European Commission

Final Reflections of the RISE Group

Independent
Expert
Report

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Research and Innovation

Final Reflections of the RISE Group

Research, Innovation and Science Policy Experts Group

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EUROPEAN COMMISSION

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Directorate-General for Research and Innovation

2019

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FOREWORD BY COMMISSIONER CARLOS MOEDAS

Since the onset of my mandate as Commissioner for Science, Research and Innovation back in 2014, the Research, Innovation and Science Policy Experts group (RISE) have been a trusted and highly appreciated source for policy advice. The RISE high-level experts provided invaluable insights on what drives openness in science, research and innovation and its implications for the design and implementation of EU policy.

Their various publications – 'Europe's Future: Open Innovation, Open Science, Open to the World', 'Mission-oriented R&I policy', 'The European Innovation Council', and '101 Ideas' – provide a lasting testament to their dedication and their original and science-based thinking.

I would like to express my gratitude to this exceptional group of people for their latest report 'Final Reflections of RISE'. This report is a last chapter in their thinking on the future of science, research and innovation. RISE provides, once again, sharp and meaningful insights on topical issues, building on their earlier work.

I warmly thank RISE for accompanying me through this amazing journey. Their commitment to deliver outstanding evidence in support of an open environment for science, research and innovation in Europe has been remarkable.

Carlos Moedas

European Commissioner for Research, Science and Innovation

ACKNOWLEDGEMENTS

I want to thank Commissioner Moedas heartily for giving the RISE group the opportunity for a truly open, intense, and critical reflection on current and future EU Research and Innovation (R&I) policy, which finds its culmination in the last RISE report.

The diversity of research backgrounds and personal experiences has enabled our group to provide a long-term and structural reflection on the role of research and innovation policy in the EU agenda.

This report builds on previous RISE work in 2017 and 2018: the book 'Europe's Future. Open Science, Open Innovation, Open to the World', the RISE report on mission-oriented policy and the RISE report on the European Innovation Council.

The RISE group embarked on a Tour d'Europe as ambassadors of European R&I policy. That learning expedition to a number of EU Member States created exceptional forums for debate with leading policy-makers and advisors and had an important impact on a set of RISE outputs. The outcome of the Tour was a network of leading policy advisors who contributed ideas to our RISE publication '101 Ideas for Europe's research and innovation policy.'

We continue to believe that the underlying value of openness in research, science and innovation policy makes the European project stronger. Openness embodies the main European values: equal access to opportunities, freedom of scientific research, solidarity and inclusiveness.

It has been an honor to work with Commissioner Moedas and it has been a great privilege to chair the RISE group following my predecessor Prof. Luc Soete, who has been a role model for me in a holistic policy perspective.

I would also want to thank all my colleagues and friends both in the RISE group as well as at the Commission, especially Johan Stierna, the former head of the RISE Secretariat.

It was one of the most rewarding professional tasks in my career.

Daria Tataj

Chair, RISE High-Level Expert Advisory Group to Carlos Moedas, EU Commissioner for Research, Science and Innovation

EXECUTIVE SUMMARY

The message of Commissioner Carlos Moedas during the Research and Innovation Days in Brussels in September 2019, at the very end of his mandate, was: 'Research and innovation are the cornerstone of Europe's prosperity. We should continue to build awareness and advocate for making research and innovation the very top of the EU's political agenda.'

This publication of the RISE group resonates very well with the call of the Commissioner.

Building on the earlier work, it provides insights on science diplomacy, citizens' engagement, disruptive technologies, procurement for innovation and mission-oriented policies.

The seven final reflections provided in this report can be summarised as follows.

1. *Public and private procurement for innovation at the national, regional or city level is key to creating a demand for innovative products, services and solutions. Public administration needs to accelerate the process of changing procurement policies and learning how to apply innovation-friendly procedures.*

2. *Citizens' engagement will be key for the success of mission-oriented policy. This engagement will need new approaches beyond public consultations or votes on social media. Looking to the practices developed at city level, there is a lot to be learned from mixed — digital and community — processes focused on a shared purpose that is meaningful for citizens.*

3. *Disruptive technologies such as 5G, artificial intelligence (AI) or blockchain are key for EU competitiveness. In order to be their drivers, there is a need for a policy mix in support of innovation ecosystems that would integrate traditional industrial policies with innovation and entrepreneurship policies to foster an ecosystem perspective.*

4. *The different levels of socioeconomic development in regions call for policies targeted towards the implementation of disruptive innovation ecosystems. The need for a transformational change calls for a dynamic approach to policymaking. Lessons learnt from successes and failures of different European policy experiments should inform the design, governance models and management practices of new, networked public–private innovation communities.*

5. *In view of the global challenges Europe faces today, there is a need for a stronger global presence and science diplomacy is an important element of the global strategy in the EU's common foreign and security policy. It helps to put a strategic focus on European values and focus on the urgency of tackling global societal challenges such as climate change or social cohesion. Through the launch of science diplomacy platforms,*

mechanisms and training initiatives with multi-level and multi-stakeholder targets, EU science diplomacy may equip the foreign policy and research communities with tools to build international partnerships and international cooperation activities.

6. *The diversity of research and innovation systems in the Member States requires that policies, including mission-oriented policies, should leave a wider margin for customisation and flexibility. The governance of such instruments must maintain accountability towards taxpayers, while at the same time simplifying to the maximum possible by learning from the best practices in the different Member States.*

7. *Transforming a traditional research-driven university into an innovation-driven entrepreneurial institution is a global — and not Europe-specific — challenge. This means in practical terms a deliberate strategy in respect of the universities' 'third mission'. The investment in on-campus innovation spaces and centres for entrepreneurship results in networking with local firms, engaging them in inspiring students and empowering researchers to pursue portfolio careers inside and outside academia.*

1 Public and Private Procurement for Innovation: Openness versus Protectionism

Luke Georghiou and Christopher L. Tucci

1.1 Introduction

Around 14% of the European Union's gross domestic product (GDP) (EUR 2 trillion a year) is spent on the purchase of goods and services. Public purchasers are the dominant buyers in many sectors including transport, energy, environmental services, health, social care and education. This chapter explores how this vast and largely untapped market power may be used to drive innovation. The application of public procurement of goods and services to innovation has a triple rationale: (1) the improvement of public services; (2) the inducement of supplier firms (and eventually other firms) to be more innovative; and (3) the pursuit of broader societal goals or missions. Let us examine each of these in turn.

- First, public services are under constant pressure from financial challenges and changing demands from citizens. Innovation offers the opportunity to gain in effectiveness and efficiency, and in some cases to create entirely new types of benefits for the public. Innovation does not necessarily need to be purely technological. It can be purely social or even blended. For example, the development of the internet of things or other technologies for assisted living can improve the quality of care for the elderly and allow them to stay in their own homes longer, while a reorganisation of the relationship between health and social care can reduce pressure on acute hospital beds by moving patients on to more appropriate and less expensive care. In most cases, such service improvements involve the provision of new services and hence a cycle of commissioning and procurement during which innovation can be promoted.

- Second, given that the great majority of goods and services are supplied by the private sector, procurement can induce industry to become more innovative and consequently more productive. This can lead to considerable spillover benefits. Satisfaction of a new need originating in the public sector may then have market potential in the private sector, with or without adaptation of the product or services. Even if the good or service is exclusively or mainly foreseen for public markets, firms gain capabilities that they may exploit in export markets. For innovative start-up and scale-up firms such as those supported by the European Innovation Council, a 'friendly' first customer is often more important than grant money. Not only does feedback lead to improvement but the firm also gains a reference customer and the credibility of a demonstrated installation needed to convince subsequent customers.

- Third, many wider societal goals can be supported through innovation procurement. Public purchasing can create lead markets, for example, in the environment or transport domains, which lead to broader diffusion and adoption of socially desirable technologies. An example would be the early

adoption of electric vehicle fleets by public authorities leading to a critical mass that makes extensive infrastructure economically viable and accelerates a transition to more sustainable transport. As we shall discuss below, procurement is thus an important instrument in the implementation of the Horizon Europe missions.

The concept of innovation procurement has a long history in the discussion of innovation policy, but in practice has proven difficult to implement on a large scale. In the European area, an early impetus came from the Aho Group report[1] 'Creating an Innovative Europe'. This was followed by policy activity including the lead market initiative. Actions continue to this day, but have failed to reach the full potential that this instrument offers. The policy focus tends to stay on the supply side, remedying deficits in finance and/or capabilities of firms. Demand-side policies (which also include regulation and cluster policies) have remained largely at pilot scale. If progress is to be made, it is first necessary to understand why innovation procurement can be a difficult instrument to use.

Several conditions need to be satisfied to succeed, while many barriers are either persistent or not well understood. The cycle — from identification of a need, through engagement of potential suppliers, preparation of a tender specification, assessment against criteria to award of contract and delivery — is governed by internal market and — particularly in liberalised markets — competition law, and requires specialised expertise in order to complete it. That expertise may be of a different nature to that exercised in standard procurement of 'off-the-shelf' goods and services. To create the space for innovation, the tender needs to be formulated as a 'functional specification' that describes the desired outcome in terms of deliverables or performance to create the space for the bidding firms to propose innovative solutions.

Success is usually linked to a high degree of interaction between purchaser and supplier to improve mutual understanding of needs and capabilities, but this is an area where careful navigation of the regulatory environment is necessary to ensure that the process is open, transparent, fair and equal between tenderers. At the point of selection, choice of the 'most economically advantageous tender' (MEAT) allows whole lifecycle costs to be considered, as opposed to a simple lowest price formula, although the latter still accounts for 55% of activity in Europe.[2] Negotiated procedures, notably the competitive dialogue, also create more space for innovation, although at a cost of time and money in the short run.

Barriers to innovation procurement are often the converse of the success factors, such as lack of scope for interaction, rigid specifications and complex tendering procedures. However, it is generally recognised that the capabilities of those commissioning and procuring goods and services are a key constraint, along with a general risk aversion in the public sector. Risk aversion can be

[1] Aho, E., Cornu, J.,Georghiou, L. and Subirá, A. (2005). "Creating an innovative Europe." Report of the independent expert group on R&D and innovation appointed following the Hampton Court Summit.

[2] European Commission (2017). "Making Public Procurement work in and for Europe." COM (2017) 572 Final. Brussels: European Commission.

rational at the individual level as innovation may often be disruptive, and hence tend to have unforeseen consequences, or even unsuccessful in the early stages, and the timescale for benefits to be recognised may be longer than the electoral cycles in which the public sector functions. In other words, people who make procurement decisions may have a conflict of interest when they come to procure highly risky but potentially highly beneficial projects.

1.2 Current EU policy

The EU's current procurement strategy was set in 2017 in the European Commission's (2017) communication on 'Making public procurement work in and for Europe' with the following six priorities[3]:

1. Ensuring wider uptake of innovative, green and social procurement;
2. Professionalising public buyers;
3. Increasing access to procurement markets;
4. Improving transparency, integrity and data;
5. Boosting the digital transformation of procurement; and
6. Cooperating to procure together.

While the strongest stress was put on transparency and ensuring regulatory compliance, the document introduces important actions that favour innovation. The first point explicitly addresses this, and in further guidance points out the range of procedures considered to be innovation friendly including functional criteria, variants, quality considerations in technical specifications and award criteria, competitive dialogue, exceptions for certain forms of R&D services and pre-commercial procurement. A Commission note from 2018, 'Guidance on innovation procurement', further elaborates on that[4]. A new procedure has been also announced that is designed specifically for innovation projects, i.e. the innovation partnership[5]. This addresses a key problem that existed with the use of other procedures, that if a research and development contract had been awarded without competition it was not possible under other procedures to purchase the product directly from the firm that had developed that innovation without a further competition. The long-term innovation partnership mentioned above covers both design and delivery phases. It may only be used when there is a need for an innovative product or service that is not already available on the market. It makes provision for multiple partners, with the possibility to pick the best solution. It does not, however, offer a solution to a common barrier to innovation, this being the prevention of material modifications to the contract after award.

Opening of markets may also be seen as a pro-innovation measure. In particular, small and medium-size enterprises (SMEs) win only 45% of the

[3] Ibid.

[4] European Commission (2018). "Commission notice: Guidance on Innovation Procurement." C(2018) 3051 final. Brussels: European Commission.

[5] Part of Directive 2014/24/EU, Article 31.

value of above-threshold public contracts[6]. While positive discrimination via quotas as such is not legally possible, there are several measures that can open markets to SMEs, including simplification of processes and greater transparency in the public procurement process. A greater population of potential bidders increases the chances of innovative solutions and reduces incumbency.

Measures to promote joint cross-border public procurement may at first seem to push against SME engagement as this involves aggregation of contracts, but in terms of providing an impetus for innovation they are significant. A larger market provides a greater incentive to innovate, with the prospect of greater sales. It reduces the disadvantage of Europe by comparison with China or the United States in this respect. Facilitation of SME consortia can offset the difficulties they might face in bidding for large 'bundles' of work.

1.3 Private Procurement

While the main policy focus is on public procurement, there is also scope for incentivising the private sector to create additional demand for innovation through supply chains. While in general firms are seeking what is, in their commercial judgement, the best solution, the risk aversion of many favours incumbent suppliers or well-established solutions. It is worth exploring policies that suggest alternative innovative solutions, for example directed at innovative SMEs, with incentives provided by the government by partially covering the risk of a new product or service. Of course, many collaborative R&D projects are constructed around such vertical arrangements but the difference here would be that the principal incentive for the supplier would be securing a market. For the purchaser, the additional incentive needs to be some form of de-risking of the transaction.

1.4 Policy Instruments

Policies to promote innovation procurement have generally been directed at alleviating these barriers. Table 1 shows a range of policy instruments addressing four main types of deficiencies. The first row represents policies to improve the framework conditions for procurement for innovation intended to address two main issues. The first issue is the principle that competition, typically expressed as price competition between suppliers, is the most important facet of procurement, whereas in many cases stimulating innovation might be more beneficial in the long run than simply using the lowest price as the only award criterion. The second issue is that SMEs may be disadvantaged in the procurement process for a variety of reasons, including lack of access to information, lack of influence over the process and requirements of technical certifications that put SMEs at a disadvantage. Thus, the first type of policy instrument seeks to increase the pool of competition while at the same time shifting the emphasis towards innovative solutions on the part of suppliers. A recent example of this type of framework instrument is the GBP 10 million

[6] European Commission (2016). "New opportunities for SMEs under the reform of public procurement legislation." https://ec.europa.eu/growth/content/8707-new-opportunities-smes-under-reform-public-procurement-legislation_en (viewed 22 September 2019).

Regulators' Pioneer Fund in the United Kingdom, which will 'support bodies to create a regulatory environment that gives innovative businesses the confidence to invest, innovate and deploy emerging technologies for the benefit of consumers and the wider economy'.

The second row addresses the issues of capabilities and internal organisation of public bodies to be able to effectively conduct procurement for innovation. By 'organisation' we mean that many public administrations may not even be aware of initiatives aimed at increasing innovation via procurement. And by 'capabilities' we mean that even if the public body is aware of the role of procurement in stimulating innovation, it may not have the internal capacity to launch such initiatives. Therefore, these types of policy instruments help public bodies in at least three dimensions.

- They raise awareness and help public bodies develop high-level strategies for procurement.
- They provide training and best practice diffusion for individuals involved in the public procurement process.
- They also provide subsidies if the cost of procurement for innovation exceeds the traditional costs of procurement.

A recent example is the German Centre of Excellence for Innovative Procurement (KOINNO) which is funded by the German Federal Ministry for Economic Affairs and Energy (BMWi) and 'advises public procurement officers on how to streamline public procurement processes and buy more innovative products'. KOINNO, along with the European Commission, also funds commissioned research by public bodies to prepare for procurement initiatives.

