A Critical Reassessment: The European Cloud University Platform and New Challenges of the Quartet Helix Collaboration in the European University System

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http://dx.doi.org/10.5755/j01.eis.1.16.31353

EIS 16/2022

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Submitted 04/2022
Accepted for publication 06/2022

Abstract

The European Commission has presented how it intends to give Europe a lead in the data-driven economy by enabling cloud-based services and world-class infrastructures for industry, scientists, and public services. In 2011 we discussed and proposed the cloud university platform for the European Union in the European Integration Studies. The purpose of the study is to deliver a critical reassessment of the European Cloud University Platform. Today a new European Open Science Cloud (EOSC) will offer Europe's 1.7 million researchers and 70 million science and technology professionals a virtual environment to store, share and re-use the large volumes of information generated by the big data revolution. The EOSC will be underpinned by the European Data Infrastructure, deploying the high-bandwidth networks and super-computer capacity necessary to effectively access and process large datasets stored in the cloud. There is also a target to build a single market for the Internet of Things: with the right standards for interoperability, and open cross-sector platforms for IoT devices and services to connect seamlessly, and scale-up, up anywhere in the EU. Our assessment is focused on the European Open Science Cloud (EOSC) and its operational functioning and implementation process. The study is based on conventional assessment methods and tools. The methodology is a mostly mixed methodology (with both qualitative and quantitative data analytics) and it pays attention to argumentation logic and actual policy planning process and operational implementation of the EOSC.

The role of Research Infrastructures (RIs), as well as cross-border innovation management approach are emphasized in recent transnational European research and innovation policy. Support for RIs form important pillars in the Horizon 2020-framework, as well as in the Horizon Europe-framework based on the idea that modern science requires unique global competitive capabilities, which individual institutions, or even individual European countries, often cannot provide by themselves. There are very good reasons to perform a critical assessment, because according to the European Cloud Initiative, over the coming 5 years, the European Commission will put forward proposals to meet the €4.7 billion investment need to integrate and consolidate data infrastructure. These vital proposals will bring together the EU and other sources, including Member States and private investments. By 2017, all scientific data produced by projects under the €77 billion within the Horizon 2020 research and innovation programme will become open by default to ensure that the scientific community can re-use the enormous amount of data they generate. This change is not marginal and needs more

European Integration Studies
No. 16 / 2022, pp. 9-23
doi.org/10.5755/j01.eis.0.16.31353

reflective discussions. The primary database of reassessment is the documents of the European Open Science Cloud (EOSC) and (1) associated European Commission work programme (overview of institution-wide deliverables), (2) the strategic plan (department strategy, objectives for 2016-2020) and (3) other EU management plans and scientific discussion associated with platform economy research. These EU documents were published after our original EIS article.

The key results of critical reassessment are: (1) There are concrete needs to strengthen links between the European Open Science Cloud, Industry 4.0 strategy and Industry 4.0 Curriculum in Europe, (2) the concept of platform needs more discussion in the future developments of the European Open Science Cloud (EOSC), (3) country-level university and research community participation in the EOSC requires more discussion and more updated operational implementation plans and programs, and (4) there is need to plan symbiotic digitalized innovation eco-system policy and economic growth policy framework for the European Union. We summarise our critical reassessment with a critical note that there are big integration challenges of the European Open Science Cloud.

KEYWORDS: European Open Science Cloud, Big Data, Industry 4.0, Higher education, European integration, Digitalization, Platform economy, Open science policy, Open innovation paradigm, Collaboration framework of European universities, Data governance, Digital platforms, Data infrastructure, European data politics, Data policy.

Disclosure Statement

Authors declare that they have no competing financial, professional, or personal interests from other parties.

Introduction

We know that today a new *European Open Science Cloud* (EOSC) will offer a virtual environment to store, share and re-use the large volumes of information generated by the big data revolution (see Central European University 2021). In the European Union there are about 1.7 million researchers and 70 million science and technology professionals who can use this system and associated knowledge services. Historically, in July 2020, the EOSC association was set up to provide a single authoritative voice for advocacy and represent the broader EOSC stakeholder community in the European Union. This new association aimed to become operational by early 2021 and rapidly expand its membership in the European Union. This is not a marginal policy issue for the future of the European Union (European Commission 2021). Today we can note that the EOSC is a strategic cornerstone of the European digital transformation strategy and mission.

The EOSC will be underpinned by the European Data Infrastructure, deploying the high-bandwidth networks and super-computer capacity necessary to effectively access and process large datasets stored in the cloud system. There is also a target to build a single market for the Internet of Things: with the right standards for interoperability, and open cross-sector platforms for IoT devices and services to connect seamlessly, and scale up, up everywhere in the EU.

EOSC's practical implementation is supported by a European data infrastructure that deploys high-bandwidth networks and large supercomputer capacity, which will be needed for the efficient use of digital resources and further processing of large datasets stored in the cloud system. The aim is to build an internal market for the Internet of Things (IoT) in the European Union, both with the interoperability standards and with open cross-cutting platforms for technical IoT devices and services. This new European infrastructure enables seamless network connections and scaling up across the European Union.

Our critical reassessment is focused on the *European Open Science Cloud* (EOSC) strategy and its operational functioning and implementation process. Methodologically his study is based on conventional assessment methods and tools. The methodology is the mixed methodology approach (with both qualitative and quantitative data analytics) and it pays attention to argumentation logic and actual policy planning process and operational implementation of the EOSC.

