Industrial Commons as a Tool to Drive Innovation in Europe

Workshop Report

Brussels, 28 June 2018

Executive Summary

European-funded R&I projects are cradles of innovation, producing large amounts of data that can be (re-)used. In this context, Industrial Commons may accelerate innovation and even spill over into complete new areas of the economy. Similar to traditional "commons", e.g. land, water and air, goods that are used in common, Industrial Commons could mean R&D-derived knowledge, data, and capabilities shared across various industrial sectors. Industrial Commons potentially provide the means to take forward industrial project results and create new markets and new business models.

The move towards Open Science is global and systemic. Digital marketplaces have been proposed as a suitable concept to share and exploit Industrial Commons. In the area of materials modelling, marketplaces are starting to prove successful. However, there is a lack of skills – for mastering ontologies –, lack of tools for data sharing and management as well as a lack of suitable platforms. On the other side, there is also a lack of incentives. The example of KU Leuven is illustrative. It focuses on three core tasks: education, research and technology transfer as a service to society. One of the success factors mentioned is a (matrix-type) organisation that links up research departments, projects and staff. Another one is an efficient technology transfer office promoting the technologies developed.

Six presentations summed up project experiences and test cases:

- TCBL: data-driven transformation of supply chains into value-based business ecosystems.
- EvalHD: a steel quality management approach, ready to be transferred to various industries.
- Market 4.0: a manufacturing equipment simulation marketplace under development.
- International Data Spaces (IDS) Association creates standards for data sharing procedures.
- The European Technology Platform on Nanomedicine aims to build successful health tech businesses in Europe and offers access to project knowledge for all stakeholders.
- Nano Commons is an integrated resource on nanomaterials data accessible to all stakeholders.

Sharing data is not sufficient: meaningful (semantic) information regarding its use and practices are also needed. Regarding data ownership, the key question concerns the ownership of the meta-levels. Technological barriers are not the only ones and incentives to sharing must be created.

The benefits of sharing data are summarised in higher visibility, new relationships and businesses, and the avoidance of duplication of efforts. Knowledge sharing fosters cross-fertilisation and spill-over effects. To exploit results outside the initial field of application, main factors are right partnerships and compatible strategies of the individual partners. Some of the identified barriers are a lack of confidence in hosting platforms; the fear that data might leak to competitors; poor governance and a lack of ontologies and standardised data storage.

Participants recommended that the European Commission embeds "Industrial Commons" in future projects by rewarding activities that aim at user engagement, standardisation (including ontology development and use) as well as sharing of open data. The main obstacles to be tackled are the lack of syntactic and semantic interoperability between data and information repositories. Ontologies are a way forward here, but this requires a systematic effort to deal with taxonomies and develop useful AI-driven data extraction tools. Even if this succeeds, there is still the obstacle of mind-sets, which could be influenced by appropriate incentives.

1. Background and Rationale

Research and innovation (R&I) play an important role in shaping Europe's future. To maintain industrial competitiveness and to be able to master future societal challenges, cutting-edge innovation and openness are essential.

European-funded R&I projects are cradles of innovation, producing large amounts of data during their lifetime and at the end of the funding process. In this context, Industrial Commons may prove an effective and sustainable tool, powerful enough to accelerate innovation and even spill over into complete new areas of the economy. There are various views and opinions on the terminology "Industrial Commons". Similar to traditional "commons", e.g. land, water and air, goods that are used in common, Industrial Commons could mean R&D-derived knowledge, data, and capabilities for design, engineering and manufacturing, applicable across industry sectors, supported with public funding as a tool to grow innovation and able to generate new opportunities for growth and jobs in Europe.

The workshop addressed ongoing projects in the Industrial Technologies part of the Horizon 2020 programme. The aim was to collect input from stakeholders and discuss the potential role of Industrial Commons as to how to make this an opportunity for product creation in the future and which impact ideas and technological developments in R&I projects may have on industry at large.

Therefore, the workshop focused on existing industrial data sharing initiatives; on open, shared and accessible examples of project outcomes and best practice; and on devising possible ways to implement the Industrial Commons concept. The ultimate objective was to explore how project outcomes and best practices contribute to accelerating industrial innovation in Europe and in particular, how European Framework Programmes can support this process.