The third row of Table 1 refers to identifying, specifying and signalling needs of the procurement process from the purchaser to the potential suppliers. The main issue that this type of instrument is aimed at is a lack of communication between the public body and the potential suppliers, with the public bodies over-specifying the solutions rather than laying out the issue to be solved. By over-specifying the solutions, the suppliers focus narrowly on delivering according to specifications, whereas there may be other ways to solve this, or even wider, problems more efficiently.

Another issue is communication with suppliers, where the criteria focus too narrowly on price and on well-understood performance metrics that may inhibit innovative solutions and new features. Therefore, these policy instruments focus on pre-commercial R&D to help scope out new solutions, as well as to create platforms where buyers (procurement bodies) and suppliers can come together in a more interactive fashion to understand the problems that the procurement is intending to solve. They may also work on technology roadmaps and scenarios to understand longer-term trends and de-risk investments in certain technologies. A recent example of these types of policy instruments is the European Procurement of Innovation Platform, developed within the Procure2Innovate Horizon 2020 project. This platform has a variety of tools

including a forum where buyers and sellers can interact, a network for training, pre-commercial R&D results and information on awards.

The fourth and final row of Table 1 refers to providing incentives to undertake procurement for innovation. As mentioned above, risk aversion on the part of individuals employed in public agencies is natural, but in many cases can stymie the best-laid public policy plans for innovation. Furthermore, once innovative solutions have been found and proposed in the procurement process, they may not be awarded, or even if awarded, they may never be implemented. Finally, many suppliers, knowing the above, are often afraid to propose innovative solutions in the first place. Thus, there is a chicken-and-egg problem for supplier innovation. Most of the deficiencies outlined here are at least partially related to incentives for adoption, and that is what this type of policy instrument addresses. One way of alleviating supplier concerns is of course to require an innovative product/service in the calls themselves, so that no one can fall back on the 'safest' course of action. Other policies provide 'insurance' against failure for buyers and/or suppliers. These could also be employed to stimulate innovation via private procurement. A further group of policies provides awards, certifications or standards recognition for innovative suppliers. A recent example of this type of policy could be the European Commission's funding of ProEmpower in a 2018 tender to procure a continuous diabetes self-management solution. This scheme is intended to de-risk the adoption of innovative solutions by both sides of the market by allowing funding for pre-commercial R&D to explore different technological approaches and then compete on best value for money, rather than lowest price, across three phases in which the best solutions are retained after each phase.

Table 1: Adapted from: Georghiou et al., 2014, "Policy instruments for public procurement of innovation: Choice, design and assessment," Technological Forecasting & Social Change, p. 4.

Policy category	Deficiencies addressed	Instrument types	Examples
Framework conditions	i) Procurement regulations driven by competition logic at the expense of innovation logic ii) Requirements for public tenders unfavourable to SMEs	i) Introduction of innovation-friendly regulations ii) Simplification & easier access for tender procedures	i) 2018 £10 million Regulatory Pioneers Fund, UK Digital Economy Act ii) 2011 proposal in EU to introduce innovation partnerships iii) Paperless procedures, electronic portals, targets for SME share
Organisation	i) Lack of	i) High level	i) The Competence

& capabilities	awareness of innovation potential or innovation strategy in procurement organisations ii) Procurers lack skills in innovation-friendly procedures	strategies to embed innovation procurement ii) Training schemes, guidelines, good practice networks iii) Subsidy for additional costs of innovation procurement	Centre for Innovative Procurement (KOINNO) of the Federal Ministry for Economic Affairs and Energy, Germany 2019 ii) Netherlands PIANOo support network, EC Lead Market Initiative networks of contracting authorities iii) Finnish agency TEKES meeting 75% of costs in planning stage
Identification, specification & signalling of needs	i) Lack of communication between end users, commissioning & procurement function ii) Lack of knowledge & organized discourse about wider possibilities of suppliers' innovation potential	i) Pre-commercial procurement of R&D to develop & demonstrate solutions ii) Innovation platforms to bring suppliers & users together; Foresight & market study processes; Use of standards & certification of innovations	i) SBIR (USA, NL & Australia), SBRI (UK), PCP EC & Flanders ii) Innovation Partnerships & Lead Market Initiative (EC), Innovation Platforms (UK, Flanders) iii) Procurement of Innovation Platform, EC, 2017
Incentivising innovative solutions	i) Risk of lack of take up of suppliers' innovations ii) Risk aversion by procurers	i) Calls for tender requiring innovation; Guaranteed purchase or certification of innovation; Guaranteed price/tariff or price premium	i) German law enabling innovation demands in tenders; UK Forward Commitment Procurement; Renewable energy premium tariffs (DE

		for innovation ii) Insurance guarantees	and DK) ii) Immunity & certification scheme (Korea) iii) ProEmpower (EC) 2018 tender to procure a continuous disease self-management solution

1.5 Procurement and the Missions

Public Procurement and Horizon Europe Missions

Earlier RISE work has already indicated the potential of innovation procurement policy to accelerate and complete the implementation of a mission-oriented policy, arguing that the power of a single market for innovation and that of public procurement may provide an additional accelerant in many cases. The University College of London Commission for Mission-Oriented Innovation and Industrial Strategy (MOIIS) in the United Kingdom has also recommended a 'reformed' public procurement process as a means to drive missions.

What could this mean for the Horizon Europe missions? In each of the five mission areas there is potential for procurement as an instrument of implementation. Examples include the following.

1. Adaptation to climate change including societal transformation — among the many potential lines of action where innovation procurement could be applied, with sustainable production and consumption being just one example. The aim here would be to accelerate a transition by adoption and diffusion of innovative technologies leading to carbon reduction, following a well-established European tradition of lead markets in this sector such as during the early stages of wind energy development.

2. Cancer —an example here could be the establishment of digital health systems, which allow large-scale application of data science to link diagnostics, trials, treatment and social care. Procurement can be used not only to ensure the innovation of systems that are fit for purpose but also to promote standardisation and interoperability across Europe.

3. Healthy oceans, seas and coastal and inland waters — waste management systems have been an early case for innovation procurement and the issue of plastics recycling and substitution could be a key target. At present, multiple systems and approaches inhibit the achievement of scale in the circular economy. Joint innovation

procurement across cities and governments could substantially accelerate innovation and establish a competitive position for Europe.

4. Climate-neutral and smart cities — energy-efficient buildings and transport systems are very often procured at city level and cities offer a key opportunity for an integrated approach to missions. European value-added may be addressed by facilitating joint cross-border procurement to drive innovation.

5. Soil health and food — in this area, services are particularly prominent, offering routes to systemic technological and behavioural change. Public land could provide early sites for more radical approaches that are then diffused to private agricultural actors.

As the missions evolve and become more clearly defined, other opportunities will emerge. Of critical importance will be the need to engage from the earliest stages those actors who will eventually commission and procure the innovations emerging from R&D. The greater the buy-in that can be obtained in the early stages, the greater the chance of successful engagement when implementation occurs. The aggregation and governance issues that have to be overcome should be addressed in parallel with research. To be successful, missions will need to include as stakeholders the eventual purchasing agencies and their regulators from the start and with their full commitment. It is also important to ensure that the barriers to innovation procurement identified above are remedied specifically in the mission sectors. These include frameworks, capability development and creating a community of suppliers familiar with the long-term goals of the mission.

1.6 Conclusions

Procurement is a potentially powerful instrument for innovation, but despite several successful experiments and smaller-scale activities, that potential has been mainly latent over a longer period. In principle, Europe should be in a good position to exploit the power of the demand side. The single market provides a strong incentive for companies to develop products and solutions that could diffuse rapidly to a scale that makes them globally competitive. Indeed, this a key underpinning of the concept of a lead market, alongside a regulatory environment that is friendly to innovation.

The biggest single barrier is one of governance. A successful procurement policy needs to be embraced by the purchasers and these are rarely the ministries and agencies with responsibility for research and development. It therefore calls for enhanced coordination across national and regional governments and Europe-wide.

The second issue that calls for attention is the permanent tension between the demands of internal market and competition policy on the one hand and the need to nurture and scale up European businesses on the other. The European procurement framework in place aims to ensure that European citizens receive the best goods and services possible for their money, and without it there is little doubt that the situation could revert to the historical position of

uncompetitive 'national champions' with little chance of progressing beyond captive markets. The framework has evolved over the years to become more innovation friendly.

A potential middle ground that addresses the above tension would be to take a step forward from the innovation partnerships and to develop a European regulatory framework such that it becomes a legitimate aspect of a call for tender to develop innovative capacity as part of developing or encouraging an innovative supply to the specification, if this can be shown to be to the benefit of the contracting authority. The rationale would be that the purchaser would benefit from a strengthened regional innovation ecosystem and be assured that the innovation would have the potential to become a continuous process rather than a one-off activity. Thus innovation procurement could also be considered an instrument of 'alignment' or 'convergence', or even the catalyst for the development of a local innovation ecosystem.

There is also room for policy experiments. Administrations could establish an 'open innovation/crowdsourcing' sandbox that allows the possibility to fund or conduct research on services or supplies that do not currently exist prior to procurement[7]. An example is the Datawell project in Manchester, in the United Kingdom, developed under the innovation partnership procurement process. As part of an open innovation platform, innovative solutions could also be proposed from the bottom up by potential suppliers and adopted quickly without going through a competitive bid process. This could be done for smaller-sized projects and be accompanied by attestations that there is no conflict of interest.

The SME dimension also needs further attention. Administrations need to work harder to create an environment that brings forward innovative solutions from SMEs or other organisations that are often excluded from the procurement process, subject to quality thresholds, or set-aside targets for socially responsible procurement. As noted, fixed quotas are not possible due to legal constraints at the EU level, although the practice can be observed elsewhere, notably in the United States. A further possibility is to incubate start-up companies that have innovative solutions to the problems posed.

For Horizon Europe, the missions represent another opening for an explicit innovation procurement policy. Technology-based supply-side support would be not enough to deliver their goals. To ensure that the benefits they bring achieve early adoption and subsequent diffusion, the demand side is a critical element. At this formative stage, securing the commitment of those who can commission and procure the solutions that the missions can offer is of utmost importance. The missions also provide an opportunity to demonstrate and embed innovation procurement as a core instrument for innovation policy in Europe, accelerate its take up and break through the glass ceiling of pilot projects.

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[7] Cordella, A., Paletti, A., and Shaikh, M. (2018). "Renegotiating Public Value with Co-Production." In C. Tucci, A. Afuah, and G. Viscusi (Eds.) *Creating and Capturing Value from Crowdsourcing*. Oxford: Oxford University Press, 181-203.

2 Citizens' Engagement in the Digital Age

Roberto Verganti and Daria Tataj

2.1 Introduction

There is a growing disconnect between the process of policymaking and citizens. Especially at the European level. The citizens' perceived disconnect is exacerbated by the intrinsic distance of EU institutions from the local culture, stemming from the principle of subsidiarity, a lost memory among the younger generations of why Europe was founded after World War II and the complexity of the challenges ahead.

At the same time, people are getting used to a more direct participation in decision-making, thanks to the possibilities offered by digital technologies. In many dimensions of life (as employees within their own organisations, as customers in the market and as members of communities) people expect to have a say, to be listened to and to collaborate on designing solutions. Policymaking is seizing this opportunity in an uncoordinated way, mainly driven by pioneering players, who are using the power of digital technologies to disintermediate governmental institutions and establish a direct dialogue with citizens. If this use of digital technologies in policymaking has been supporting the dynamics of parties (and affecting elections), the use of digitalisation to support the institutional process of political dialogue, deliberation, legislation, and implementation is still lagging behind. The result is a loose connection of citizens with politicians, but an extremely poor connection of citizens with political institutions.

This disconnect, paired with the fears that global challenges are bringing, is fuelling a mistrust towards policymaking, fostering localization (as opposed to globalisation), polarisation, individualism, protectionism. This calls for facilitation of an authentic engagement of citizens in institutional policymaking.

The crisis of identity

The digital transformation opens novel ways for how to engage citizens in policymaking. These new practices extend far beyond the use of a digital toolbox, social networking sites, gamification, crowd sourcing or multimodal communication channels. They are induced by the changes in the governance model with the transformations of society and organisations.

The most radical practices are based on a new way of thinking about the changing society. The theory of the network society offers a conceptual analytical framework to grasp in a systemic way the new social, economic and political reality[8]. Following this theory, we should search for the origin of the multidimensional crisis in Europe today in the issues evolving around the hybrid identities of individuals and communities. This hybrid identity manifests itself by a shared sense of belonging simultaneously to diverse networks held together

[8] Castells. M. (1996), *The Rise of the Network Society*. Blackwell Publishing Ltd.

by sometimes-contradictory values of national identities and global communities[9].

This belonging to these networks and communities induces a crisis of identity of nation state institutions and undermines the established power relations of the society expressed in its system of governance. Hence, there is an ever-deepening divide between mainstream politicians, policymakers and governments and the networked social movements in today's society.

Disrupting the government sector

As much as large established corporations with strong brands based on clear values and global value chains are disrupted by new behavioural patterns of their users and consumers and the introduction of new products, services and business models, in a similar manner governments tend to fail to connect with this new social reality in the crisis of identity. Reconnecting to citizens is key and this reconnecting means the government itself needs to engage in developing a novel way of thinking as a precondition for building bridges and bonds to these communities. Namely, connecting to a fragmented, interconnected and ever morphing social structure — which escapes the traditional hierarchies that are organised vertically and reflect traditional demographics statistics — turns engagement at the conceptual level from a top-down policy to a decentralised process led by communities themselves and not by the government. To be precise by the distributed leadership in these communities.

2.2 The State of the Art

Citizen and public engagement are not new concepts. The idea behind citizen engagement is that citizens should participate in the deliberations over the decisions that affect their lives. Yet civil society engagement has often been considered as an energy- and time-consuming activity that requires substantial effort and motivation from public institutions, balanced with a profound commitment by citizens. Considering these factors, in the past engagement has been pondered in regard to the investment it requires. Yet growing evidence confirms that under right conditions, citizen engagement can help institutions to achieve several objectives: informing the design of a reform programme, improving implementation effectiveness and improving the monitoring and evaluation of reform programmes[10]. These benefits can be clustered according to three layers of impact[11]:

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[9] Castells, M. (2019) *Rupture. The Crisis of the Liberal Democracy*, Polity Press.

[10] A. Manroth, Z. Hernandez, H. Masud, J. Zakhoud, M. Reboilledo, S.A. Mahmood, A. Seyedian, Q. Hamad, T. Peixoto (2014). "Strategic framework for mainstreaming citizen engagement in World Bank Group operations. Engaging with citizens for improved results." Working Paper, The World Bank, Jan 2014. http://documents.worldbank.org/curated/en/266371468124780089/Strategic-framework-for-mainstreaming-citizen-engagement-in-World-Bank-Group-operations-engaging-with-citizens-for-improved-results

[11] Shaxson, L.; Bialak, A.; Ahmed, I.; Brien, D.; Contant, B.; Fisher, F.; Gwyn, E.; Klerkx, L.; Middleton, A.; Morton, S.; Pant, L. and David Phipps (2012). "Expanding Our Understanding of K*: A Concept

- **Instrumental**. The direct benefit in terms of the instruments, policies and practices of policymakers, on how they go about the process of achieving innovation. This is the more practical and immediate benefit of citizens' engagement with the output of the policy cycle, and specifically interacts within the process of decision-making.

- **Conceptual**. The benefit in terms of better understanding of the subject matter. On the one hand, the extent to which policymakers better understand the context and reality of the scenario of action, the behaviours, the aspirations, and the constraints of the social system. On the other hand, the extent to which citizens understand the dynamics, thinking and impact of programmes, beyond their individual perception. In this perspective, public engagement becomes a process of sense making, through the integration of multiple perspectives through participatory interpretation. The dynamics here are iterative and heuristic, through a continual process of evolving inquiry and action.