The Gothenburg Summit – a European vision for education and culture

The education landscape across Europe has been changing and there has been a process of international vision building. At the *2017 Gothenburg Summit*, EU leaders outlined a broad vision for education and culture. In its December 2017 official conclusions, the European Council called on the EU Member States, the Council, and the Commission to take forward a number of initiatives. The Gothenburg Summit outlined the future of the European Union's university policy. It aims to strengthen strategic partnerships across the EU between European universities. This new policy framework encourages the establishment of some twenty "European universities" by 2024. These European university networks consist of bottom-up university networks across the EU. Students can obtain a degree by combining studies in several EU countries and universities. This concrete activity will help to promote the international competitiveness of the European universities.

The key principles of the Gothenburg Summit were: (1) Joint responsibility to put people first, (2) more men and women in employment and ensuring easier access to labor markets, (3) fair employment and good working conditions for the European labor market, (4) investments in people to facilitate transitions between jobs, and (5) further actions (European Commission & The Government Office of Sweden 2017). The general guiding principles of the Gothenburg Summit were as follows. The first principle of the Gothenburg Summit was a shared responsibility to put people first, that is, this principle was humanistic and humancentric. The second principle set out the objective of increasing the number of men and women in working life and facilitating general access to the labour market. The third principle was fair employment and good working conditions in the European labour market. The fourth principle was investments in people to facilitate the transition in the European labour market. The fifth principle was the planning and implementation of other additional policy measures. Further actions were linked to Euro policies underlining gender equity and social cohesion (European Commission & The Government Office of Sweden 2017, p. 5).

Key institutional and organisational steps to European Cloud University

We can note that key institutional and organisational steps to the realisation of the European Cloud University have been three key elements: (1) start-up of the European Open Science Cloud (EOSC), (2) new definitions of European Data Strategy, and (3) reorganisation of the European Research Area (ERA). All these principles are strategically linked to the promotion of digital transformation in Europe.

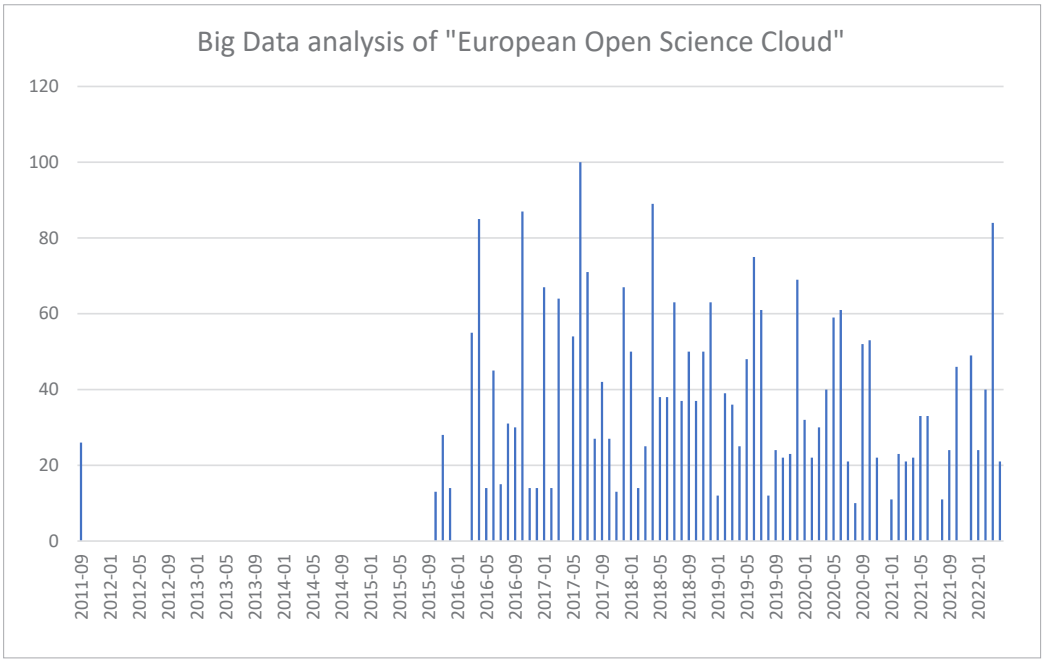
The European Open Science Cloud (EOSC)

We can note that the European Open Science Cloud was reflected in many ways our original paper (Kaivo-oja & Stenvall 2011). In Fig. 1 we have reported Big Data analysis of the concept of the "European Open Science Cloud". We can note that our original was noted internationally in 2011. It took some years to raise broader international interest to the European Open Science Cloud.

The Austrian Presidency and the European Commission invited stakeholders from all EU Member States to celebrate the launch of the European Open Science Cloud (EOSC) in 2018. The official launch event on 23 November 2018 marked the conclusion of a long process of consultation and reflection with various stakeholders and it was a pioneering start-up event for the European Open Science Cloud. We can critically note that it took for the European Union seven years to implement the basic idea of European Cloud University and platform approach. The Vienna Declaration (see a very official political agreement text in Appendix 1) on the European Open Science Cloud Governance Structure (EOSC Vienna Declaration (eosc-launch.eu) summarized the demanding consultation process by highlighting most important steps. The EOSC Vienna Declaration emphasized the need to actively support this joint European effort to ensure smooth and

Figure 1

Big Data analysis of "European Open Science Cloud" (Google Trends Database 20.4.2022)



successful implementation of the European Open Science Cloud (EOSC). The political willpower was very strong in the Vienna Declaration.