2. Presentations

Participants were welcomed to the Workshop by **Signe Ratso**, Deputy Director-General for Research and Innovation. The event would investigate ways to take up valuable project outputs in order to maximise their impact on innovation. Industrial Commons potentially provide the means to take forward industrial project results and create new markets and new business models. It offers the prospect of drawing together diverse stakeholders, pooling their visions, ideas and results to create win-win scenarios for ground-breaking innovations, developing new routes to job creation and growth by breaking down barriers between traditional industry silos. Thanks to the ICT revolution, a vast amount of options is at our disposal today to build a unique innovation ecosystem that embraces diverse technologies and industries. Opening up the research and development process to other players, could mean in particular:

- Using results obtained by others to create innovative new products;
- Repurposing products to be used in other ways (e.g. software built on top of existing software leading to new products);
- Collaborating between companies to pool data and benefit from larger data sets;
- Handling issues of data ownership adequately.

The workshop further aims to explore links between this initiative and Open Science.

Patrick Brenier, Deputy Head of the Open Data Policy & Science Cloud Unit in DG Research & Innovation spoke next about the EU Perspective on Open Data and Open Science. The movement towards Open Science is a global and systemic movement towards accessibility and reusability of research outputs and practices. The European Commission plays three roles: research funder, data regulator ensuring fair access and use, and policy maker driving forward crucial developments (e.g. European Open Science Cloud). To ensure harmonisation and good data management practice, Data Management Plans will become mandatory in projects in the new Framework Programme "Horizon Europe". The aim is to be "as open as possible, as closed as necessary"; however, there may be opt-outs for reasons of privacy, IPR and alteration of project scope. The six principles ("lines of action") of the European Open Science Cloud (EOSC) model (see fig. 1) could serve as a basis for the next steps in the Industrial Commons discussions.

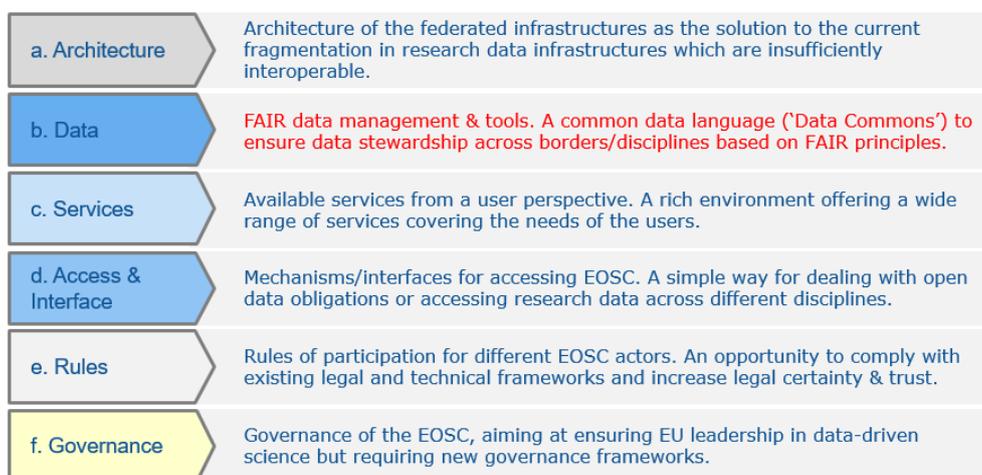| a. Architecture	Architecture of the federated infrastructures as the solution to the current fragmentation in research data infrastructures which are insufficiently interoperable.
b. Data	FAIR data management & tools. A common data language ('Data Commons') to ensure data stewardship across borders/disciplines based on FAIR principles.
c. Services	Available services from a user perspective. A rich environment offering a wide range of services covering the needs of the users.
d. Access & Interface	Mechanisms/interfaces for accessing EOSC. A simple way for dealing with open data obligations or accessing research data across different disciplines.
e. Rules	Rules of participation for different EOSC actors. An opportunity to comply with existing legal and technical frameworks and increase legal certainty & trust.
f. Governance	Governance of the EOSC, aiming at ensuring EU leadership in data-driven science but requiring new governance frameworks.