- **Capacity building**. The benefit in terms of strengthening the ability of citizens and policymakers to work together towards implementation of the actions. Engagement here is a bidirectional relationship, leveraging networks of people and organisations able to actually act and change systems. The citizens become part of the instruments, not only informants. This is a much deeper and more broad-based impact, which takes on a life of its own even after the instruments are discontinued.

Engagement of citizens can also take different forms, depending on the different phases of the policy cycles in which it occurs, including:

1. in **agenda setting**, where citizens can participate in the identification of relevant problems and challenges, and of their relative priority;

2. in **policy formulation**, where citizens can participate by helping policymakers to build the scenario on how to address the challenges, or to understand the desirability of that scenario or even by proposing possible specific solutions to the challenges;

3. in **decision-making**, where citizens may have a precious contribution on understanding the feasibility and usability of specific measures;

4. in **policy implementation**, where citizens have a key role in terms of diffused behavioural changes, granularity and diffusion of solutions, compliance, commitment to voluntary and non-regulated actions;

5. in **policy evaluation**, where citizens are precious in providing feedback and contributing to learning from the actual implementation and impact of programmes.

Paper Emerging from the K* Conference held in Hamilton." Ontario, Canada, April 2012, Hamilton, Ontario: United Nations University Institute for Water, Environment and Health.

To support the practice of public engagement, concepts such 'co-creation' and 'co-production' have emerged in scholarly work and in practice. They describe the systematic pursuit of sustained collaboration between government agencies, non-government organisations, communities and individual citizens.

Participatory approaches, however, have so far been confronted with a trade-off between span and intensity of engagement. In other words, this is as follows.

(1) Some methods have focused on the span of engagement, by engaging the largest possible number of people. Classic examples are public consultations and polls, where questionnaires can be used to assess the inclination of the public towards specific policies. Consultation, however, is often further stimulating disengagement. It supports a judgmental approach, in which the citizen sits back and judges, rather than acts. Within the frameworks of the polarisation spurred by social media, consultation — which is nowadays even easier and cheaper — is instead fostering even more disengagement and distance between judging of (filtered) information or engaging in action. More recently, inspired by the opportunity offered by digital tools, and, specifically, by advancements in open innovation, there have been attempts to engage citizens in slightly more active interactions. Starting from the flourishing research on open innovation at a corporate level, some research is examining open innovation strategies regarding citizen engagement in the co-creation of future scenarios[12,13,14,15,16]. We can talk, in this case, of 'crowd-policing' where, inspired by crowdsourcing approaches, policymakers invite the public at large to submit ideas about future programmes[17]. These initiatives can be complemented by wider access to data. Indeed, citizens are nowadays leaving rich traces of their behaviours, intentions, wishes and profiles. This data, when not within the sphere of privacy, and when freely accessible (e.g. through open social media such as Twitter) can enable, through sentiment analysis, people's orientation to be captured (which in most cases does not require access to identities but unpersonal analysis). Early examples of the use of citizens' data for better planning come from the analysis done at the MIT Media Lab on citizens' movements in cities thanks to signals from their mobile phones. These data can be combined with open data made available by public institutions, where the EU is a significant player given the span of geography and population[18]. Vice versa, crowd-policing exercises are important sources of open

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[12] Bourgon, J. (2007). "Responsive, Responsible and Respected Government: Towards a New Public Administration Theory." *International Review of Administrative Sciences*, vol. 73, No. 1, pp. 7-26.

[13] Fugslang, L. (2008). "Capturing the benefits of open innovation in public innovation: A case study." *International Journal of Services Technology and Management*, v.9, n. 3-4, 234-248.

[14] Horne, M.; Shirley, T. (2009). "Co-production in public services: a new partnership with citizens." London Cabinet Office Strategic Unit.

[15] Nam, T., Sayogo, D. S. (2011). "Government 2.0 Collects the Wisdom of Crowds." *Social Informatics*, 51–58.

[16] AA.VV., (2019). "Civic Engagement and Politics: Concepts, Methodologies, Tools, and Applications: Concepts, Methodologies, Tools, and Applications, Management Association Information Resources." IGI Global.

[17] See for example the iniziative of the Citizens Foundation (https://citizens.is/about-cf/) or by Argu in the Netherlands (https://argu.co/).

[18] See for example: https://data.europa.eu/euodp/en/home.

data that can spur understanding of diffused creativity and orientation not only for policymakers but also for all those interested in public dynamics (e.g. for better planning of transportation or healthcare services). Here, since the development of digital tools for crowd-policing is rather a new research area, the amount of supporting theories is still limited. The lack of a precise representation of an archetypal model for public engagement, through a digital tool, underlies a lack of common understanding of what this kind of instrument might precisely do, and even more so, if connected to innovation policies. What is emerging from early attempts, however, is that although digital technologies enable the scaling up of engagement to a large numbers of stakeholders and citizens today, the level of interaction with the public is often limited and the results often disappointing. Public polls imply a passive role of citizens, and crowd-policing, which ask citizens to be 'policymakers for a day', produces massive amounts of ideas, without real engagement of citizens in the making, for what concerns their role, capability of real action and knowledge. Overall, these methods therefore privilege span, but compromise on intensity.

(2) Other methods have focused on 'intensity' of engagement, by involving the public in intense sessions where they do not only express their opinion and ideas but, rather, they contribute in practice to the co-design and, sometimes, the implementation of the policy. They could be labelled under the umbrella of tools applied in the deliberative democracy approach. Deliberative democracy is defined as a citizen-centric approach based on a transformational process of democracy where different voices are engaged in formulating policies along all stages of policymaking in an attempt to create the best solution to policy issues, rather than just giving citizens a mere chance to vote[19]. Past attempts to translate debates between citizens and government officials into the conclusion of collective policy decisions have demonstrated that this is not an easy task, especially in the most delicate phase of assisting people to propose relevant and meaningful alternatives that are politically and lawfully realistic and implementable. Among these experiments, the most famous one is the controversial 'Icelandic constitution-making experiment', which despite its tremendous innovativeness has not demonstrated that it represents the success many initially hoped for. Significant institutional hurdles during the final draft phase did not enable factual results to be achieved before the parliament. Despite the epilogue, much can be learned from this experiment about creating a constitution-making process as a non-political issue dissociated entirely from the political forum: people's engagement through participative deliberation modes does not imply a replacement of traditional democratic procedures or experts' role. Rather, it is intended to complement and support it, by leveraging on the idea that broader participation can lead to better decisions with respect to the traditional indirect democracy processes[20]. Deliberative democracy can be an innovative and powerful method to affect public awareness but cannot be considered as a viable substitute for traditional sources of political consensus. The limitation of the application of such innovative methodologies in the

[19] Chambers, S. (2003). "Deliberative Democratic Theory." *Annual Review of Political Science*, No. (6): 307-326.

[20] Landemore, H. (2015). "Inclusive constitution-making: The Icelandic experiment." *Journal of Political Philosophy*, 23(2), 166-191.

revision of the foundations on which democratic states are built is partly due to the fact that these tools have been traditionally nurtured in the realm of urban planning, where the issues and debates typically concerned issues of a different nature where the citizen's voice has proven to be more influential and coherent. Collaborative methods were brought into policymaking only recently. As the example of Iceland shows, they still need to be more effectively implemented and better examined to understand which results they can stimulate in the long run. Experiments that leverage on this learning and focus on citizens' engagement aiming not only at deliberation but also at raising awareness, improving understanding of citizens' orientation and collecting more detailed information on behaviours and the implementation issued, have been addressed by recent EU-funded projects, such as Public Engagement 2020[21] or Engage2020[22]. A wide array of possible methods is provided by the Action Catalogue[23]. This shows how these methods still privilege intensity of engagement, but are typically focused on small communities or reach a limited number of people[24].

2.3 The Future Direction for Citizens' Engagement

Participatory processes of citizen engagement should move beyond the trade-off between span and intensity of engagement. Thanks to new generations of digital technologies and new advances in the understanding of collaborative design and in collective experiences, it is possible to create engagement practices that both involve citizens in active participation and at the same time address the needs of disconnected communities. Especially for the areas where the EU policy cycle has more impact: the construction of a shared scenario, values and principles among citizens that can then inform local policy from the bottom up, rather than the more traditional path of influence that plays only at the level of institutional governance processes. At a moment of social and political polarisation, a collective future shared vision building is needed. This would be a process of definition of a common set of values, attitudes and joint activities: a future shared vision's purpose is to provide motivation and facilitate effective collaboration so that policies can be based on a common vision and goals. The objective of future scenario building is to help communities and local governments to better plan, develop and manage their policies based on negotiated and shared values that would stand a much higher chance of being owned by communities. Key to this innovative process is enabling policymakers to take a longer-term perspective that encompasses citizens' future needs, anticipated reactions to the policy, including unintended consequences, and the likely impacts of proposed developments.

In this new context of EU policymaking, it is possible to significantly improve both the span and intensity of engagement by promoting systems that leverage the following principles.

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[21] https://pe2020.eu/

[22] http://engage2020.eu

[23] http://actioncatalogue.eu

[24] Salter, J., Robinson, J., and Wiek A. (2010). "Participatory methods of integrated assessment—a review." *Wires Climate Change*, Johan Wiley & Sons, Volume 1, September/October 2010, 697-717.

Meaning-driven (or purpose-driven) engagement

'(S)he who has a why to live for, can bear almost any how,' said Friedrich Nietzsche, as cited in Viktor Frankl's memoir[25]. A significant insight is that one of the most powerful ways to engage people is not by sharing the 'how' of things, but the 'why'. This possibly most compelling argumentation is developed in Frankl's seminal work[26] and has recently spurred an even more intense analysis of the power of meaning in society[27]. This implies that any effective citizens' engagement system should include a significant focus on building a co-created understanding of a common vision. In contrast to early experiments in using digital technologies for public engagement, and in particular in contrast to crowd-policing, the point is not only to co-create the solutions, but to first and foremost co-create a vision of a desirable future.

Engagement by design

Effective engagement should not come simply from dialogue and exchange of information. Engagement comes from active participation in the making, and this comes from active participation in the **design** of the direction. Behavioural theories and design thinking are shedding light on the power of the action of co-creating to engage people in change. An example is the 'IKEA effect'[28] or previous studies on the endowment effect, where engagement is connected to a feeling of ownership (in our case, in co-owning the 'meaning' or the 'direction' of policymaking). The endowment, in this case, is generated by participating in the design and making of something. Although engagement of the public through co-design and co-making has already been inspiring for several attempts at public engagement in the past, it is important to avoid a classic pitfall: to ask citizens to participate by being 'policymakers for a day', with roles that goes beyond their space of expertise and capability to actually act. If this approach (such as living labs) can work for simple and local systems and small numbers of people, it leads to disappointing results when used at the level complex European policies. The IKEA effect implies that the public participate by contributing within the space they can master. There is an analogy with assembling an IKEA cabinet: people do not necessarily love to design and manufacture a piece of furniture themselves, and in particular, they do not have the capabilities, resources and time to do it in a sustainable way. However, people feel engaged by assembling (and sometimes repainting or decorating) the furniture that IKEA has manufactured. It is a small contribution but proportional to the real capabilities and space of action of people, which is the right level for engagement.

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[25] Frankl, V. E. (1984). *Man's search for meaning: An introduction to logotherapy*. New York: Simon & Schuster. 1984.

[26] Ibid.

[27] Bailey C., Lips-Wiersma, M., Madden, A., Yeoman, R., Thompson, M., and Chalofsky, N. (2019). "Meaningful Work: Prospects for the 21st Century." *Journal of Management Studies*, Special Issue, May 2019.

[28] See for example Norton, Michael; Mochon, Daniel; Ariely, Dan. (2011). "The IKEA effect: When labor leads to love." *Journal of Consumer Psychology*. 22: 453–460, September 2011.

Texturing

Leveraging on the IKEA effect mentioned above, effective citizen engagement can be implemented through texturing activities: i.e. to have them add layers of details and action to a foresight scenario and policy put forward to the public. This works as a platform sketch, where the individual stakeholder or citizen can add texture, within her/his own space of expertise and action. The process of texturing has the power to support a convergent approach, towards the crafting of a shared direction. This perspective encompasses on the one hand the power of visualisations to represent collective cognitive processes, both in terms of rational, symbolic and emotional meaning. From this perspective, visualisations are a richest means of narrative. On the other hand, by texturing we indicate the engaged action of the 'doing', i.e. texturing as a design activity conducted by citizens on top of proposals put forwards by decision-makers. Texturing enables us to make the co-creating activity tangible and aimed at producing a concrete output[29].

Representations and Citizenship

The representation of the object of co-creation is fundamental. Representation in policymaking shifts from being a principle for delegating someone else towards decision-making in the policy process, to a principle of co-creating the object of the policy. The representation is the means by which the object of the policy is represented, formed or shaped. In other words, the object of the texturing activity can range from representations of social scenarios, to specific picturing of elements of reality — from visual to textual representations, from static to interactive (gaming) experiences and from individual to social processes — where the outcome is not only the object per se, but also the development of knowledge and, especially, the building of capabilities and social assets (such as the cross-national connection among citizens who texture similar scenarios). What matters, in fact, is not only the communication between policymakers and citizens, but also and above all the communication among the citizens themselves, especially citizens in different countries. In this perspective, the tools of citizens' engagements are tools of creation of a more engaged European citizenship.

Engaging through Images and Pragmatic Imagination

Citizens do not speak the language of policymaking. Moreover, when it comes to Europe, they do not even speak the same language. Which common language can therefore be used to engage citizens in policymaking? An interesting perspective can be to leverage the power of images as a common Esperanto. Thanks to digitalisation and social media, citizens are increasingly used to communicating and building a dialogue through images. This is even more suitable when working on scenario building by using imagination[30,31].

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[29] Marback, R., (ed.), (2016). *Representation and Citizenship*. Detroit, MI: Wayne State University Press.

[30] Scharmer, Otto C. (2008). *Theory U: Leading from the future as it emerges*. Berlin: Berrett-Koehler Publishers.

[31] Pendleton-Jullian, A.M., Seely Brown, J. (2016). *Pragmatic Imagination*, Blurb.

Indeed, one of the most powerful way to build engagement is the co-creation of shared meaningful images of future directions. This approach can work in two ways. The first is by texturing actual visual images of specific scenarios: this has the advantage of developing a deeper understanding of the specific subject matter, but suffers the limitations of being context-specific. It therefore requires the development of ad hoc tools for every specific policy area and matter. The second is by working through metaphorical images, which act at a deeper cognitive level[32]. The power of building shared meaningful images is also to enable the assimilation, in people's emotional mind, of 'Memories of the future'[33]. Which implies that the brain uses images, plans and ideas just like real memories and experiences in order to filter information and guide decisions. Therefore, imagining potential future policies opens people's mind so that they are ready to see the signs relevant to those policies if and when they occur. These memories of the future are therefore deep emotional factors, connected to aspirations and desires, to spur public engagement.

Digitalisation

The concepts introduced above (meaning-driven engagement, by design, and in particular through texturing of a real of metaphorical object/image) ensure intensity of engagement. To add breath of span (e.g. scaling up engagement to a large number of citizens throughout Europe) there is a need to combine those principles with the opportunities offered by digital technologies. Digital technologies enable familiar, interactive and pervasive experiences. They may transform participation from a citizen's donation of time and cognitive energy to an entertained activity, if carefully conceived in terms of gamification. They also enable better understanding of the interaction, with extreme granularity of details and information.