Today the European Open Science Cloud (EOSC) is an environment for hosting and processing research data to support all the EU science activities. The process to create the EOSC was initiated by the Commission in 2015. The key idea was to develop a trusted, virtual, federated environment that cuts across EU borders and scientific disciplines to store, share, process and re-use digital objects of research (like publications, data, and software) following four FAIR principles: (Meta)data are assigned a globally unique and persistent identifier, Data are described with rich metadata. Metadata clearly and explicitly include the identifier of the data they describe. Fourth principle is that metadata are registered or indexed in a searchable resource (Wilkinson et al. 2016).

The interim governance is composed of the EOSC Governance Board with (1) representatives from all the EU countries, countries associated with the Horizon 2020 program (and now Horizon Europe program), with (2) the European Commission to ensure effective supervision of the EOSC implementation, with (3) the EOSC Executive Board: representatives from the research and with e-infrastructures communities and the EOSC stakeholders (European Open Science Cloud 2021). Today the EOSC brings together institutional, national and European stakeholders, initiatives, and data infrastructures to develop an *inclusive open science ecosystem* in Europe. We can note that this development is a new policy element of social inclusion policy and European integration policy in the European Union. This policy decision can create a potential momentum for new insights and innovations, higher research productivity, and improved reproducibility in science, technology and innovation activities (see also Kaivo-oja & Stenvall 2012). New open science principles describe a more inclusive, collaborative, and transparent world of research. (European Open Science Cloud 2021).

Later in May 2015, the European Commission proposed creating a European Open Science Cloud for the Competitiveness Council. The strategic aim was to federate existing research data infrastructures in Europe and realise a web of FAIR data and related services for science, making

research data interoperable and machine-actionable following the FAIR guiding management principles described above in previous section. In the initial phase of development until 2020, the Commission invested around €320 million to start prototyping the EOSC through project calls in Horizon 2020 - the Commission's research and innovation funding programme. In March 2018, the European Commission finally published the EOSC Implementation Roadmap detailing the main action lines of the first EOSC implementation phase until 2020. A multi-layered framework, and interim governance structure was established from November 2018 to steer and oversee the operational implementation of the EOSC from 2019 to 2020. (European Open Science Cloud 2021).

European Data Strategy

The European Data Strategy recognises the EOSC as the nucleus for science, research and innovation data space, which will become articulated with the nine sectoral data spaces foreseen by the data strategy. The EOSC timeline indicated in the European Data Strategy foresees the following stages: (1) by 2025: deploy EOSC operations to serve all the EU researchers; (2) from 2024: open up, connect and articulate the EOSC beyond the research communities, with the wider public sector and the private sector activities, and (3) post-2020: establish a renewed, stakeholder-driven EOSC governance structure possibly in connection with the launch of a corresponding EOSC European Partnership in the first quarter of 2020. (European Commission 2021).

In a nutshell, this is actually the European Data Strategy. The European data strategy aims to make the EU a global leader in a data-driven society. Creating a single market for data will allow data to flow freely within the European Union and across industries and sectors for the benefit of businesses, researchers and public administrations.

European Research Area (ERA)

The EOSC is a central element supporting knowledge circulation, diffusion, and uptake in a revitalised European Research Area (ERA), which aims to fit for the digital Industry 4.0 age. One of the fourteen actions introduced in the Communication on a new European Research Area for research and innovation consists of ensuring a novel EOSC that is offering a web of FAIR data and related advanced services.

Further actions were linked to the Euro policies in the following ways. The Summit witnessed the joint proclamation of the European Pillar of Social Rights by the European Parliament, the Council, and the European Commission. (European Commission & the Government Office of Sweden 2017, p. 5). The European Commission´s Work programme (2021) includes key statements, which provide an updated situation analysis of the European digital transformation policy. This Work Programme includes strategic EU policy statements (European Commission 2021, p. 4), which in a nutshell are including policy statements. The European Commission (EC) wants to ensure that there really will be Europe's digital decade. The EC wants to propose a roadmap with clearly defined goals for 2030, such as key policy variables, as for (1) connectivity, (2) skills, and (3) digital public services. This EU approach will follow four clear principles: *the right to privacy and connectivity, freedom of speech, free flow of data, and cybersecurity.* Following the idea of the digital decade era, the European Commission will take action across these different policy areas, notably with legislation covering the safety, liability, fundamental rights, and data aspects of artificial intelligence. There will be *a Data Act* to set the right conditions for better control and conditions for data sharing for citizens and businesses. The European Commission will propose *a new European digital identity* to make it easier to do tasks and access services online across European member countries and ensure that European citizens will have greater control and

peace of mind over what data they share digitally and how this content is used. Planning work for an international agreement for *a fair tax system* continues. This reform will provide long-term sustainable revenues for governments. The European Commission will propose a digital levy in near future. In the same spirit of a fair business environment, the EC will propose *a legal instrument to level the playing field as regards foreign subsidies*. These planned EU actions uphold fairness of governance in the digital world.

The EC will also update new industrial strategy (linked to Industry 4.0 transformations) for Europe to take into account the impacts of the COVID-19, the global competitive context, and the acceleration of the twin green and digital transitions. The EC will continue its ongoing review of competition rules to ensure they are fit for the changing market environment, including the accelerating a determined digitalisation of the economy.

