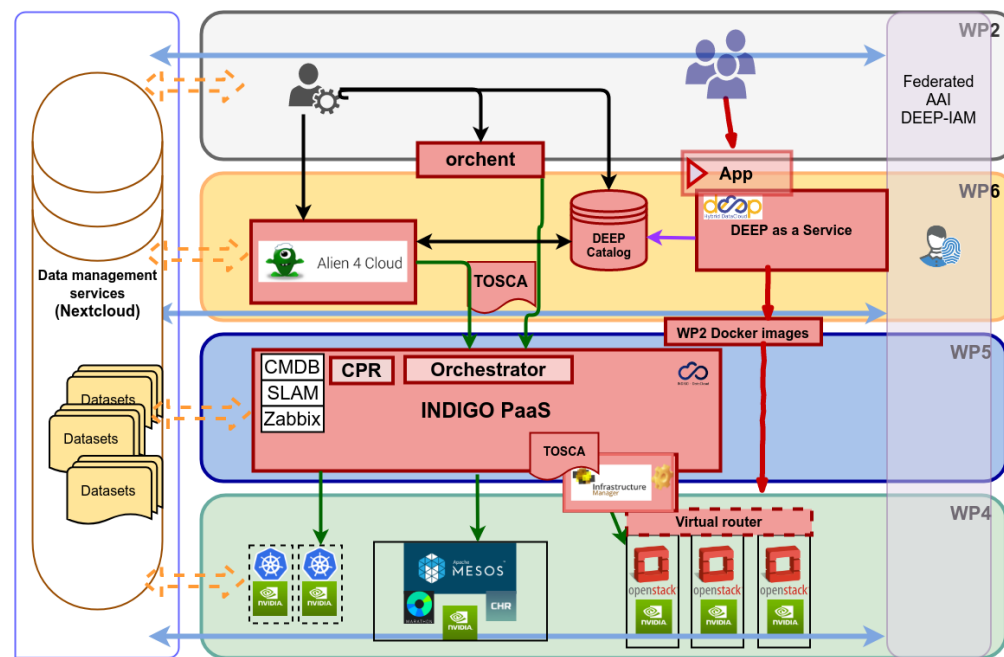


Research Data Life Cycle and Cloud Platforms

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F. Aguilar, PhD Thesis, 2017



A. López, DEEP Hybrid DataCloud architecture

implemented following

A set of Common Software Quality Assurance Baseline Criteria for Research Projects

<https://github.com/indigo-dc/sqa-baseline>

What next from CSIC

- #CSIC**
- **Better understand each ECOSYSTEM** in Open Science, and our role
 - NOT ONLY MONEY BUT KNOWLEDGE (AND INFLUENCE) CONTROL
 - POSITION AT RELEVANT FORA WITH ARGUMENTS AND EXPERIENCE
 - DISCUSS IN DETAIL IP RIGHTS AND LICENSES (**like N-C on data**)
 - **Reinforce support to Open Access/Science**
 - **CSIC Open Access Mandate (effective 1st April 2019)**
 - EXPLOIT EOSC ADVANCES (*from EOSC-Hub, EOSC-Synergy, INDIGO DataCloud, XDC, DEEP Hybrid DataCloud, Cos4Cloud*)
 - **E-INFRASTRUCTURE AND EVOLUTION OF P-P AGREEMENTS**
 - **REINFORCE TRAINING AND DISSEMINATION, NETWORKING!**
 - **Support new ideas exploiting Open Access/Data/Software**
 - **Data with privacy constraints but key for improving life quality**
 - Long term data series
 - Involve society (education and dissemination)
 - Keep in mind “AI FOR GOOD”



Epilogue

« Je vis comme je peux dans ce pays malheureux, riche de son peuple et de sa jeunesse, provisoirement pauvre dans ses élites, lancé à la recherche d'un ordre nouveau et d'une renaissance à laquelle je crois. Sans liberté vraie et sans un certain honneur, je ne puis vivre. »

« J'ai toujours pensé que si l'homme qui espérait dans la condition humaine était un fou, celui qui désespérait des événements était un lâche. »

Albert Camus, 1958