Until now, global policymaking has often addressed the digital transformation with a reactive attitude: observing the phenomenon and trying to deal with its negative implications once they emerge. But the digital transformation, if properly and proactively managed, also brings a great opportunity for global policymakers: the chance to reconnect with citizens, to better engage them, to overcome the barriers of physical distance and fears. In a way, the idea of using digital technologies in policymaking is not unique. What is needed, however, is to turn the use of digital technologies from a means to support public consultation (through digital polling or social dialogue enabled by digital technologies, or, even more extreme, by enabling digital democracy) which, as said above, implies a passive and disengaging role of citizens, and often a biased perspective, or from crowd-policing (by engaging citizens in the creation of proposals and ideas) into a means to support co-design with and among citizens.

[32] Lakoff, G. and Johnson, M. (1980). *Metaphors We Live By.* Chicago: University of Chicago Press.

[33] Ingvar, D.H. "Memory of the Future: an essay on the temporal organization of conscious awareness." *Human Neurobiology*, 4: 127-136, 1985.

Big data, open data

We know a lot about diverse communities, and we are able to dig into big data to find all sorts of new patterns and structures. Data is the crude oil of today's economy and politics. Big data managed by governments about citizens, firms, institutions and the society at large provides enormous learning opportunities. The challenges are twofold: what questions to ask to dig into the data pools and how to interconnect the real and digital worlds where some of citizens are not digitally literate, others are very fluent and a vast population falls somewhere in between.

To engage citizens in this new context we need a new way of conceptualising them as individuals and as a collective. Fundamentally they function as individuals and as a collective as a network of networks. This implies that to engage as individuals and as a collective we should think about the exponential nature of networks, the networks effect, the power of mass-self communication and the post-truth nature of our times.

Network thinking

Network thinking is an innovation framework based on the theory of the Network Society[34]. This framework envisages networking and innovation as a dynamic process of co-creating value in economic or societal terms. It can be used to help analyse the mechanisms and dynamics of engagement with citizens — engaged as providers of ideas and data, critical thinkers, co-creators, doers, makers, influencers and leaders. It changes fundamentally the power structure: it is not governments that engage with citizens through a one-to-many protocols. It is every single citizen, firm or institution that has the power to mobilise and engage other citizens, firms and governments alike.

A good example of network thinking in practice is the design of the knowledge triangle collaborative partnerships. These Europe-specific private–public partnerships are known as the EIT Knowledge and Innovation Communities[35]. These collaborative networks connect the processes of knowledge production, learning, innovation and creation value through entrepreneurial projects. They are usually shown through institutional lenses as networks of research institutes, universities, industry and startups or scaleups. However, the network thinking innovation framework puts an emphasis on the dynamic processes which together accelerate the emergence of innovation ecosystems by engaging diverse stakeholders — institutions or businesses, as well as social agents, such as digital communities or leaders of social movements. The richness of for-profit and social innovation makes diverse groups collaborate and influence their innovation communities. These communities create dynamic trusted

[34] Tataj, D. (2018). "Innovación y Emprendimiento: Un Binomio Para el Crecimiento de la Economía Española." *ICE Revista de Ministerio de Industria, Comercio y Turismo del España*.

[35] See more at www.eit.europa.eu.

ecosystems and in theory democratise innovation and access to entrepreneurial opportunities[36].

In this context, any citizen-led project has the possibility to impact policies, strategies and practices to an unprecedented level. They can produce information that may go viral across social networks being either validated, supported or dismissed.

This vital capacity cannot really be controlled. Enabled by technology, every person who knows network thinking and uses it to build and grow networks and communities can engage citizens in policymaking at a level that exceeds the capacity of governments in our times of legitimacy crisis.

A pioneering case: How Barcelona engages citizens

Cities are by their very nature closer to citizens than any regional or national governance bodies. Through the election process and track record in dealing with local issues, politicians stay tuned to and seek ways of engaging with voters.

The new municipal governments elected in the largest Spanish cities in 2015 provide many examples how #ciudadesdemocraticos or democratic cities experiment with engaging citizens in the digital age[37]. Within this movement, a concrete case of the newest digital practices is the Decidim platform in Barcelona[38].

Barcelona City Digital Plan (2015-2019) strove to democratise access to data and give back the ownership of data to citizens[39]. The city council has engaged them in co-design of these policies and strategies. This has been done by an online platform Decidim ('We decide' in Catalan) but more importantly by connecting the online with the offline worlds and bringing in issues which exceed the questions of digital trust and access to data by multinational corporation, even though this has been a vital element of the project. It is encouraging to note that the innovative software of Decidim — open source, free of charge and copyleft — is now being used by over 40 000 Barcelona citizens and 60 cities around the world.

One of the ways to use this platform is the 'Open budget' initiative launched in 2016 by Barcelona City Council. This tool presents the city budgets in detail with transparency and clarity to citizens. Opening up the budgetary data and organising it according to departments, years and functionalities allows data from the past to be compared with budget forecast. Framing this information in a city context empowers citizens to act on this knowledge. All data is available

[36] Tataj, D. (2015). *Innovation and Entrepreneurship. A Growth Model for Europe beyond the Crisis*, Tataj Innovation Library, New York.

[37] Roth, L., Monterde, A., Calleja Lopez A., (ed.) (2019). *Ciudades democráticas. La revuelta municipalista en el ciclo post-15M*, Icaria Politica.

[38] https://www.decidim.barcelona.

[39] Bria, F. (2019). *Barcelona digital city. Putting technology at the service of people*, Ajuntamiento de Barcelona.

in open format in three languages: Catalan, English and Spanish. 'Open budget' is an example of how presenting the information with respect to citizens can get them engaged to co-create city policies.

Yet another aspect of how the city council has been striving to engage citizens is its gender policy. Inclusion is the first step towards engagement. Monitoring pay differences and the gender gap, especially in STEM education and tech sector jobs, and implementing gender equality policies for city co-funded events such as Smart City Expo or Mobile World Congress, are also ways to engage specific groups of citizens and design policies towards social inclusion, digital inclusion or labour market inclusion.

Finally, what can be observed is the non-digital nature of issues being co-decided by the citizens — as related for example to urban mobility, clean air and large-scale urban transformation. Following consultations, discussions, brainstorming, voting and reaching out in a strategic way to diverse interconnected or disconnected communities (neighbourhood groups, city planners, designers, architects and students), the government managed to push forward such progressive policies as closing large parts of the city quarters (called in Barcelona 'manzanas' or apples) to urban traffic or limiting transit traffic. The creation of 'super manzanas', as these city areas are called, has resulted in tangible changes including reduced levels of noise, cleaner air and higher real estate prices in line with a demand for housing providing a better quality of living.

2.4 Conclusions

Summing up the reflections above the following conclusions can be put forward.

Lessons learnt show that in the digital age the identity of both the citizens and governments has changed. In this context, there are new opportunities that have not yet been spotted to engage citizens and be engaged with citizens in policymaking.

1. There is a much greater potential to foster positive and democratic processes of engagement through digitalisation, if properly designed.

2. Interconnecting communication and collaboration across networks and communities, which are most often of a hybrid nature, can go viral.

3. Co-creation of engagement is to be experimented with at the very level of designing the engagement process. Policymakers can use the lenses of co-creator, partner or even an entity with which citizens engage. The new role of government can be built around the concept of orchestrating ecosystems beyond the traditional top-down, or even top-down and bottom-up, approaches.

4. Leadership in the digital society demands new skills such as communication, social media, design thinking or network thinking.

5. Change can be unleashed not only by relying on policy programmes, instruments and projects but also by empowering European citizens as micro and nano designers, influencers and actors.

6. 'Meaning' should be placed at the centre of citizens' engagement, enabling them to participate in building scenarios and understanding where to go, rather than simply what to do. Meaningful discussions should take place close to issues having a material impact on citizens' everyday lives — health, clean air, traffic, education, safety, etc. — to empower them.

7. Citizens are best engaged 'by design', i.e. not through communication and information sharing, but through creative co-creation of future scenarios. This includes digital platforms that enable citizens to 'texture' a scenario, by bringing their own contribution, so that: (1) policymakers can develop instruments that account for possible future behaviours and feasibility, and (2) citizens will have a sentiment of endowment for the instruments, and acknowledge their participation in their creation (Memories of the future).

8. Awareness and cyber security mechanisms minimise the impact of fake news and bot campaigns.

9. Cities are important sandboxes for building awareness and understanding of their new practices concerning how to engage citizens. Digital technologies empower real European cross-country networks to lead the process.

10. Digital engagement by design is a novel space and in need of experiments and knowledge sharing at European, national and local levels, so that institutions can maximise learning, build effective tools, share accessibility and data and nurture a new language for the engagement of citizens.

3 5G, AI, Blockchain: How Disruptive Technologies will drive Ecosystem Innovation

Daria Tataj

Four years do not seem to be a very long time. However, a lot has changed since Commissioner Carlos Moedas announced the '3Os' policy of 'open science, open innovation and open to the world'. During his tenure, we have witnessed an acceleration of technological progress and the polarisation of the geopolitical situation. These two interlinked developments leave Europe's future with questions regarding the nature, degree and reciprocity of openness as the very fundamental assumption behind the EU's research, science and innovation policy.

EU research, science and innovation policy has been rooted in European values behind openness such as equal access to opportunities, trust in public institutions and respect for diversity. The policies based on these values will be put to the test in a situation where technological advantage, speed of technological deployment and the capacity to capture value from technology-enabled business models will result in a new economic geography over the next decade. On this dynamic global map, the accumulation of knowledge, capital and foremost of all the key competitive asset of today's economy — entrepreneurial tech talent — will show to what extent the forthcoming Horizon Europe is fit for securing Europe's long-term prosperity and socioeconomic model.

3.1 Disruptive Technologies driving Innovation Ecosystems

One example of how disruptive policy decisions might impact on innovation ecosystems, was the American 'man on the Moon mission'. It organized all available tangible and intangible resources – fundamental science, technology development and deployment, public and private funding and foremost talent. The result was that the US started to innovate in radically new and innovative ways with the state playing an entrepreneurial role as an investor and procurer. The spillover effect had tremendous impact on the development of the whole semi-conductor industry, the Internet, GPS and the whole new digital economy with network-based business models leading to unprecedented accumulation of capital.

Since then, the world has further polarized. One of the reasons for this change is the trade conflict between the US and China. This conflict – some call it a trade war – goes far beyond free trade and market protectionism. Rather, it is centered around technologies such as, for example, AI and blockchain, and technology standards around 5G. The race of the superpowers again becomes fueled by the political assumption that the technological supremacy will drive the global power structure.

Another challenge relates to the results of the EU Parliamentary elections of May 2019. The fragmented political scene with substantial victory of nationalist forces might be prone to prioritizing national interests over Union interests. In a

world oscillating between the two superpowers, such a fragmented Europe leaves itself more vulnerable. Our resources such as knowledge, talent and funding must be invested in the creation of European high-performance innovation ecosystems. While European values such as openness are key for innovation, Europe needs to become more entrepreneurial in the way in which we invest these resources. This situation requires Europe to accelerate systemic change to capture the value of its R&I investments

In such a situation, it becomes tempting to perceive mission-oriented policy as a potential vehicle to consolidate the European project and help capture value in Europe. Inspiration about how the current EU policy on missions could be effectively implemented can, for example, be found in the '101 Ideas' publication — a collection of key insights gathered in 2018 during discussions between leading policy experts in 18 European countries and the RISE Group. These are some of the key ideas to be taken forward[40]:

- Idea 61. Missions as tools for more impact and soft coordination. This idea puts the spotlight on the missions as a tool for aligning interests of stakeholders towards a shared purpose. Based on the assessment that the Societal Challenges in Horizon 2020 have not achieved the necessary level of coordination, the sense of shared purpose - and the sense of shared urgency - could be used to coordinate the diverse EU instruments and the national funding programs.

- Idea 63: Define the "Owner" and the "Risk". This insight puts emphasis on responsibility and accountability. It means that the governance and management of the implementation of missions should go beyond the coordination principles in Horizon 2020 and the role of the Principal Investigator as the consortium coordinator. If best management practices from the private sector could increase the effectiveness of mission implementation, then we are in a situation where especially academic partners should build new competencies and new governance models.

- Idea 64: Cities can empower missions. The emphasis on cities - such as Copenhagen, Helsinki, Porto or Barcelona, is to draw upon their experience in engaging local communities to set policy directions through participatory budgets. This knowledge and experiences could inform the process of setting the agenda for missions, specifically how to connect top down policies with bottom up citizens' initiatives.

3.2 5G and Technology War

In April 2019, the White House administration announced sanctions against the Huawei, China's most technologically advanced wireless communication networks company. The implications of this act are simple: the United States cannot afford to be surpassed by any superior network technology of the future

[40] RISE Group (2019). "101 Ideas for the future of European research and innovation policy." DG RTD European Commission.

and 5G is the most advanced network infrastructure that is ready for large-scale commercial deployment today.

Only two other companies in the world have alternative technologies to Huawei and neither of them is American. They are both European. Nokia and Ericsson have technological assets that are equally advanced as those of Huawei and their chances of winning the competitive game are greatly increased by the damage caused by the US government to Huawei. However, this competitive advantage resulting from the geopolitical situation will be temporary. European policymakers need to face the contradiction between openness, free trade and single market policies as the drivers behind competitiveness through competition, and the implications of the China–US trade war for Europe's leading network technology providers and developers. Reformulating the policy response may be beneficial for Europe's future, if not at the overall policy level at a level of policy operationalisation that will allow a prompt response to the temporary window of opportunities. Mobilising Europe's innovation communities such as, for example, the European Institute of Innovation and Technology's (EIT) Knowledge and Innovation Communities (KICs) could potentially accelerate the response and unleash the network effect.

The use of 5G in the tech world is, and will be, faster than any previous wireless technology[41]. It will reshape the information and communication technology assets into a platform integrating services such as finance, media, transport and energy, optimising value chains and adding a new dimension to safety and cyber security. The deployment of 5G gives a new gateway on how to manage complex integrated systems such as smart cities, integrated climate mitigation systems, multimodal transport systems and public health systems. Becoming a processing platform with an integrated real-time data system based on 5G infrastructure will profoundly change the business models driven by AI and secured by blockchain. As a consequence, telecoms, information and communications technology (ICT) and application service providers (ASPs) will enter the same competitive arena. The advantage will come if they shift their value-based thinking to network thinking, which underlies the success of the platform economy in the digital age.

3.3 Innovation through Network Thinking

Network thinking is the cornerstone of innovation whereby network-based business models and the platform economy are key growth drivers. Anchored in the theory of the network society, network thinking puts together into a system the enabling technologies such as 5G, AI or blockchain and a social structure based on real-time communication, big data-driven social networking and collaboration patterns, open innovation models and entrepreneurial culture. These are all complex systems and the opportunity comes from the human capacity to orchestrate these systems using technology and leadership capacity to innovate at the ecosystem level.

[41] Fianncial Times (2018). "The future of connectivity." https://www.ft.com/reports/future-connectivity.

Convergence of the technological and non-technological innovation paradigms is key for innovation though network thinking. Tech talent, especially entrepreneurial tech talent, is the key asset for driving growth based on network-based business models beyond solely technological innovation. This talent is a scare resource and the talent gap is considered by global CEOs as the key bottleneck to creating disruptive start-ups and growing them into global scale-ups both within and outside large enterprises. To leverage the market opportunity created by disruptive technologies and network-based business models, a new leadership mindset and a 'skill-box' must be widely developed across ecosystems.