And as a final political statement, the EC works for ensuring *dignified, transparent, and predictable working conditions*, a legislative proposal to improve the working conditions of people providing services through platforms will be presented with a view to ensuring fair working conditions and adequate social protection. Clearly defined goals linked to the EOSC for 2030, are *(1) better connectivity, (2) better skills, and (3) better digital public services.*

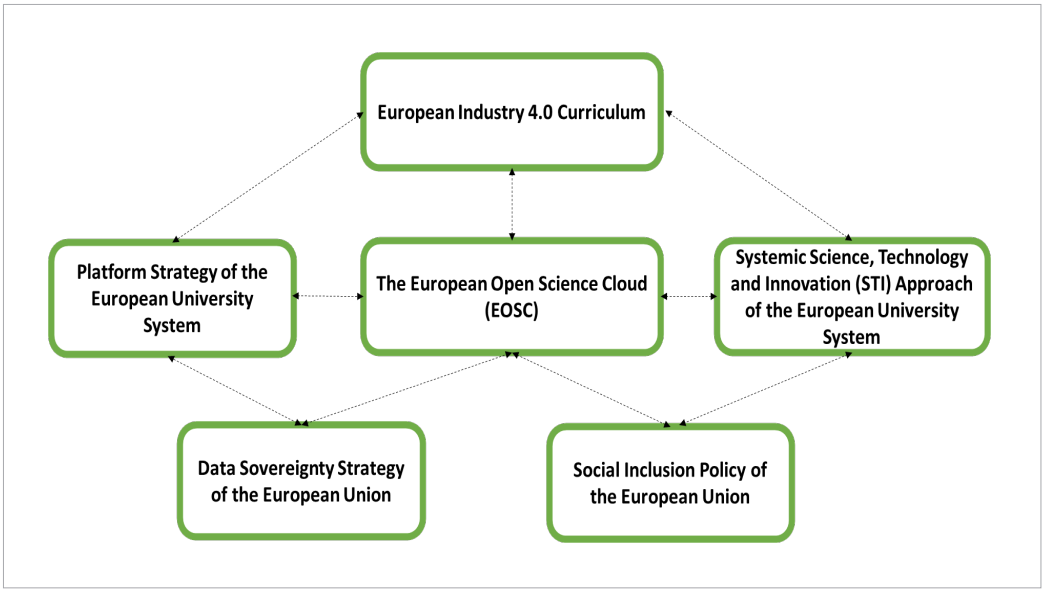
Critical assessment of the European Open Science Cloud (EOSC)

In Fig. 2 we present critical elements of assessment of the European Open Science Cloud. From the perspective European integration policy planning, we note that key critical elements are: (1) European Industry 4.0 Curriculum, (2) Platform Strategy of the European University System, (3) Systemic Science, Technology and Innovation Approach of the European University System, (4) Data Sovereignty Strategy of the European Union and Social Inclusion Policy of the European Union. We note also that Research Infrastructure (RI) Strategy can be seen as a key element of the European University System. Data sovereignty means keeping ownership and control of personal and organisational data, so it remains subject to your own governance structure.

EOSC Strategic links to Industry 4.0 approach

It is a generally known fact that we are in the age of the Fourth Industrial Revolution. The main challenges are related to the exponential growth of digital tools and products that include robots, cobots, connected objects, communication systems, data centers, and associated energy con-

Figure 2
Critical elements of assessment of the European Open Science Cloud



sumption. The European Open Science Cloud (EOSC) has a huge potential to support European companies and corporations to be in the forefront of Industry 4.0 development. In Jan 2020, the European Commission (2020, p. 10) noted in the official report "Skills for Industry Curriculum Guidelines 4.0: Future-proof education and training for manufacturing in Europe": "While there are already examples of effective approaches towards adapting engineering training to the needs of Industry 4.0, numerous education and training providers only now begin to consider the necessary development. Reshaping curricula is a considerable challenge, implying complex decision-making processes and various administrative obstacles. Many departments and faculties are still dominated by traditional approaches and subject-related 'silo thinking', while the new industrial age requires fundamentally new mind-sets and visionary leadership."

This European policy statement can be taken as a critical assessment of the EOSC operations. In the European Union there are many needs to offer more a source of inspiration, conceptual guidance and good practice examples of the EOSC operations. Awareness and good case studies are needed. There is need to have more guidelines, which are applicable for both designing fundamentally new educational offers and advancing existing Industry 4.0 curricula, depending on the level of required change. We are broadly aware that advanced manufacturing and the Industry 4.0 agenda have a high priority on the political agenda of the European Union, and these issues are seen as a key enablers that will lead European society towards higher industrial competitiveness, sustainable growth and job creation, and improved societal wellbeing.

EOSC strategic links to the Platform economy thinking

We can see government systems as digital platforms (Bygstad & D'Silva 2015). Government as a platform combines the three characteristics of the digital era governance: (1) Human centricity, (2) full digitalization and (3) common goals. By combining these three characteristics, and including feedback loops for measuring their success, it reaches three goals: efficiency, inclusion and institutional change. The digital era governance cannot happen if there are services that don't leave a digital trace. Many benefits of digitalisation are lost, if there is no data. Data is pre-condition for most of Industry 4.0 technologies. Digital by default strategies help and enable developing digital services in the right way. Another helpful approach is to build common data sharing funnels, such as the X-road in Estonia. (Koponen 2018, X-Road® — e-Estonia (e-estonia.com)).