Fig. 1: Lines of Action for the EOSC

In his talk, Dr **Gerhard Goldbeck** of Goldbeck Consulting in Cambridge, UK proposed the concept of Digital Marketplaces as an engine to share and exploit Industrial Commons. He sees Industrial Commons located in the "valley of death" between academic innovation and industrial application. There is need for additional resources to leverage the value of commons via three "interoperability" steps:

- Firstly, linking up the data in various repositories and databases (syntactic integration, annotation, metadata);
- Secondly, facilitating their semantic integration (e.g. through ontologies, knowledge graphs, automated extraction, AI-enabled analysis);
- Thirdly, creating trusted and secure marketplaces of human interaction and collaboration (supported by reward mechanisms).

He showed that in the area of materials modelling, marketplaces are starting to prove successful. Marketplaces allow search for domain information and knowledge, interaction between experts as well as the creation and deployment of new applications and business.

Also, reflecting the perspective of industry, Dr **Rudy Koopmans** of the Plastics Innovation Competence Centre in Fribourg, Switzerland and EMMC emphasised the need for marketplaces as a tool to trade industrial commons in an open innovation environment. Digital technologies support connectivity and the sharing of data and information. Marketplaces are capable of bringing together a diverse range of skills, tools (e.g. semantic analysis, search) and expertise and prove to be a formidable tool to incentivise industry towards open innovation. On the one side, there is a lack of skills, for instance people do not know what ontologies are, which tools there are for data sharing and managing, as well as a lack of platforms. On the other side, there is a lack of incentives. For industry to participate or share any information clear commercial benefits need to be articulated. Finding the right information combined with the right stimuli leads to innovation with economic impact.

Professor Dr **Dominiek Reynaerts** of KU Leuven presented his university' innovation activities. Ranked as Europe's no. 1 innovative university, KU Leuven focuses on three core tasks: education, research and technology transfer as a service to society. One of the success factors mentioned is a (matrix-type) organisation that links up research departments, projects and staff. It facilitates multidisciplinarity and financial autonomy for each department through links between scientific disciplines as well as links to society and industry. Several market relevant start-ups were founded, now financially independent (e.g. 7 IPOs and 124 spin-offs to date). Ideas generated have been promoted efficiently through a linked technology transfer office.

Six project presentations summed up project experiences and test cases.

Mr **Jesse Marsh** of project TCBL talked about business models with new supply chains for customer-driven small series production. The objective of the project is to create a transformational ecosystem capable of constantly innovating the business and process models of the European textile and clothing industry. To achieve this the project has created the "TCBL Open Platform" which links to public knowledge from social media platforms (fab labs type) as well as knowledge from its own TCBL ecosystem: private data from TCBL users and data from new and third party services (some of which introducing blockchain-base services). Access to the Platform services is via TCBL Single Sign On, allowing for cross-platform cloud services and

open data exchange within the value-based TCBL community, thus creating industrial impact. The project proposes a model for transformative cross-industry innovation aiming at a data-driven transformation of supply chains into value-based business ecosystems.

Professor Dr **Harald Peters** of RFCS-project EvalHD presented an approach applied to the steel sector that could be transferred to other (metal and non-metal processing) industries. Steel quality assessment via evaluation of high-resolution product and process data is an impressive methodology that has benefitted the steel sector enormously and is applicable to other industries. However, there are obstacles to be overcome (e.g. missing collaboration platforms and tools as well as a lack of seed money to make the technology transferrable). First promising attempts are visible, nevertheless.

Mr **Sergio Gusmeroli** of Politecnico di Milano mentioned the European Commission Working Document "Guidance on sharing private sector data in the European data economy" (SWD (2018) 125 final of 25.4.18 which accompanies the Communication "Towards a common European Data Space"). An important enabler for data sharing is the availability of open platforms for industrial Internet of Things and data analytics. Several projects, for instance BEinCPPS and MIDIH, are developing the FIWARE for INDUSTRY platform. These projects and many others (e.g. Market4.0), build upon this platform to also link to manufacturing applications in 30 EU smart specialisation regions within the Vanguard Initiative. This means that while the diffusion of open platforms is well accepted within the industrial manufacturing R&I community, the availability and accessibility of open data is still in its infancy and at the moment focuses more on highly specialised marketplaces or trusted closed platforms, rather than on large open data spaces.