Network thinking is at the core of the new leadership paradigm epitomised by the ability to orchestrate ecosystems and innovate at the ecosystem level. This ability manifests itself through the capacity to unleash exponential growth driven by the network effect and originating in the simultaneous orchestration of diverse systems — human, technological, economic, social and political. Network thinking behind the leadership paradigm unites into an agile balance of four leadership skills: trust and control; being tightly knit locally and loosely coupled globally; balancing bureaucracy with an entrepreneurial culture; and finally combining competition with collaboration. Learning to master these four dimensions helps leaders gain power from becoming community managers and influencers. The emerging art of ecosystem innovation will be executed across entrepreneurial networks and innovation communities leveraging the digital and non-digital spaces of human interaction.

The growth model based on network thinking underscores the accumulation of capital and valuation of the very largest companies in the world, including Alphabet, Amazon, Facebook and Uber. None of these giant tech firms existed 30 years ago. Since in the network or platform economy 'the winner takes it all' Europe has to change its expectations about diverse research and innovation networks. By design they carry an exponential growth potential and for some reason many of them have not managed to unleash the network effect whatever their goals and key performance indicators (KPIs) are. It is true that exponential growth is enabled by exponential technologies. However, it is led by human leadership. Quality innovation through network thinking is the key success in the digital age when change happens in real time, in the real world.

3.4 Technology matters

European values put welfare, environmental sustainability, social inclusion and security at their heart. And this social contract is more important than ever. At the same time, to afford such a model, European policymakers across all areas must recognise that technology matters.

With 5G, the technology competition focused on this networking technology will rise exponentially since these networks multiply by 20 the transmission capacity and by 50 the volume of data transmitted. Consequently, they make real the deployment of the 'internet of things' and 'internet of humans' that connects billions of objects and machines and probably also people in the future. This will spread information about all areas of society and business with extraordinary

speed to every place in the world connected to the internet, opening up key questions regarding data ethics, data security and data sovereignty[42].

5G is the infrastructure of version 2.0 of the network society. All the processes and dynamics we have witnessed so far will be exponentially accelerated. In such a situation, the question is whether the control and coordination of policies regulating wireless communication standards, open data, open access, the general data protection regulation (GDPR), digital tax, single market labour regulations and directives related to venture capital and SMEs in the digital economy and many other policies focused on industry verticals will be detrimental. The evidence shows that reality will move faster than regulators and therefore the capacity to deploy at all government levels — including regions and cities — the so-called 'sandbox approach', with innovative procurement and pre-commercial procurement policies and procedures and citizens' engagement with the design of policies, remains very important.

Disruptive technologies such as 5G, AI and blockchain are critical for the development and deployment of new applications. Europe remains a powerhouse of excellent science and this should not change. At the same time, policymakers should stimulate large science infrastructures such as CERN or Barcelona Supercomputing Centre to foster an innovation and entrepreneurship culture that will create interfaces where science capacity can be more quickly translated into economic and societal value. Networking these institutions and embedding them into mission oriented-policy is vital to consolidate innovation value webs for Europe's future.

The fact that disruptive technologies such as 5G, AI or blockchain matter should not be underestimated even if what we witness may seem to be hype. This is similar to the origins of this ICT, when Europe managed to set out the network technology standards that gave a decade-long advantage to Nokia and other European companies.

Now, in a situation where Huawei is already prototyping 6G, mission-oriented policy could play a key role in pushing European companies to compete and to collaborate at the same time, using one of the network thinking principles. The large scientific infrastructure institutions and the European Innovation Council (EIC) or even the EIT KICs could undertake leadership and accountability to drive exponential growth across Europe's innovation ecosystems.

3.5 Technology and Ecosystem Innovation

An innovation network can be conceptualised as a manifestation of a specific type of social organisation characteristic of the network society. Consortia that will be created to design and operationalise mission-oriented research and innovation projects will epitomise an innovation network where science,

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[42] Digital Future Society (2019). "Towards better data governance for all: Data ethics and privacy in the digital era." Barcelona.
https://digitalfuturesociety.com/app/uploads/2019/08/060819_Toward_better_data_governance_for_all_dfs_mwcapital_DIGITAL.pdf

innovation and technology meet with markets and societies. Innovation has always been a social phenomenon and different sorts of innovation networks also existed in the industrial age. However, under the new regime of 5G, AI and blockchain, innovation networks will gain a new dimension and advantage coming from managing or leading innovation and an ecosystem level where openness and closeness, regulation and freedom, and institutional barriers and individual creativity will continue to escape the existing legal frameworks.

Given the high ambition in dealing with the mission-oriented approach to tackle grand challenges such as clean water, climate change, sustainable cities, fight against cancer and the future of food, any technology-driven innovation is based on a paradigm combining the digital and the off-line worlds, the product and the service economy. Technology is fundamental but definitely not enough to complete complex missions, which reflect cross-societal, cross-disciplinary, global, and urgent challenges. Interlinking the physical and the virtual reality creates a multidimensional world of constant flux. Leadership in such a world, where technology matters so much, needs to be spread and distributed across all partners – both academic and non-academic – who collaborate to achieve a mission.

As far as the new and existent mission-oriented innovation networks become a network of networks, this meta structure will synchronically be interlinked at micro and macro levels, reconfiguring interconnected nodes and probably leading to increasing the innovation divide across Europe's Member States and regions within these states. As nodes have different importance and functionality within the network, the transformation and reallocation of resources can be engineered by investment and public procurement in deploying disruptive technologies.

In this context, consortia will be influenced as much by using disruptive technologies as by their capacity to absorb, process, and share information and collaboration, which are as relevant and useful for accomplishing the purpose of the mission. If a node does not contribute to processing the flow of information and creating value, it becomes redundant, in which case a network reconfigures itself by deleting useless nodes and adding new ones. While the policy should mitigate the risks of brain drain, net knowledge loss and outflow of smart capital is embedded in the logic of the network economy, by no means should it cover and fund dysfunctional nodes of innovation. Policies which assume that the government is the single centre of control and command are doomed to fail. However, we need to be alert to the inertia of governance systems. Unless there is a change of governance systems, the existing innovation networks and communities will continue to produce a similar output in terms of quality and will function in a largely unchanged pace in terms of speed, direction and meaning.

3.6 Disruptive Technologies and Emerging Markets

Undoubtedly, many European regions will be largely disrupted by absorbing the speed of disruptive technologies. We need more policies to build leadership capacity to manage this process, and foremost to create and capture value in Europe. Many innovation hubs in Europe spread between Oxford and

Cambridge, or clustered in metropolitan areas of London, Northern Brabant, Paris, Grenoble, Munich, Helsinki, and Stockholm, are still at the forefront of technology development. However, the pool of innovation hotbeds has been broadened. Countries in the emerging markets including China, Brazil, and India have overcome their initial stage as cheap global outsourcing sites. They have become innovators in their own right and scope, spearheading technology development. This means that European economies are now faced with intensifying competition and a surprise effect coming from what is called an 'innovation blowback'.

Consequently, the missions can inspire a new policy perspective, which can be gained from reflecting on 'the open to the world R&I dimension'. R&I policy makers may want to put more emphasis on the more symmetrical or even revers knowledge, talent and investment flows between most advanced innovation economies and the emerging markets or emerging innovation hubs in less developed European regions. As demonstrated by the case of Huawei, disruptive innovation happens in the emerging markets to an extent unforeseen a few years ago.

Emerging innovation hubs in Europe may also become the primary places for creativity, new technology innovation and new network-based business models. This means, in practice, that the open to the world paradigm may benefit – besides underpinning the mission-oriented approach – as well from looking to solutions which cater to the underprivileged mass markets of consumers and users. Certainly, many leading European companies have already been looking into emerging markets as a source of knowledge and talent for many years, including examples such as the Nokia Research Center in Bangalore, Philips Research in Shanghai, or the ABB Corporate Research Center in Kraków.

3.7 Conclusions

What remains a weak link in many, perhaps even most, of the European innovation ecosystems, is the entrepreneurial culture both in private and public sectors. This missing link in the innovation process will probably also affect policy. The entrepreneur is the actor behind and driver of innovation. Technology as an enabler, and innovation through Network Thinking carries the opportunity to unleash exponential growth. Surely, the R&I landscape will be affected by the leadership talent gap and this is in principle nothing new. However, with the rollout of such disruptive technologies as 5G, AI and blockchain, all processes of inflow and outflow of knowledge, talent and capital will happen at an unprecedented speed with little chance to reverse the trend if Europe fails to calibrate its growth model for the polarised tech-driven global economy.

There are many questions that policy makers should be asking when preparing regulatory frameworks, funding instruments and reforms. What is the greatest impediment to successfully transitioning to 5G, deploying AI and blockchain? How will these technologies be delivered to remote areas and less developed regions such as rural areas which are typically underserved? When will the full capabilities of 5G, AI and blockchain be a reality? When can we expect an ubiquitous network in Europe and how will these technologies the world? What

will be the groundbreaking applications, and will they originate in Europe? How will missions benefit from the deployment of disruptive technologies? How will governments and companies continue to protect consumer privacy and users' data? How can European entrepreneurs and investors capitalize on disruptive technologies and what can we do to capture value in Europe?

In summary, the following reflections can be put forward in the context of disruptive technologies.

1. **Openness:** Scrutinise how Europe can benefit from openness as the underlying value behind Horizon Europe and what risks openness carries under the current paradigm of Horizon 2020. Focus this analysis on foresight around global technology standards, re-allocation of capital and mobility of entrepreneurial tech talent. Look at the EU's investment in R&I through the perspective of an 'entrepreneurial state,' calculating returns on investment and not only measuring success through societal impact and scientific excellence.

2. **Innovation networks:** Formulate ambitious expectations towards European knowledge and innovation networks and communities, such as for example EIT KICs, European Cooperation in Science and Technology (COST) and alumni of the European Research Council (ERC) and Erasmus programs, in order to improve their performance and innovation through Network Thinking. Benchmark the outcome of this new way of ecosystem innovation against their historic KPIs.

3. **Ecosystem innovation:** Incentivise the consolidation of European R&I infrastructures, funding institutions, networks and communities into a more tightly-knit ecosystem. Empower leaders to limit bureaucracy within EU-funded schemes at the level of reporting and administration. Foster open innovation ecosystems with a caveat that open does not mean free. Forming collaborations must include internal and external partners as well as customers, consumers, and creative communities. The shared economy models provide examples of how such networks can unleash value.

4. **Tech culture:** Creating an open innovative culture requires proper leadership and human resource management. Invest in entrepreneurial skills and spread Network Thinking to empower leaders who can orchestrate innovation ecosystems. Put more emphasis on entrepreneurial tech talent to promote entrepreneurial role models in the public and private sector and inspire the younger generations to undertake entrepreneurial career paths.

5. **Brain drain:** Foster polices to prevent brain drain, and at the same time fund programs directed towards re-emigration or tech talent and tech talent mobility. Put special attention to networking and talent development directed at entrepreneurial tech talent, women in tech, multicultural talent and diversity. Incentivise top scientists and all types of innovators to stay in Europe or return to Europe when they have accomplished a successful career abroad.

6. **Leadership:** Promote innovative leaders in business, government, academia and social movements as role models. Giving public recognition for scientific achievements or contributions to open source software, or mentoring schemes may be as important as monetary rewards. These talent management practices enable and encourage creative individuals to dare to think beyond existing technology frameworks and current markets. The key success factors for network orchestrators include a combination of management practices. They foster an unconstrained environment for finding creative solutions, sharing prototypes across organizational boundaries using co-opetition and thus changing from being collaborators to competitors and vice versa depending on a particular module of a product or service.

7. **Innovation districts:** The decision to locate resources (co-locate) in a certain physical space is based on the existence of micro networks of high-level decision-making, linked to macro networks of decision implementation. Invest in local ecosystems – especially focusing on mid-sized cities within large metropolitan areas, as well as city-capitals of European regions, which are often located at a substantial distance from the leading innovation hubs in a Member State – to attract talent, knowledge and capital. This is why decisions of where to place R&D facilities of public or business organisations are based also on intangible factors such as access to micro networks of partners, collaborators, and competitors converging in certain selective physical 'innovation districts'. This is a different concept than investing in science parks or research infrastructure. The focus should be put on interconnectivity, interoperability, capacity and willingness to network.

8. **Intellectual Property Rights (IPR):** Activities related to science, technology, and innovation are carried out in a number of diverse settings beyond institutions. In some settings, fundamental or deep technological research is protected by tight IPR policies and procedures. In other environments, protection of IPR is not that important or neglected in principle, as success depends on the speed of business or industrial application of an idea, often using a wide range of users who copy, exploit, and improve the initial product. Balance open science policy with respect for technological reality where tight IP barrier are a source of superiority and should be protected.

9. **Technology:** Technology-driven innovation is no longer a sustainable competitive advantage and often becomes a legacy of established industry players. But technology matters today more than ever if the innovation it enables serves people and societies, fulfills the needs of markets and is able to create a 'tipping point.' For different stakeholders of the innovation process, this 'tipping point' will be different by definition. It may lead to higher contributions to R&D by the private sector, an increased concentration of high-tech manufacturing and a smaller size of manufacturers, more start-ups or spin-offs in fast-emerging sectors, less dispersion of scientific knowledge, and more interaction between science and technology, or higher R&D intensity in

small and medium-sized companies, which usually display a higher propensity to grow and expand internationally.

10. **Industrial policy:** European industrial policy in times of tensions between the US and China requires a consolidated approach with two perspectives: the short-term and the long-term. In the short term, Europe needs to build a political consensus to offer superior investment opportunities to keep tech talent and firms in top European ecosystems. There are many available instruments in the current programmes and even more with the EIC as a leading example in Horizon Europe. In the long-term, Europe needs to maintain principles of competitiveness and focus on developing and setting industry standards, data protection standards, and ethical and public security standards. The link between regulation, implementation of the Single Market and Digital Single Market and networking entrepreneurial innovation ecosystems across Europe and across the globe requires a strong focus on integrated, systemic solutions rather than stand alone silo policies. Creating demand for rolling out advanced technology solutions in Europe may be achieved through smart city policies and e-government policies, for instance.

11. **Regional development:** Consider allocating funding lines for deployment of disruptive technologies for regional development, cohesion and structural funds in under developed regions and mid-size cities. Consider allocating funding lines to incentives development of applications through disruptive technologies by start-ups and innovation communities originating at the peripheries of innovation networks.

4 A dynamic Approach to Developing and Implementing Disruptive Innovation Ecosystems in Regions

Mary Ritter, Willie Donnelly and Bill O'Gorman

4.1 Introduction

This chapter explores how we can approach the development and implementation of disruptive innovation ecosystems in EU regions. Commencing with providing readers with background information and a rationale as to why EU policymakers and implementers should focus on generating policies to implement disruptive innovation ecosystems in EU regions, the chapter questions if we should reimagine the concept of region and how we might embrace embedding smart specialisation strategy innovation chains within this concept. The chapter then discusses a new paradigm for creating greater innovation performance cohesion between regions. This paradigm is to create an environment whereby the 'innovation-poor' and/or 'knowledge-unendowed' regions engage with 'innovation-rich' and 'knowledge-endowed' regions in a cohesive process that is of mutual benefit to multiple regions.

This is followed by a section that elaborates how we should use the concept of smart specialisation and the entrepreneurial discovery process (EDP) to create disruptive technologies but more especially to create a dynamic environment for the continuous emergence of disruptive technologies. This leads to a discussion as to how the mission-oriented approach can facilitate the development and implementation of disruptive innovation ecosystems. Next, we focus on sustainable innovation and knowledge as a platform that leads to economic development through the use of multidisciplinary and transdisciplinary aspects of disruptive innovation. This culminates in the presentation of a conceptual framework for the implementation of disruptive innovation ecosystems in regions.

The chapter concludes by presenting a set of lessons learned through engagement with the RISE group and identifies challenges in implementing disruptive innovation ecosystems in regions.