There are many institutional changes that are required to get everything out of the later stages of digitalization such as hyperconnected society, artificial intelligence (AI), blockchain, etc. For the public sector, the most important transition is the transition from "New public management" to "Digital era governance". New public management guided government organizations to efficient but budget lead, siloed approaches. Typically, very large organizations were divided to smaller groups, competition inside the public sector was increased. A lot of public work was done via tenders and projects and there were new monetary reward systems for leaders and groups. The NPM approach emphasized doing things right, while sometimes having a blind spot in doing the right things – at least from the whole of government public service perspective. Because of these kind of problems, digital tools don't work well with the NPM paradigm. Too often similar apps and digital productions are produced in neighbouring municipalities, APIs are non-existent or non-standardized and common public goal is completely missing. However, the benefits of digitalization come from various network effects and victorious loops that are not visible when one is only looking at digital practices in each government agency and municipality individually. This can be a problem in the context of EOSP. (see Dunleavy et al. 2006, Koponen 2018)

Today, the impacts of the platform economy on public services and government are not well known. Many possibilities are still open and hidden. The potential for the digital platform economy to help restructure services and governance structures of European Union. An algorithmic

revolution, Big Data analytics and cloud computing are well-known drivers of digital development. Platforms are often used in coordinating market transactions in an extremely efficient way. However, in order to apply the platform-concept to the public sector, an experimental approach is needed. Public platforms cannot be built by transposing mechanical models of the private sector to the public sector, because the organisational logic of public services is quite different than open markets. Collaborative value co-creation in the Platform Economy needs more attention in the context of EOSC (see Hautamäki & Oksanen 2018). Human beings can be both consumers and citizens are this is a fundamental starting point to develop platforms for private and public sectors. There can also be hybrid platforms, which include elements of both private and public platforms. Typically (1) platform owner, (2) objectives, (3) industries, (4) business model and (5) challenges of the platform economy are different in various alternative platforms of private and public sectors (Ottlewski & Gollnhofer 2019).

Public media attention is mainly focused on private sector platforms that pursue profit maximization objectives. However, public sector platforms have recently emerged providing solutions for socio-economic challenges in our highly disruptive times (including European Covid-19 era crisis). They share some commonalities with private sector platforms, but they are fundamentally different in their social goals and premises. Moreover, there are hybrid platforms which may blend/mix the characteristics of private and public sector platforms to offer innovative solutions. The possibility of public and private partnerships should always be taken seriously.

One key aspect of platform economy thinking is the functionality and nodularity of various platforms. In Fig. 3 we have presented Tiwana´s analysis of platform integration (Tiwana 2014). One strategic barrier of the EOSC approach can be that there is not very clear strategic approach, how to manage various possible functionalities of the European Open Science Cloud. In any case there should be some kind of transparent way to handle this challenge.

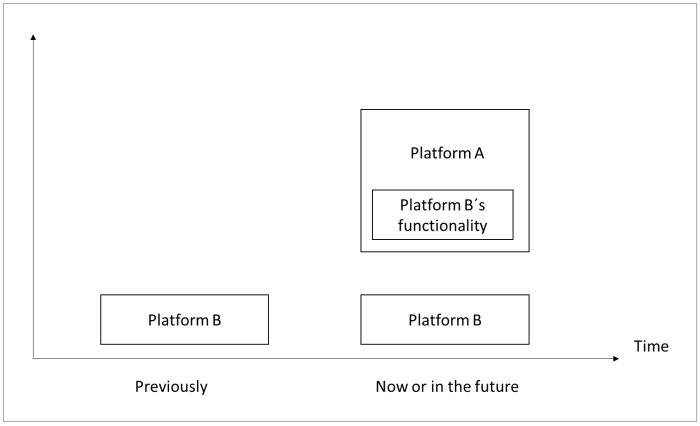


Figure 3
Envelopment of one platform (B) by a platform (A) in a adjacent market (Tiwana 2014, p. 36)

Another critical aspect of the structure of the European Open Science Cloud is how products, services and platforms of European universities should be organised. Fig. 4 demonstrates this challenge in many ways. We know that universities have originally been organised physically, but now digital aspects matter more. This means that the delivery systems, purchasing systems and digital contents matter more and more. For example, MOOC, Massive Open Online Courses alternatives need more attention in the EOSC development (see e.g. EURES, European Commission 2021, edX 2021, Kim 2015).

There are some unsolved problems in the EOSC. Platform modularisation has four downsides for app developers. Well-known and identified key problems are (Tiwana 2014, p. 105): (1) Modularity imposes additional costs on app developers, (2) app performance takes hits, but not always, (3) modularity constraints experimentation and apps may be reformulated in European universities and (4) Leveraging the platform increases app developers´ vulnerability. These four problems must be solved in some ways and strategic decisions. Modular platforms give platform

owners an increased capacity to innovate within a platform. There should be more open and critical discussion, how these four key problems are solved within the EOSC. The question of modularity is a key question, because designing a perfectly modular platform is almost impossible. There is need to recognise, anticipate and resolve all app-platform dependencies in advance (see e.g. Baldwin & Clark 2000, p. 6).

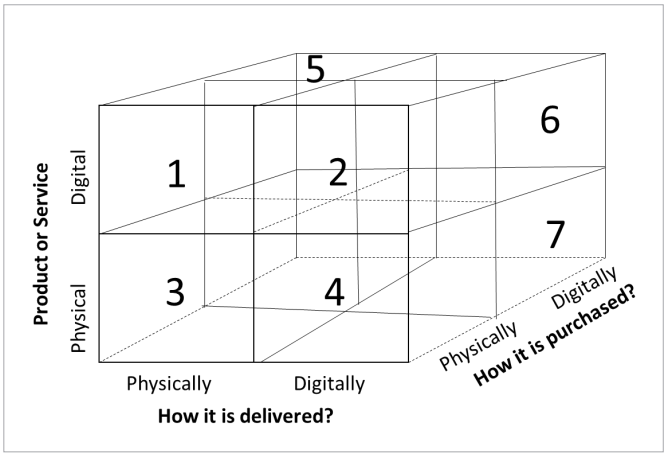


Figure 4
The packetization cube framework (Tiwana 2014, p. 14)

The socio-technical anticipation of European Open Science Cloud needs probably more attention in this respect. For example, the expected integration of AR/VR technologies to the EOSC is a huge European opportunity in global competition of higher education, but there is not too much discussion in the European Union and in the EOSC. The platform architecture is a broader question than successful apps. This is a challenge for a platform owner, for the EOSC.