Mr **Lars Nagel** of the International Data Spaces (IDS) Association highlighted the paradigm change of data as a new economic asset in a data-driven economy. Companies share only 1% of their industrial data and prefer to keep them in-house due to a lack of FAIR[1] practices. The IDS reference architecture facilitates the finding and authentication of data transfer partners and keeps data owners in charge of the conditions for data use. The IDS, as a peer-to-peer network links different cloud platforms through secure exchange and trusted data sharing thus providing an extension of data access control. It aims at setting standards for data sharing procedures and connecting all kinds of data endpoints.

The nanomedicine translation hub, as presented by Mr **Alexandre Ceccaldi** of the European Technology Platform on Nanomedicine, aims to build successful health tech businesses in Europe. It offers access to industry knowledge, tailored support to the needs of projects, open to all stakeholders and offered as a service free of charge thanks to European Commission support. The Technology Platform has also set up the European Nano medicine Characterisation Lab, an infrastructure for the characterisation of pre-clinical nanomedicines including nanomaterial interactions with biological systems. It also develops better analytical methods in response to regulators' needs and supports research stakeholders.

Mr **Egon Willighagen** from the Department of Bioinformatics of the University of Maastricht presented briefly the concept of Nano Commons as a single integrated resource for valid and consistent nanomaterials data, accessible by scientists, regulators, NGOs and industry (e.g.

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[1] FAIR: Findable, Accessible, Interoperable, Reusable, see also https://www.nature.com/articles/sdata201618

access to experimental workflows, data processing, analysis, data visualisation and toxicity prediction).

The ensuing questions-and-answers-session highlighted the need not only for the mere sharing of data but also for meaningful information regarding its use and practices. An inquiry about industrial practice of International Data Spaces revealed that the validation of this concept has only been within project use cases. Regarding the ownership of the data, the crucial question should rather be, "Who owns the meta-levels?" It was felt that it cannot be sufficient to tackle only the technological conditions of data sharing, but also the human aspects and ways to create incentives to sharing.

3. Discussion

The afternoon session had workshop participants discussing and sharing experiences in three parallel groups focused on three specific questions. The following summarises the contributions made in the groups under each question.

Question 1 - What do you see as the added value of offering outcomes that are open, shared and accessible?

The sharing of data provides a higher visibility of both, the research topics and one's own contribution. Creating a community (ecosystem) with the potential of establishing relationships with the most important stakeholders and creating synergies between projects, innovators and industry is a valuable source of information and a way to avoid duplication of research efforts. It helps members to structure their work more effectively and achieve early validation of project results. A culture of knowledge sharing may increase awareness and user engagement for both academia and industry. Knowledge sharing fosters cross-fertilisation, spill over effects and other benefits, as innovation through cross-disciplinary sectors and applications is encouraged. Furthermore, this "many-eyes principle" helps accelerate technology uptake, fill innovation gaps and continually improve technology. Such interactions may also lead to new ideas for business models, e.g. from fully free to fully monetised models.

Question 2 - Can you imagine that your project outcomes could be applied or taken up by other industries? How? Is your project's exploitation strategy targeting those other industries?

The design of a partnership, as well as individual partners' strategies is essential for a project's exploitation strategy. Exploitation of results across industries works better when, from its outset, a consortium is designed to include a broad spectrum of end-users from diverse industries. Cluster activities engaging industry end-users across consortia with appropriate exploitation activities could help boost take up of a technology or methodology by other industries. Furthermore, the leveraging of various dissemination and communication channels allows reaching other stakeholders. Online platforms, market places and digital innovation hubs are useful tools for facilitating cross-sector fertilisation through project results and data. It is important, when disseminating results, that projects provide useful and adequate descriptions of products and their proposed use.

Question 3 - Any other barriers that could prevent you from operating fully open, shared, accessible and sustainable? In what way could there be support by the European framework programme in the future for this type of innovation?

Some of the identified barriers are the following: a lack of confidence in the platform that hosts the data; the fear that data might leak to competitors; a lack of fair-play rules and transparency in the governance. Limitations caused by intellectual property rights' protection of background knowledge lead to "islands of information" due to the lack of ontologies and standardised data storage, as well as due to other deficiencies, such as liability considerations as well as issues related to the reliability, sustainability, security and interoperability of the data. Regarding the lack of incentives and infrastructures or access to it, the European Commission could directly support this type of innovation in several ways. Firstly, by pro-

actively demonstrating its benefits; secondly by fostering and deploying relevant artificial intelligence and cybersecurity methodologies to raise users' trust; thirdly through new policies and incentives supporting open data (not necessarily by making it mandatory but by "penalising" users who opt out), and fourthly by ensuring the continuity and sustainability of the data repositories.