4.2 Background and Rationale

There is no doubt that since its inception, cohesion policy has been playing a major role in strengthening cohesive economic policies, development and practices across the EU-28. However, whereas the concept of the cohesion policy is to support the development of less developed and lagging countries and regions to enhance their innovation capacities and capabilities so as to reduce the economic, social and territorial disparities between EU countries and regions[43], according to the 2019 Regional Innovation Scoreboard report[44],

[43] European Union (2007). *Treaty of Lisbon Amending the Treaty on European Union and the Treaty Establishing the European Community*. 13 December 2007, 2007/C 306/01. http://en.euabc.com/upload/books/lisbon-treaty-3edition.pdf

disparities still exist. Whereas the report indicates that there has been a net improvement in innovation performance across the 159 regions observed, since the first RIS report was published in 2009, and there has been a process of convergence in regional performance with decreasing performance differences between regions[45], the regions are still categorised into innovation leaders (38 regions), regional strong innovators (73 regions), regional moderate innovators (97 regions) and regional modest innovators (30 regions). Other reports and research, however, suggest that the level of improvement or convergence in innovation performance between regions is relative to the 'starting innovation performance' measure and the level of European Structural and Investment (ESI) funds invested in and absorbed by certain regions[46]. The 2019 RISE report also states that all regional innovation leaders belong to countries identified as innovation leaders or as strong innovators in the European Innovation Scoreboard, and almost all regional moderate and modest innovators belong to countries identified as moderate and modest innovators in the European Innovation Scoreboard[47]. Even though regional 'pockets of excellence' can be identified in some moderate innovator countries (for instance, Crete, Friuli-Venezia Giulia and Prague), there are still innovation and economic imbalances existing between EU regions.

4.3 Regions and Smart Specialisation Strategy Innovation Chains

A question that must be posed is, does the concept of region need to be reimagined? There are many political and administrative reasons why the notion of region must be retained. But from socioeconomic and innovation-led growth perspectives, is it reasonable to retain the concept of region as '… a territory less than its sovereign state, possessing distinctive supralocal administrative, cultural, political, or economic power and cohesiveness, differentiating it from its state and other regions'[48] or to define region as a functional entity based on economic linkages that may not match political borders but can span regional or even national boundaries[49]. With the accelerated rates of (i) changing technology, (ii) availability and amount of data, (iii) knowledge creation and diffusion, (iv) convergence of technologies and (v) global awareness boundaries between regions, territories and societies have blurred enormously. **Therefore, there is a need to review current thinking and practices as regards the delivery of ESI funds and the measurement of the positive impact of these investments.**

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[44]European Commission (2019). "Regional Innovation Scoreboard." Brussels. https://ec.europa.eu/growth/sites/growth/files/ris2019.pdf

[45] Ibid, p. 4.

[46] See for example, Crosbie, N., O'Gorman, B., Peck, F., (2016). "Innovation Performance in Europe's Lagging Regions." Presentation to the RSA Annual Conference 2016, Graz, Austria.

[47]European Commission (2019). "Regional Innovation Scoreboard." Brussels. https://ec.europa.eu/growth/sites/growth/files/ris2019.pdf, p.4.

[48] See Cooke, P., Uranga, M. G., & Etxebarria, G. (1997). "Regional innovative systems: Institutional and organisational dimensions." *Research Policy*, 26(4,5), 475- 491; and Cooke, P., Uranga, M. G., & Etxebarria, G. (1998). "Regional systems of innovation: An evolutionary perspective." *Environment and Planning A*, 30, 1563-1584.

[49] OECD (2011). "Organisation for Economic Co-operation and Development."

Smart specialisation since its inception and articulation by a group of academics in 2008[50] has gained tremendous traction and embedded use across the EU-28. The original concept was based on the entrepreneurial discovery process (EDP), on identifying what a country does, what it is proficient at and what it does best as regards R&D and innovation. However, the concept seems to have been somewhat diluted over time in that nearly every Member State and its regions are pursuing the same set of smart specialisations. In many cases, the pursuit of smart specialisation may not be pertinent to a region's endowments of culture, societal structure, infrastructure, human capital, technological intensity, industry mix or access to relevant resources (financial, human and natural). In summary, not every region has the capacity or capability to pursue a comprehensive smart specialisation strategy. However, this should not preclude them from engaging in the entrepreneurial discovery process and being part of a smart specialisation strategy that is external to their region. In other words, most, if not all, regions should be capable of and encouraged to be part of smart specialisation strategy innovation chains (akin to supply chains in the business and industry domains).

4.4 Innovation Performance Convergence

Each region has its own set of innovation and knowledge generation and diffusion skills regardless of the technological base or setting in which these skills are used and propagated. **The challenge, to progress reducing the economic, social and territorial disparities between EU countries and regions, will be to develop an inclusive environment and process that enables the 'innovation-poor' and/or 'knowledge-unendowed' regions to engage with 'innovation-rich' and 'knowledge-endowed' regions in a cohesive process that is of mutual benefit to multiple regions.**

Because Moore's Law[51] is as much applicable today as it was in the 1960s when first mooted by Gordon Moore, physical boundaries between regions/countries and psychological boundaries between cultures are no longer impervious to innovation growth and knowledge creation/dissemination/exchange facilitating incremental and disruptive technology (both software and hardware). Therefore, no longer can smart specialisations be bounded by region, territory or other boundary. Rather, such a scenario demands greater emphasis on open innovation, open source platforms, open and dynamic policies and the dispersal of knowledge and technology to generate public (citizen) (and as opposed to merely 'open') innovation. This transcending of boundaries, facilitated by the ever-evolving digital platforms, will generate an ever-increasing need for new dynamic governance models. Over the last three decades, policymakers have viewed science parks as key to the generation of place-based innovation

[50] Foray, D., David, P.A., Hall, B.H., (2011). "Smart specialization From academic idea to political instrument, the surprising career of a concept and the difficulties involved in its implementation." *MTEI-WORKING_PAPER-2011-001.*

[51] Moore's law is a 1965 observation made by Intel co-founder Gordon E. Moore that the number of transistors placed in an integrated circuit (IC) or chip doubles approximately every two years. Because Moore's observation has been frequently cited and used for research and development by multiple organisations, and it has been proven repeatedly, it is known as Moore's law. (see https://www.techopedia.com/definition/2369/moores-law online. Accessed May 2019.)

growth. Current thinking considers innovation districts as essential to the innovation-growth model because districts will involve a diversification of industries, businesses and citizens as key elements of the innovation process. However, by their very nature these entities are territorial and geographically bounded. **The challenge therefore is to create and implement dynamic inter-regional ecosystems[52] with equally dynamic governance and business models that nurture innovation-growth tactics involving multiple-region European and Global value chains.**

4.5 Smart Specialisation and Disruptive Technology

The original objective of the smart specialisation concept was to ensure that innovation drove regional economic development. It is, however, important that regional smart specialisation initiatives are aligned with the European objectives of innovation-led growth, inclusion and sustainability. Europe's commitment to social challenges provides a framework by which these three objectives and global challenges can be achieved. Added to this, in a globalised economy, internationalisation is an important consideration in the design and implementation of research and innovation for smart specialisations. Unfortunately, the European research ecosystem is fragmented between European and national research frameworks, which are largely publicly funded programmes. On the other hand, many private research, development and innovation systems (RDI) are centred on the activities of foreign direct investments (FDIs)[53], which often have little impact on indigenous industries. The speed of development and disruptive nature of new technologies and associated business models provides opportunities to refocus the smart specialisation process and accelerate regional economic growth. One can use telecommunications as an example. The liberalisation of the telecommunications marketplace and the emergence of new disruptive wireless networks allowed underdeveloped countries to skip a generation and invest in state-of-the-art infrastructure. Regions in which smart specialisations are based on more traditional industries can leverage disruptive technologies to accelerate their presence in new markets. However, for this to be effective, a number of R&I structural changes are required. In practice, this requires the creation of an integrated R&I ecosystem linking basic, applied and technological research and connecting this to business applications. This is particularly relevant in the case of research into more disruptive technologies and innovations, which are driving new disruptive business models. **The challenge therefore is for Europe to better align its research, science-based innovation and capital investment towards societal impact. An early understanding and application of such disruptive business models is essential if Europe is to secure its position as an innovation leader on the global stage.**

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[52] O'Gorman, B, O'Neill, M., Brett, B, (2017). *A Guide for Developing and Implementing Region-specific Joint Action Plans (JAPs) and Inter-regional (transnational) JAPs (iJAPs).* Oak Tree Press, Cork.

[53] Technically, Foreign Direct Investment (FDI) is an investment made by a firm or individual in one country into business interests located in another country. However, in the context of defining the industry stock or mix in a region or country. FDI refers to industries, businesses and other organisations operating in a country that are not wholly owned by citizens of that country. They are entities that are wholly or majority owned by foreign companies/investors that set up new operations or acquire the business assets, ownership or controlling interest of entities in another country.

In a globalised economy therefore, innovation and internationalisation are intrinsically linked. European Innovation Leader regions are 'globally connected'. Such regions have a critical mass of firms and academic institutions actively involved in global research programmes and technology networks. Conversely. innovation-lagging regions need to leverage established and new research and innovation mission-oriented ecosystems such as the European Institute of Innovation and Technology's (EIT) Knowledge and Innovation Communities (KICs)[54] and other mission-oriented models to reduce the gap with Innovation Leader regions.

4.6 Mission-oriented Approach

Europe, through the future 'Horizon Europe' policy, is committed to adopting a mission-oriented approach to addressing global challenges [55]. A key advantage of such missions is that they enable a systems approach to innovation working, for example, at the level of whole value chains or more ambitiously of districts/cities where multiple systems come together. Linked to this, a key recommendation of the Lamy High Level Group[56] is that missions should be open to all actors in the research and innovation cycle, in particular new actors in innovation and change such as cities and regions (particularly those in periphery 'innovation-poor', 'knowledge-unendowed' regions) which could act as 'innovation laboratories of change' in piloting new ideas and concepts [57]. **A critical challenge here is the engagement of citizens, for whom the mission approach provides a clear context within which to understand the rationale for Europe's commitment to responsible research and innovation (RRI) and the impact and benefits that can be expected to accrue.**

The mission-oriented approach may also be a step in the direction of developing dynamic inter-regional engagement and governance. To be successful, however, the mission-oriented approach requires a highly effective dynamic multi-stakeholder innovation ecosystem. The RISE report on Mission-Oriented Research and Policy[58] identified the need for new governance to be able to align multiple mechanisms and domains at least at the level of the broader challenge and supported the approach proposed by the Aho group to appoint senior individuals of high standing and demonstrated independence with the remit to create a platform and orchestrate European action in the area across

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[54] https://eit.europa.eu/

[55] https://ec.europa.eu/info/designing-next-framework-programme/mission-oriented-policy-next-research-and-innovation-framework-programme_en

[56] European Commission (2017). "Lab – Fab – App: Investing in the European Future we want." Report of the High Level Expert Group on maximising the Impact of EU Research & Innovation Programmes, Brussels. http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/hlg_2017_report.pdf

[57] Ibid.

[58] European Commission (2018). "Mission-oriented Research and Innovation Policy: A RISE Perspective." Report of the High Level Expert Group on Research, Innovation and Science, Brussels. https://ec.europa.eu/info/sites/info/files/mission_oriented_r_and_i_policy-a_rise_perspective.pdf

directorates-general, Member States and regions to liaise between R&D performers, regulators, users and sectoral stakeholders[59].

One example that clearly illustrates this approach is the EIT's well-established family of eight KICs which themselves are mission-oriented in the areas of climate change, digital, energy, food, health, raw materials and urban mobility[60].

The KIC model is based on the development of a cross-sector innovation community spanning EU Member States and regions. The initial three KICs (EIT Climate-KIC [61], EIT Digital[62] and EIT InnoEnergy[63]), were a unique experiment in ecosystem development, bringing together business, academia and public bodies to create a trusted community of partners. The learning emerging from these three KICs was incorporated into five new KICs established in subsequent years. To illustrate the model, EIT Climate-KIC is now a large and diverse community with more than 370 partners from 33 countries across Europe. Approximately 50% of these partners come from the business sector (both large corporates and SMEs), about 30% are universities and research institutes, while the remaining 20% or so comprise public bodies including NGOs and, very importantly, city and regional governments. Through this thriving ecosystem, EIT Climate-KIC's mission is to provide catalytic and systemic change through innovation for climate action, working through an innovation ecosystem that can trigger impact at scale[64]. Thus, although during the KIC's early development, innovation activities tended to be more incremental point innovation in nature, the now well-established EIT Climate-KIC strongly addresses transformative systems innovation, focusing on the levers of change (such as finance, policy, knowledge, new business models, education and technology) that create the scaling of innovation for significant impact (for example WINnERS[65], Climetrics[66]; for a strategic overview see Transformation in Time[67]).

Within the KIC innovation community ecosystem model, regional cross-sector innovation clusters can network with other regional clusters across the entire European KIC community providing a platform for engagement between

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[59] Aho, E., Cornu, J., Georghiou, L. and Subirá A. (2006). "Creating an Innovative Europe." Report of the Independent Expert Group on R&D and Innovation Appointed following the Hampton Court Summit.

[60] European Institute of Innovation & Technology. https://eit.europa.eu/

[61] Climate KIC. https://www.climate-kic.org/

[62] European Institute of Innovation & Technology. https://www.eitdigital.eu/

[63] InnoEnergy. http://www.innoenergy.com/

[64] European Institute of Innovation & Technology (2018). "Transformation, in time: EIT Climate-KIC Startegy 2019-2022." https://www.climate-kic.org/wp-content/uploads/2018/12/Transformation-in-time.pdf

[65] European Institute of Innovation & Technology, Climate KIC. https://www.climate-kic.org/success-stories/winners/; http://www.winners-project.org/

[66] European Institute of Innovation & Technology, Climate KIC. https://www.climate-kic.org/success-stories/climetrics/; https://www.climetrics-rating.org/

[67] European Institute of Innovation & Technology (2018). "Transformation, in time: EIT Climate-KIC Startegy 2019-2022." https://www.climate-kic.org/wp-content/uploads/2018/12/Transformation-in-time.pdf

innovation-leading and innovation-lagging regions. This is augmented by the EIT's 'Regional innovation scheme'[68], enabling KIC innovation activities and learning to spread throughout the east and south of Europe. Ultimately, the pan-European innovation ecosystem can itself network with ecosystems beyond EU boundaries to support global innovation. An added dimension to the support for mission-oriented systems innovation is created by cross-KIC collaboration. Collectively, the EIT KIC family has a total innovation community of almost 1 500 partners across Europe. This networking of ecosystems enables individual regions to participate in and contribute to large-scale mission-oriented innovation, with projects focused on their particular smart specialisations and directed towards different components of the mission's systemic innovation approach. It is a networking of 'placed-based' (test bed) demand/challenge-led innovation where cities and regions, themselves, are frequently the challenge owners.