EOSC strategic links Inclusive country-level participation and social inclusion policy

Social inclusion is a catchphrase of European integration policy. This policy issue is underlined in many policy agendas and policy declarations of the European Union, especially now in the conditions of Covid-19 crisis. In Fig. 5 we have visualised some fields of social inclusion. If we want that the EOSC serves the idea of social inclusion, we must understand in deeper ways how the activities of European STI ecosystem systems serve the targets of social inclusion. As widely recognised, especially, the unresolved problem of structural exclusion needs more attention (Thomas et. al 2012).

The key challenge of social inclusion is how EU policies help people to fight against poverty. get better education, better knowledge and information services and improve quality of life in Europe. If we want to integrate social inclusion targets of the European Union to the EOSC, some

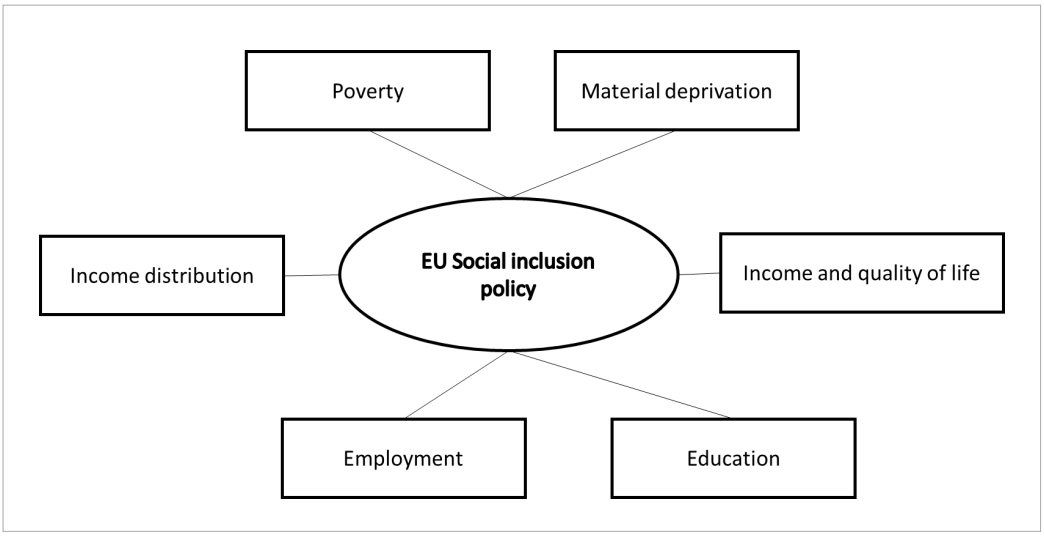


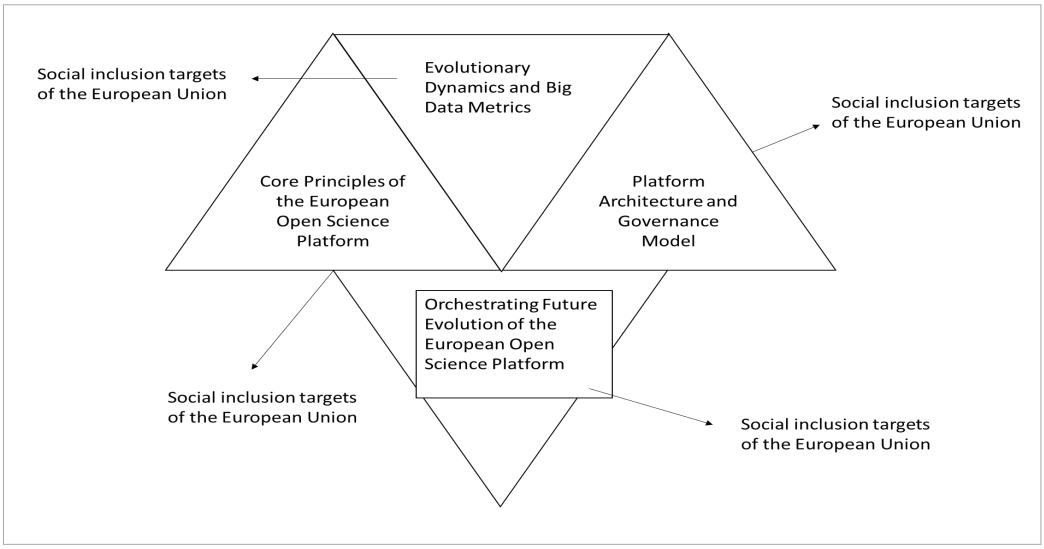
Figure 5
EU social inclusion policy: Key variables

key aspects are presented in Fig. 6. According to our critical assessment, we still lack many critical elements of social inclusion policy in the context of the EOSC.

Fig. 6 can be used and applied in the planning process of architecture and governance of the European Open Science Cloud (EOSC). In this way we could pay more attention to the principle of governing as governance (see Kooiman 2003). In the context of data management policy this principle is a relevant aspect.