The interactive discussions pointed out further that Industrial Infrastructures could play a crucial role in providing expertise for sharing and managing data.

Participants recommended that the Commission make "Industrial Commons" an integral part of future projects, by rewarding activities that aim at user engagement, standardisation (including ontology development and use) as well as sharing of open data.

Further suggestions included, for example, the need to ensure an interlink between the FAIR principle and International Data Spaces, the need to invest in building a community culture (and its associated skills) through EU-wide harmonised practices, brokering infrastructures and financial or fiscal incentives for data sharing, and the need to ensure sustainable support for open data repositories across Europe.

4. Conclusions and Next Steps

Participants agreed about the need to encourage and ensure ways to share data and information for innovation. The need exists also in the industrial domain and many industrial stakeholders are working on solutions to create new business while sharing essential information and maximising re-use of ideas and the dividends of project collaborations.

There is also agreement as to the obstacles that exist for harnessing data and information that is there but hidden or not easily accessible – in company-internal data repositories, in the heads of engineers, in published papers. One aspect of this real difficulty is the virtual non-existence of syntactic and semantic interoperability between data and information repositories. Ontologies are a way forward here, but this requires a systematic effort to deal with taxonomies and develop useful AI-driven data extraction tools. Even if this succeeds, there is still the obstacle of mind-sets. Not everyone is at ease with a sharing mind-set, as there are notions of ownership of data and information that generate prohibitive protection mechanisms and practices. The mind-set issue can be resolved if persons are assured that knowledge and information sharing does not necessarily mean giving knowledge and information out for free. There are ways to share which maximise the benefits for all, whilst protecting ownership and ensuring credit to whom it belongs.

What the workshop has delivered is an encouragement to EU Research & Innovation to pursue ways to make data and information generated by publicly funded project digitally available, codified and standardised, and linked together in interoperable ways. This way they can be (re-)used and made available to users for the sake of generating knowledge and creating innovations and not by "re-inventing humanity's wheels". This aim is noble! It is about turning taxpayer's hard-earned resources into researchers' "gold".

Annex 1: Agenda

10:30   **Welcome to the Workshop**
Signe Ratso, Deputy Director-General, DG Research & Innovation

Europe – A potential innovation powerhouse?
Chair: Peter Dröll, Director "Industrial Technologies", DG Research & Innovation

Keynote speeches aim to set the scene on experiences with a wide scope of innovation activities in Europe

The EU perspective on open data and open science
Patrick Brenier | Deputy Head of Unit A2, DG Research & Innovation

10:40   **The industrial perspective**
Gerhard Goldbeck | European Materials Modelling Council
Rudy Koopmans | European Materials Modelling Council

The academic perspective
Dominiek Reynaerts | Katholieke Universiteit Leuven

Industrial Commons – Are there relevant project outcomes & best practice that can be shared?
Moderator: Luca Polizzi, Assistant to the Director of Industrial Technologies, DG Research & Innovation

Jesse Marsh | TCBL

Harald Peters | ESTEP WG

Sergio Gusmeroli | PSYMBIOSYS

Lars Nagel | International Data Spaces Association

Alexandre Ceccaldi | ETP Nanomedicine

Experts will showcase project outcomes and best practice that are working towards making those outcomes open, shared, and accessible by other industries

11:40   Brief presentations (10 minutes each) will focus on:
- Description of the project outcomes or best practice suitable for adoption in other contexts
- If applicable, description of type of facility or service
- Identification of main obstacles to becoming open, shared and accessible by other industries
- EU added value of Industrial Commons

Short discussion and Q&A with the invited experts.

12:40   **Lunch**

Interactive discussion
Facilitator: Arnaud Petein, Programme Officer, D2, DG Research & Innovation

13:30
Questions moderators: Dirk Beernaert, Birgit Bittmann-Hennes, Fragkiskos Archontakis

15:30   **Wrap-up, conclusions, next steps**
Doris Schröcker, Head of Unit D1 (Strategy), DG Research & Innovation

16:00   **Meeting closes**