To give an example: one smart specialisation domain for the South East region in Ireland is focused on high-value sustainable dairy products. A major challenge for the realisation of this smart specialisation is the negative environmental/climate impact of rapid growth in dairy in the context of global warming (greenhouse gas emissions) as well as water and soil pollution. The development of new innovative and disruptive solutions to address these challenges can be best achieved through collaboration between the Irish smart dairy research and innovation ecosystem and the broader Climate-KIC innovation community. The interface for engagement is provided by the Climate Mission established by the KIC. **The overall challenge will be gaining a cohesive and meaningful understanding, acceptance and embracing of the mission-oriented approach by R&D performers, regulators, users and sectoral stakeholders to develop more cohesive, integrative, inclusive inter-regional regional innovation ecosystems (iRIS)[69].**

4.7 HEI-sustainable Innovation-knowledge: a Platform for Regional Economic Development

Ever since Birch pointed out that that more than 85% of the US economy was based on the activities and employment levels of SMEs and his comments about the need for governments to provide the proper environment for start-ups and for existing firms to expand as being critical for sustaining the development of economies[70], most economies have focused on supporting the creation and development of SMEs and embarked on a trajectory of supporting entrepreneurs and entrepreneurship. Whereas the cohesion policy framework programmes up to Horizon 2020 were heavily focused on R&D and innovation (RDI), SMEs, through the SME instruments supports, took centre stage in Horizon 2020. Through SME instruments, SMEs were encouraged to engage with projects funded by the European Regional Development Fund (ERDF),

[68] European Institute of Innovation & Technology (2019). "EIT Regional Innovation Scheme." https://eit.europa.eu/our-activities/outreach/eit-regional-innovation-scheme-ris

[69] O'Gorman, B, O'Neill, M., Brett, B. (2017). *A Guide for Developing and Implementing Region-specific Joint Action Plans (JAPs) and Inter-regional (transnational) JAPs (iJAPs).* Oak Tree Press, Cork.

[70] Birch, D.L. (1987). *Job Creation in America: How Our Smallest Companies Put the Most People to Work*. Free Press: New York.

especially if they had 'innovations that were close to market' with the emphasis being on 'SMEs with a clear commercial ambition and a potential for high growth and internationalisation are the prime target'. Therefore, from around 2010, it is evident that EU policymakers were considering a more market-led and 'hands-on' innovation-growth focus to economic development and sustainability across the EU.

Prior to this, public institutions were embracing a more entrepreneurial approach to their governance. No more so than in HEIs, where in the late 1990s the focus was on the necessity to develop 'entrepreneurial universities' as a result of the pressures universities faced to contribute to socioeconomic development in their respective regions[71], and they also needed to adapt to the demands and extreme complexities and uncertainties brought about by the disruptive and accelerating changes in technologies as well as the availability and changing dynamic of easier access to and use of information[72]. Accordingly, HEIs, in order to address the challenges of the knowledge-based society and knowledge-driven innovation to contribute to local, regional and national economic development, have embraced entrepreneurship to the extent that they have become more reliant on receiving inputs from industry leaders and entrepreneurs for developing, and sometimes managing, education programmes. So too in developing regional innovation and enterprise policies, local and regional government have become more reliant on receiving inputs and directions from entrepreneurs and leaders of industry[73]. However, by their very nature entrepreneurs and leaders of industry and business are driven by their own business needs and self-interests. Therefore, if there is a conflict of interest between addressing a business need or providing support for a 'public good', the entrepreneur, business owner or leader of industry/business will (must) prioritise his/her business needs. Equally, if the entrepreneur, business owner or leader of industry/business has been funded by public funds to perform a 'public good', invariably he/she will disengage when these funds have been consumed. Therefore, while accepting inputs from entrepreneurs, business owners or leaders of industry/business, there is a need for the leadership of public sector organisations and HEIs to retake the lead role in regional economic development and be both the catalysts and facilitators for enabling civic society to be co-creators of the dynamic environment required for the realisation of the 3Os (open innovation, open science and open to the world) and inter-regional knowledge flows whereby disruptive innovation can flourish. **The challenge will be to wean public sector leaders away from their dependence on entrepreneurs, business owners and leaders of industry/business to re-establish themselves as catalysts in the community directing resources to embed disruptive innovation in their regions.**

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[71] Clark, B. (1998). *Creating Entrepreneurial Universities: Organizational Pathways of Transformation. Issues in Higher Education*. Elsevier Science Regional Sales: New York.

[72] Clark, B. (2001). "The entrepreneurial university: New foundations for collegiality, autonomy, and achievement." *Higher Education Management*, *13*(2).

[73] See for example the development of the South East Action Plan for Jobs (SEAPJ) 2015 – 2017 policy document, https://dbei.gov.ie/en/Publications/Publication-files/South-East-Action-Plan-for-Jobs.pdf

A key aspect of the regional smart specialisation policy is the focus on innovation as a platform for regional economic development. The triple helix model of innovation refers to a set of interactions between academia, industry and governments, to foster economic and social development. As the knowledge society evolves, there is increased recognition of the importance of the citizen not simply as a consumer of services but as an active participant in shaping the society of the future. Therefore, as the knowledge society evolves the emphasis of the role of research and innovation has evolved from the narrow concept of drivers of economic development to instruments for the creation of a sustainable society. This shift towards sustainability has an important impact on how the roles and interactions of individual players and entities are viewed/valued within the quadruple helix model. **Consequently, it is essential that both EU and national investments in regional economic development consider strategies for the transformation of government agencies towards a leadership role in the creation of open innovative structures that actively promote sustainable investments and solutions for and with society.**

Government agencies are major providers and consumers of services and as such are frequently the major 'challenge owners' in society. Therefore, their influence as co-creators of sustainable innovation in and for society is tightly coupled to the level of open and sustainable innovation embraced by such agencies, and to their access to the innovative solution providers. Consequently, the European Commission needs to develop Europe-wide policies and initiatives that encourage national and regional public sector organisations to embrace more open and responsive organisational and operational structures, particularly in their engagement with quadruple helix partners, to drive greater service innovation within both public and private sector organisations. In particular, as government agencies evolve towards the application of open innovation concepts to deliver services to stakeholders, there is an opportunity for these agencies to be early adopters of disruptive innovation facilitating a more rapid take-up of new technologies for the benefit of society. **The challenge will be for the Commission to incentivise public sector organisations to take risks and to ensure there is a sharing of experiences and know-how derived from framework programme outcomes across the EU.** For instance, in the case of smart cities, there is a need to prioritise the transfer of outputs and experiences from invested cities to other cities and regions so as to increase the uptake of open source products and services.

In the fourth industrial revolution, the role and flow of knowledge is as important to innovation-led growth and prosperity as the production of steam was in the first industrial revolution. While HEIs remain central to the creation of knowledge through their research and teaching programmes, the community of knowledge creators and co-creators has widened considerably. A factor limiting the use of this co-created knowledge, for the economic and social development of regions, is the absorptive capacity of society to embrace and apply this knowledge. At the regional level, HEIs can mitigate this shortcoming by being catalysts in the creation of regional, inter-regional and global quadruple helix clusters that can be mobilised to enhance their region's social and economic impact through the global exchange and sharing of research and

innovation knowledge, learning and experience. **To achieve this, the challenge for investment is twofold: (i) the creation of European-level multidisciplinary research networks and (ii) the use of higher-level institutions as platforms for entrepreneurial development.**

4.8 Multidisciplinary and Transdisciplinary Aspects of a Disruptive Innovation Ecosystem in Regions

One of the major impacts of digitalisation and the emergence of disruptive innovation and technologies has been the realisation that many societal challenges require a broader multidisciplinary and transdisciplinary approach to research and innovation; they require multidisciplinary networks in a multi-regional domain. While it is true that institutional organisational structures based on specific discipline areas and peer review systems hamper the growth of such network platforms, the creation of a European framework based on the concepts of open innovation and open science has the potential to accelerate their growth. The creation of such networks should be focused on strategic research challenges (missions) which have local, regional and global dimensions incorporating academic and industry stakeholders. However, it is not just institutional limitations that create obstacles to multidisciplinary research; it is also cognitive constraints, including the methodological and conceptual barriers associated with domain-specific research environments. A particular challenge for multidisciplinary and transdisciplinary research is the ability to mine vast volumes of data and identify associations between knowledge from different domains[74]. For example, the emergence of disruptive technologies such as artificial intelligence (AI) and high-performance computing (HPC) enable the creation of multidisciplinary and transdisciplinary integrated platforms for data analytics support.

The second part of this investment challenge is the creation of third-level institutions as platforms for entrepreneurial development. Third-level institutes have a very important role to play in delivering and propagating the entrepreneurial discovery process through leveraging their global knowledge networks and international partnerships to support regional competitiveness and economic growth. This is particularly important in supporting SME capacity and capability development through the application of their research capacity and know-how. HEIs have a particularly important role in enabling FDIs to more effectively engage in research and innovation activities in the region in which they operate thus increasing the FDI innovation footprint within that region. Therefore, it is important to explore ways in which HEIs can leverage their national and international research and innovation networks to help to identify existing and new global value chains for local industry participation. In particular, HEIs are well positioned to act as agents for change especially in supporting industry in understanding and leveraging the impact of emerging disruptive innovation and, equally, disruptive business models. From a regional sustainability perspective, HEIs are also well positioned to extend the concept of

[74] MacLeod, M., (2018). "What makes interdisciplinarity difficult? Some consequences of domain specificity in interdisciplinary practice." *Synthese*, Vol.195, Issue 2, pp 697-720. [online] Available at https://link.springer.com/content/pdf/10.1007%2Fs11229-016-1236-4.pdf Accessed May 2019.

entrepreneurship to incorporate greater participation of non-scientific domains in the entrepreneurial process. Areas of creativity and design are increasingly seen as key to the design and development of new products and services. HEIs, therefore, have the capacity to drive new innovation models for product and process design based on multidisciplinary entrepreneurial clusters. **The challenge is to encourage and incentivise HEIs to embrace the role of catalyst and facilitator to actuate the entrepreneurial discovery process (EDP) in their regions.**

4.9 Disruptive Innovation Ecosystems in Regions

In conclusion, therefore, the key aspect in implementing a dynamic disruptive innovation ecosystem in regions is to implement a framework as depicted in Figure 1. The concept of such a framework is to nurture collaborative interactions between advanced and lagging regions to improve the two-way flow and exchange of knowledge and human capital within a mantel of dynamic governance that facilitates the sharing of expertise and experiences in a collaborative way across and between regions. In the spirit of furthering the realisation of the 3Os[75] it is essential that such collaborative interactions between advanced and lagging regions, to improve the two-way flow and exchange of knowledge and human capital, are both encouraged and incentivised. This suggestion is only partially about implementing cohesion policy, but it is mostly about creating, implementing and sustaining a disruptive innovation environment across Europe. In line with what is expressed in the RISE 2019 report, the authors of this chapter contend that 'innovation leader' regions, because they are 'resource-rich', 'innovation-rich' and 'knowledge-endowed' regions, will invariably continue to prosper and grow while, on the other hand, 'innovation-poor' and/or 'knowledge-unendowed' regions will continue to lag behind these regions. Therefore, the proposed concept in Figure 1 is not merely to find parity between regions but rather to identify and utilise the smart specialisation entrepreneurial discovery process of multiple regions in a collaborative cohesive manner to the mutual benefit of regions, their citizens and society at large across the EU Member States.

[75] European Commission (2016). *Open Innovation, Open Science, Open to the World – A vision for Europe*, European Commission, Brussels.

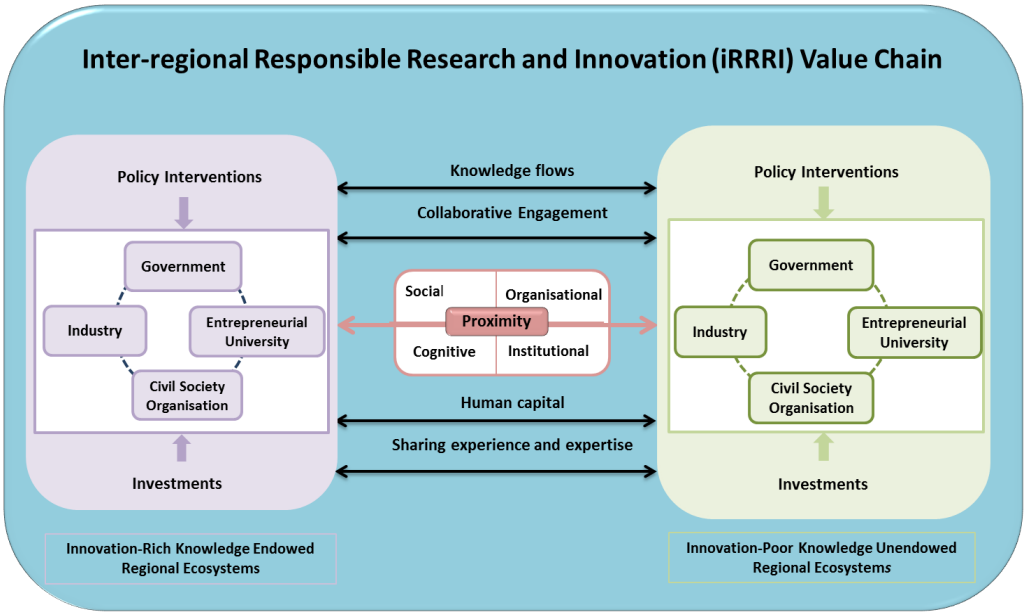

Figure 1. Conceptualisation of an Inter-regional RRI value chain (source: Authors) ©

4.10 Conclusions

- Each region has its own set of innovation and knowledge generation and diffusion skills regardless of the technological base or setting in which these skills are used and propagated

- Smart specialisation and the entrepreneurial discovery process (EDP) are not confined within borders, but are trans-regional, and therefore there is a need to implement policy from this perspective.

- Social and economic innovation and territorial disparities still exist between EU regions and Member States. As a result, there is a need to create an inclusive environment and process that enables the 'innovation-poor' and/or 'knowledge-unendowed' regions to engage with 'innovation-rich' and 'knowledge-endowed' regions in a cohesive, mutually beneficial manner.

- The current delivery of European Structural Investment (ESI) and European Regional Development (ERDF) funds is still very much focused on smart specialisation. Therefore, in order to enhance the realisation of smart specialisation, these funds need to embrace and promote the uptake of disruptive technologies.

- Disruptive technologies need new disruptive business models that lead to new integrated, collaborative global value chains.

- Global value chains, disruptive technologies and disruptive business models demand that we reimagine the concept of regions as functional entities

based on economic linkages that may not match political borders but can span regional or even national boundaries.

- HEIs are increasingly pressurised to adopt the role of 'entrepreneurial universities' to contribute to socioeconomic development in their respective regions. Therefore they need to adapt to the demands and extreme complexities and uncertainties brought about by the disruptive and accelerating changes in technologies as well as the availability and changing dynamic of easier access to and use of information

- Aligning research, science-based innovation and capital investment towards societal impact to actuate early understanding and application of disruptive business models requires HEIs to go beyond their traditional roles as education and knowledge providers and to become catalysts in the EDP (the maturing of the entrepreneurial university).

- The mission-oriented approach provides a framework for accelerating the flow of new knowledge and disruptive technologies between regions while at the same time enabling regions to customise solutions to address their societal needs.

- Citizens are no longer passive consumers of technology and services, rather they are prosumers and co-creators of products and services and active participants in shaping the society of the future.

- In order to develop and implement disruptive innovation ecosystems in regions, the Commission needs to promote cohesive and meaningful understanding, acceptance and embracing of the mission-oriented approach by R&D performers, regulators, users and sectoral stakeholders to develop more cohesive, integrative, inclusive inter-regional regional innovation ecosystems (iRIS).

Key challenges

- Reviewing investment funds to align them to support inter-regional, multi-disciplinary engagement to co-create and co-implement disruptive innovations to achieve the EU's stated missions.

- Exploring how EU, national and regional mechanisms or instruments can align with the European Institute of Innovation and Technology's (EIT) family of eight Knowledge and Innovation Communities (KICs) as one of the inter-regional innovation ecosystem strategies to develop and implement disruptive innovations in approaching and building complementarities and synergies.

- Creating acceptance at EU policy level of the development and implementation of a Europe-wide strategy that increases the engagement, interactions and exchange of knowledge between innovation-rich and knowledge-endowed regions and innovation-poor knowledge-unendowed regions (this strategy is conceptualised in Figure 1 above).

- Encouraging regional stakeholders from a diversity of regions to engage with each other in developing inter-regional innovation ecosystems.