Figure 6

The European Open Science Platform (EOSC) and social inclusion challenges



EOSC strategic links to STI strategy of innovation, closed innovation and symbiotic innovation systems

In Table 1 we have outlined key innovation approaches and their links to product, service and platform approaches. Symbiosis innovation management approach is needed in the most of futures-oriented futures studies (see Kaivo-oja & Santonen 2016). A key point in this context is that we claim between closed and open innovation approaches there is a symbiosis approach because closed innovation and open innovation are not performed in pure forms nowadays in very international and globalised world of innovations. For example, the government of South Africa made an interesting study about its STI policy and future needs with Big Data analytics (NACE Secretariat 2019). This process was focusing on all STI resources and challenges. Actually, this study was linked to symbiosis of closed and open innovation approaches in a global setting. Similar possibilities of digital Big Data analysis tools are today available for the European Commission and its member countries. Research potential of European Union in various domains can be accessed via basic research publication activity with indicators of European Union member countries and other countries in the EOSC and Scopus databases. Integration of various Big Data sources and pools need more attention in the EOSC administration and agencies.

Table 1

Closed, symbiosis and open innovation: Product, service and platform approaches

	Closed innovation	Symbiosis	Open innovation
Product	Typical market approach	Typical public-private approach	New market approach
Service	Typical market approach	Typical public-private approach	New market approach
Platform	New market approach	Typical public-private approach	Emerging private and public approach

EOSC strategic links Data sovereignty questions and challenges

Many EU member states are transitioning to a new economy built on data and digital economy. Individuals and firms in EU member states have expertise in using data to create new goods and services as well as in how to use data to solve complex problems. In Fig. 7 we have outlined key alternatives of data sovereignty policy. Every nation must define its own data sovereignty policy, but there are also some needs for European integration. As a recent OECD paper, the author notes, 'Data flows have brought risks, weaknesses, and complications as well as benefits' (Svantesson, 2020). Today understanding data governance models is, therefore, a key strategic challenge for EU Member countries. It is impossible to define the rules of data governing or data governance models by one organisation or one project.

Partnerships are needed in many fields of data management. There must be broader discussion in society and also in the context of the European Open Science Cloud. Micheli et al. (2020) identified four key emerging data governance models, which may function as useful alternatives to today's dominating platform models: (1) Data sharing pools (DSPs, see e.g. Mattioli 2017), (2) data cooperatives (DCs), (3) public data trusts (PDTs), and (4) personal data (Micheli 2020, p. 7, Lehtiniemi 2017). To avoid concentrating public and private resources at the mercy of large-scale enterprises located elsewhere, especially as concern over digital protectionism grows (Aaronson, 2019; Svantesson, 2020), we believe than European Commission, and EU member countries should consider these avenues as part of a forward-looking Big Data-strategy and link to the next steps of the EOSC.

An important dimension to discuss is the extent to which these models democratise data governance in the European Union. For example, we must pay more attention to the social power of algorithms (Beer 2017). The warnings about the big data divide already are given (see Andrejevic 2014).

As a general critical comment, we can recommend applying data governance models in the next phases of the European Open Science Cloud and its digital applications. Data domain, data scope, and organizational scope are key elements of data governance models (Abraham et al. 2019).

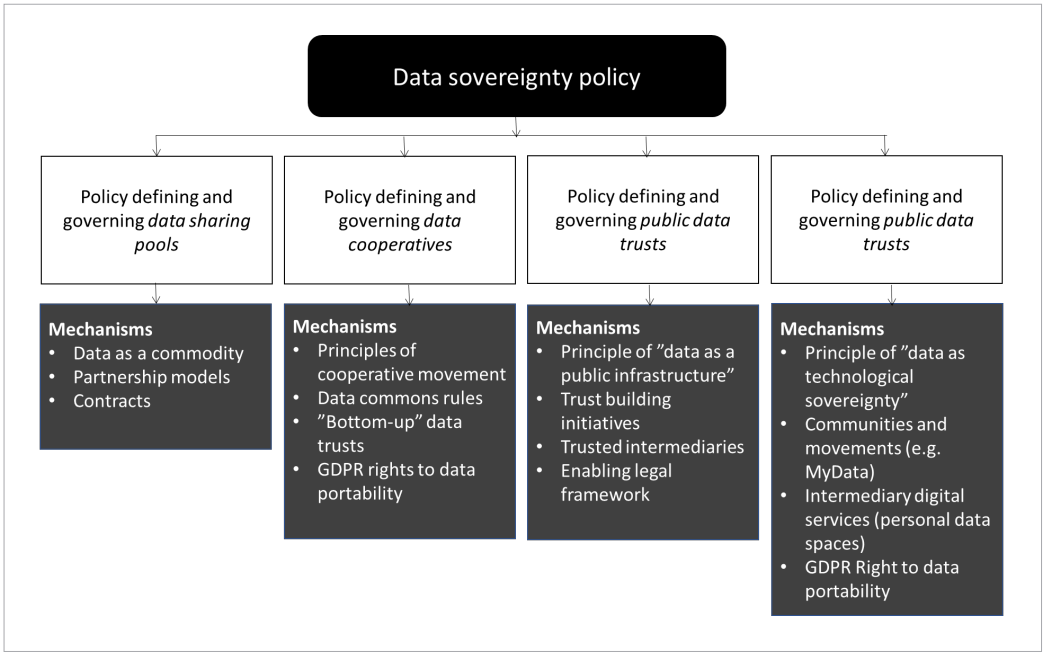


Figure 7
Data sovereignty policy. Relevant alternatives for the planning of the EOSC

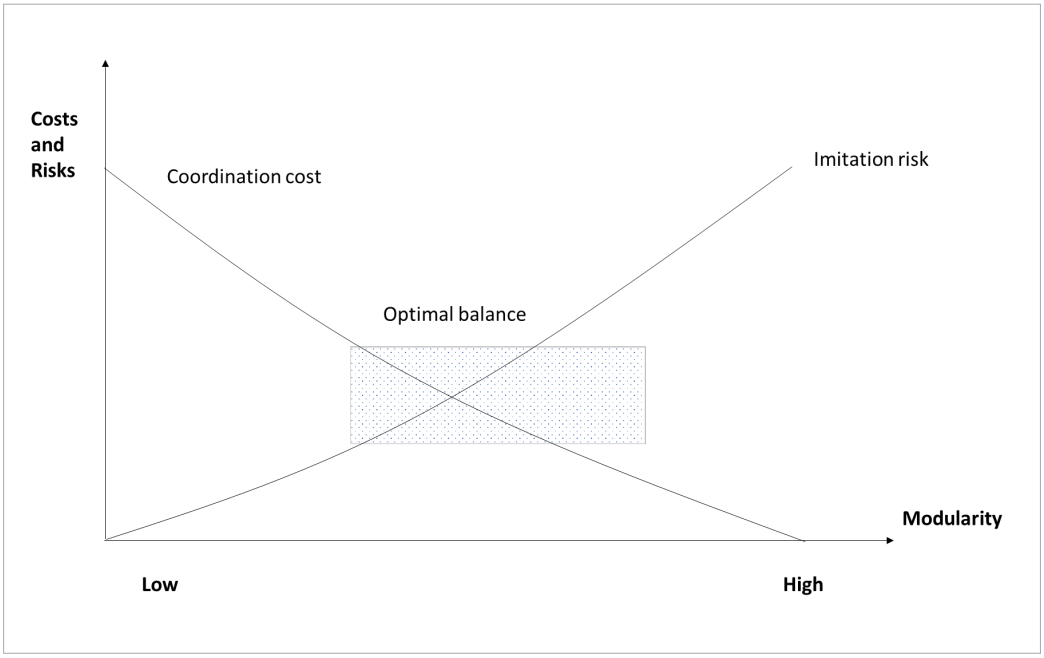
Other strategic questions

European Union faces today competition in the global context. For example, the BRICSA countries are arriving to the global arena of STI ecosystems (Kaivo-oja & Lauraéus 2017). We can claim the also European Open Science Platform faces global platform competition, because it includes various possibilities of massively distributed innovation.

In Fig. 8, we present a basic analysis about this point of view. This figure 8 informs clearly us about costs and risks of modularity in platform management.

Figure 8

Modularisation challenge. Seeking optimal balance between coordination costs and modularity. (Tiwana 2014, p. 105)



The packetization cube framework (Tiwana 2014, p. 14) informs us about seven alternative modular packets of digital services. We can ask, which are European packets in relation to European cloud university platforms? Finding an optimal balance is not easy because drivers like deepening specialisation, packetisation, software embedding, the Internet of Things technologies, and ubiquity increase systemic complexity of the European decision environment. This is a very good reason to plan and foresight reasonable coordination costs and modularity (Fig. 6).

Emerging platforms are changing the rules of competition. Platform ecosystems are normally composed of externally produces complements that augment the capabilities of the platform. New innovations that different platforms often emerge in the downstream part of the platform´s value chain. The true platform must be at least two-sided. There must be app developers and end-users that interact with each other using the platform. This is not happening automatically. The most successful platforms start as standalone products and services. The platforms which serve and help various industries are the most useful and desirable. We can claim that industry-agnostic platforms include the highest potential for the European Union. (see e.g Tiwana 2014, p. 20-21).

Modularisation challenge needs very much attention in the future. Especially European Cloud Initiative must take the modularisation challenge seriously.

Summary and conclusions

The key conclusions of critical reassessment are: (1) There is a need to strengthen strategic links between the European Open Science Cloud and the Industry 4.0 strategy and Industry 4.0 Curriculum in Europe, (2) the concept of public platform alternatives needs more discussion in the development of the European Open Science Cloud, especially concerning modules of the platforms, (3) country-level and university-level participation and especially social inclusion of the European Open Science Cloud needs more discussions and more updated and concrete operational future-proof implementation plans and governance programs. In this context, we discuss complex systems and foresight activities in this complex systemic context (see e.g. Kaivo-oja & Stenvall, 2013), and (4) there is a need to plan symbiotic and digitalized innovation eco-system policy and general economic growth policy framework for the European Union (see Kaivo-oja & Santonen 2016). Especially, the full potential of Big Data analytics and analyses needs to be implemented in the European Union. Data sovereignty means keeping ownership and control of personal and organisational data, so it remains subject to its own governance structures.

We note that the platforms, which serve and help various industries are the most useful. We can claim that industry-agnostic platforms include the highest potential for the European Union. Today a very important dimension to discuss is the extent to which these platforms and data management models democratise data governance in the European Union. We must pay more attention to the social power of algorithms. The warnings about the big data divide already are given. Social inclusion must not only be a catchphrase concept if we want to avoid big data divide in the European Union.

It is clear that research into the platform economy of open science requires a lot of additional research, which should be multidisciplinary in nature and as transparent as possible

Appendix 1

In this appendix 1 we use the exact formulation of the EOSC declaration to avoid wrong political interpretations. See the Declaration of European Open Science Cloud (EOSC) in an exact form: EOSC Vienna Declaration (eosc-launch.eu).

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