- Engaging citizens meaningfully in responsible research and innovation (RRI) processes

- Prioritising the creation of smart specialisation strategy value chains and global innovation chains.

- The development and implementation of training programmes to facilitate public sector executives to meaningfully engage with the mission-oriented process so as to create sustainable disruptive innovation environments in their respective regions.

- Encouraging HEIs to retake the lead role in regional economic development and be both the catalysts and facilitators for enabling civic society to be co-creators of the dynamic environment required for the realisation of the 3Os (open innovation, open science and open to the world) and inter-regional knowledge flows whereby disruptive innovation can flourish.

- Facilitating and incentivising HEIs to be catalysts and facilitators of the entrepreneurial discovery process in their respective regions.

5 Europe as a Stronger Global Actor through Science Diplomacy[76]

Marga Gual Soler, Dainius Pavalkis and Mary Ritter

The term 'science diplomacy' was popularised by the American Association for the Advancement of Science (AAAS) and The Royal Society through the 2010 landmark publication 'New Frontiers in Science Diplomacy.'[77] The report defined science diplomacy as 'the use of scientific interactions among nations to address the common problems facing humanity and to build constructive, knowledge-based international partnerships'.

A commonly used three-pillar framework for science diplomacy consists of:

- 'diplomacy for science' to facilitate international scientific and research cooperation through the joint work of international actors;
- 'science for diplomacy' to use science cooperation to improve international relations between countries and societies; and
- 'science in diplomacy' to inform foreign policy objectives with scientific advice.

The concept has continued to evolve over the last decade, reflecting different countries' motivations to build scientific partnerships to advance national needs, such as national security or economic growth; regional actions to address cross-border interests, such as water governance; and global efforts to meet planetary needs, such as climate action or sustainable development.

Thus, the practice of science diplomacy is not limited to nation states and is gaining momentum among subnational and supranational actors, including in the EU. In what follows, we elaborate on how to strengthen the EU's global leadership role through science diplomacy and present ideas for a more effective internal and external EU science diplomacy, including through the next research and innovation framework programme, Horizon Europe.

5.1 European Science Diplomacy 2015-2019

In 2015, the European Commissioner for Research, Science and Innovation Carlos Moedas made science diplomacy a top priority in the Commission's agenda to position research and innovation at the centre of the EU global action to address global challenges. In 2016, the European Commission defined science diplomacy as:

[76] The authors thank the Horizon 2020-funded projects S4D4C and InsSciDE for insights and discussions on the future of science diplomacy in Europe https://www.science-diplomacy.eu.

[77] The Royal Society (2010). "New Frontiers in Science Diplomacy: Navigating the Changing Balance of Power." The Royal Society.

'The use of science to prevent conflicts and crises, underpin policymaking, and improve international relations in conflict areas where the universal language of science can open new channels of communication and build trust.'[78]

This vision for a European science diplomacy was further developed and expanded in the "Open to the world" chapter of the RISE book 'Open innovation, open science, open to the world: a new vision for Europe'[79]. Over the last four years, the Commission has focused on aligning EU scientific endeavours with external policies and strategic partnerships and investments across the globe, and in making science, technology and innovation vital tools of 'soft power'[80] in the search for solutions to common problems.

The report 'Open Europe'[81] highlights key achievements in science diplomacy during Commissioner Moedas's mandate, including the following:

- Promoting global peace and strengthening EU external and neighbour relations through science to address conflicts and tensions in international politics. The EU has supported the launch of SESAME, a highly advanced particle accelerator bringing together scientists from across Middle Eastern countries[82], boosted innovation capacity and improved research infrastructure in the Balkans and eastern Europe, and established a Horizon 2020 association agreement with Ukraine.

- Cooperating on a global scale to respond to global health crises, such as the Ebola and Zika outbreaks, and to understand major global planetary transformations such as a changing Arctic. The EU has driven international scientific cooperation and research dialogues with non-EU partners that precede political negotiations on complex issues, ranging from the impacts of climate change to energy to new transport routes.

- Establishing strategic partnerships with key regional actors to address common challenges, such as the PRIMA partnership in the Mediterranean. PRIMA was the first research partnership aimed at developing novel solutions for sustainable water management and food production bringing together 19

[78] European Commission (2016). "Open innovation, open science, open to the world: A vision for Europe." Brussels (available at: https://publications.europa.eu/en/publication-detail/-/publication/3213b335-1cbc-11e6-ba9a-01aa75ed71a1).

[79] European Commission (2018). "Europe's future: 'Open innovation, open science, open to the world: reflections of the Research, Innovation and Science Policy Experts (RISE) High Level Group." (available at: https://publications.europa.eu/en/publication-detail/-/publication/15e2ff8d-c525-11e8-9424-01aa75ed71a1).

[80] The term 'soft power' was coined by Joseph S. Nye at the end of the 1980s to describe the ability of actors (such as states, international institutions, and non-governmental organisations) to influence the behaviour of others to get the outcomes they want through appeal and attraction instead of coercion or force (see J. S. Nye (1990), *Bound to Lead: The Changing Nature of American Power*, Basic Books).

[81] European Commission (2019). "Open Europe - Policies, reforms and achievements in EU science and innovation 2014-2019 under EU Commissioner Carlos Moedas." Brussels.

[82] See http://ec.europa.eu/research/index.cfm?&na=na-160517&pg=newsalert&year=2017.

European and Mediterranean countries[83]. Other areas of transboundary research partnerships are ocean management (the Belém Statement) and climate change (Mission Innovation).

- Creating a platform to help refugee scientists find job placements in EU research institutions.

- Attracting exceptional non-EU researchers and innovators to the EU, thus broadening Europe's pool of talent.

Such efforts demonstrate how collaboration in research and innovation yields broader political, societal, economic and security benefits, such as promoting the integration of less developed countries into the global scientific community, supporting regional peace and security or helping combat the root causes of forced migration, among many others.

However, often the science diplomacy dimensions of research activities implemented in non-EU countries can be implicit (e.g. smart specialisation, EURAXESS, ERC, EIT or COST). Beyond the most visible EU science diplomacy initiatives like SESAME or PRIMA, there is a wealth of de facto science diplomacy embedded in relationships developed for large-scale infrastructures or mega projects, such as future emerging technologies (FET) flagships, that needs to be documented and strategically communicated.

5.2 Towards EU leadership in Science Diplomacy

In 2019, the EU is facing a pivotal political moment of institutional change in an international environmental characterised, for example, by resurgent nationalism and populism movements, a sharp decline in US global leadership, a retreat of multilateralism and free trade, and Brexit. But this geopolitical scenario also provides Europe with a unique opportunity to fill a void in international scientific leadership[84]. In this context, Horizon Europe emerges as a beacon of openness and global collaboration to strengthen the influence and positive impact of the EU in an increasingly multipolar and uncertain world.

The international dimension of Horizon 2020 was reinforced as part of the priorities set for the last part of the programme between 2018 to 2020. The 2018 'Report on the Implementation of the Strategy for International Cooperation in Research and Innovation', part of the impact assessment of the Commission's proposal for Horizon Europe, noted that science diplomacy 'shall be used more extensively as an influential instrument of the EU's external policies'[85].

Science diplomacy can help strengthen the European identity domestically and internationally, help build EU soft power and reaffirm and project its values to

[83] See http://ec.europa.eu/research/environment/index.cfm?pg=prima.
[84] See https://www.nature.com/articles/d41586-019-01568-x.
[85] Available at: https://ec.europa.eu/research/iscp/pdf/policy/progress_report_oct-2018.pdf.

the world. For example, the EU extended its effective multilateralism[86] and collective-responsibility approach during the Ebola epidemic in West Africa, not only for global health security goals, but also as a reflection that European values dictate that the EU represents more than its own interests.

The EU does not just fund research. Its policies might affect non-member countries. For example, Plan S — the bold initiative to make all scientific works freely available as soon as they are published[87] — aims to become the global framework for open access scholarship. The EU's push for open science is a highly visible 'brand-building' exercise in the global research area and the most ambitious demonstration yet of European scientific leadership.

Another example is found in standards and regulations: the 2007 REACH legislation made firms around the world register safety information on market chemicals in the EU, forcing them to match European standards. Recent data-protection laws affect all private companies that want to operate in Europe. And the EU is also at the forefront of the battle against plastics pollution: the European Parliament has approved a ban on single-use plastic items by 2021.

5.3 A joint-up approach for more effective EU Science Diplomacy

Establishing the EU as a stronger actor in global science diplomacy will require greater interconnectivity between the EU research and foreign policy agendas as well as coordinated international actions between EU institutions and Member States. With its new global strategy of 2016, the EU for the first time acknowledged a role for research in foreign policy[88].

Ahead of the 2019 European Parliament elections, the European Commission set out a number of recommendations to the EU strategic agenda for 2019-2024[89]. Some of these priorities include: managing migration; understanding ecological, social and economic transitions; adapting to digitalisation and human-centric artificial intelligence; embracing green growth and sustainable consumption and production; fighting climate change and environmental degradation; ensuring energy security; and developing strong relations with close neighbours.

All these challenges are cross-disciplinary and cross-sectoral, transcend national borders and can only be solved through international cooperation. For Horizon Europe to be an effective instrument to improve EU science diplomacy, setting priorities will require a whole-of-Commission approach to international strategic

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[86] "Effective multilateralism" can be defined as "the development of a stronger international society, well functioning international institutions and a rule-based international order" (see European Council (2003), European Security Strategy.

[87] See https://www.coalition-s.org.

[88] European Union (2016), "Shared Vision, Common Action: A Stronger Europe." Global Strategy for the European Union's Foreign and Security Policy.

[89] European Commission (2019). "Europe in May 2019 - Preparing for a more united, stronger and more democratic Union in an increasingly uncertain world." Brussels (available at: https://ec.europa.eu/commission/sites/beta-political/files/comm_sibiu_06-05_en.pdf).

investments and global research partnerships to proactively address foreign policy needs.

Such a strategy would require closer alignment between DG Research & Innovation and other parts of the Commission responsible for foreign policy, development cooperation, neighbourhood policy, climate and environmental policy or trade to help inform EU external action roadmaps. It would, however, also require closer coordination between the EU and national levels to raise the EU's capacity to act globally.

5.4 Science Diplomacy through Horizon Europe

Europe's future growth and prosperity depend on its ability to remain a world leader in research and innovation. Horizon Europe will be the most important instrument of European science diplomacy, for example via its association agreements and participation from across the world.

The Horizon Europe association rules might extend beyond EU enlargement, European Economic Area (EEA) and European neighbourhood policy (ENP) countries, to include all countries with proven science, technology and innovation capacities. In the process of negotiating the rules of participation, the EU will have to demonstrate adherence to values such as openness, inclusiveness, equality, responsible research and innovation, and sustainability.

Specific priorities and agendas of sectoral policies may favour different research cooperation partners in each thematic area (climate change, cancer, oceans, disruptive technologies, carbon neutrality, food, etc.), and each will require a tailored approach to international collaboration and partnerships. An example is the Strategic Research and Innovation Agenda for the Black Sea (SRIA)[90], which is part of the EU's key regional policy framework in the Black Sea.

Horizon Europe identifies five overarching global challenges for action in health, security, digitalisation, climate, energy, mobility, food and natural resources. The programme will also include five high-profile, cross-cutting 'missions' to orient research toward solutions to some of the major challenges faced by European citizens, including climate change, cancer, water and oceans, climate-neutral and smart cities and soil health and food. Achieving these missions is not just a scientific exercise — these are multi-stakeholder efforts that will require multi-sector partnerships and alignment with the EU's external policies, including enlargement, neighbourhood, trade, development and defence.

The mission-oriented approach in Horizon Europe is not only likely to ensure the effectiveness of research and innovation funding by pursuing clearly defined targets to tackle global challenges, but represents an unprecedented opportunity to help reduce the gap between science and policy, facilitate linkages to non-research and innovation policy measures, and build bridges between people and nations. The requirement of a mission to achieve a

[90]See https://ec.europa.eu/info/news/launch-european-black-sea-strategic-research-and-innovation-agenda-2019-may-08_en.

challenging goal will make them strongly reliant on scientific excellence, providing arguments for a more targeted and strategic international cooperation approach vis-à-vis high-tech partner countries that could support delivering on the missions. Missions could, therefore, be an important element of science diplomacy, positioning Europe as a world leader in tackling climate change, cancer etc., and attracting international partners.

In addition, non-funding instruments such as policy dialogues on science and technology cooperation with key international partner countries, regions and organisations deserve more attention to pursue a more effective EU science diplomacy.

Through the lens of science diplomacy, Horizon Europe can work towards better co-ownership in research partnerships, citizen engagement and joint priority setting and shared benefits to fully unleash the potential of international research collaboration.

5.5 Intra-European Science Diplomacy

Science cooperation can also be used as an instrument for EU internal cohesion and promotion. The framework programme has been a powerful force for European integration, with an unrivalled system of cross-border research projects and training fellowships enabled by the single market. But with the United Kingdom scheduled to leave the EU, and with populist and nationalist sentiments growing in many nations, threats to a united Europe are seen as threats to scientific research[91].

A mission-oriented approach is an opportunity to better communicate and engage EU citizens with the research achievements financed by their tax money and their positive impact on their daily lives. Take for example Copernicus and Galileo, the EU's earth observation and location space services, set to bring tangible benefits to the single market, contributing to economic growth and supporting multiple areas such as climate change, agriculture, oceans, transport, digitalisation, security, and defence. The Galileo space programme shows the true value of European sovereignty and intra-European science diplomacy, as no single Member State alone could have put 26 satellites in orbit for the benefit of over 700 million current users worldwide[92].

Institutionalised partnerships are research initiatives that can foster intra-European science diplomacy. These are long-term partnerships set up through dedicated EU legislation between the EU and multiple Member States, such as the already mentioned Partnership for Research and Innovation in the Mediterranean Area (PRIMA).

Another area where intra-European science diplomacy can be useful is in helping reduce the imbalance in funding between the older EU Member States

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[91] See https://www.nature.com/articles/d41586-019-01561-4.

[92] See http://www.europarl.europa.eu/news/en/headlines/economy/20181116STO19212/how-the-eu-supports-galileo-copernicus-and-other-space-programmes.

(EU-15) and the newer ones (EU-13)[93]. Despite efforts by the European Union and the Member States as well as the inclusion of the 'Widening participation' package in Horizon 2020, significant gaps remain between European regions in research and innovation performance. In the seventh framework programme (2007-2013), the EU's newest members only received 4% of total EU research funding. In the current Horizon 2020 (2014-2020), that share rose by only 0.4%.

Horizon Europe should simplify and harmonise rules to increase the participation of under-represented countries, regions and institutions, provide Structural Funds to improve the quality of their research infrastructure, and improve the capacity of scientists from the least research-intensive regions to compete for funding. The European Institute for Innovation and Technology (EIT) and its Knowledge and Innovation Communities (KICs)[94] can serve as models since they cover all of Europe and also have a special Regional Innovation Scheme (EIT RIS) to increase the innovation capacity of European regions that do not yet benefit directly from the EIT and its KICs, and can help address this EU-15/EU-13 divide.

Finally, further action is needed to continue the push towards open science, especially to make data available in matters most pertinent for society. For example, data on air and water quality is not yet widely available across the EU.

5.6 Prospects for the future of EU Science Diplomacy

Potential Science Diplomacy Tools

Results from the three Horizon 2020-funded science diplomacy projects S4D4C, InsSciDE and El-CSID[95] demonstrate the increasing number of actors and networks interested in EU science diplomacy from all sectors (higher education, civil society, multilateral organisations, national and regional governments, etc.), but also reveal a lack of support, coordination and training tools available (as described by Luk Van Langenhove in the RISE book)[96]. Suggestions for further research include the following:

[93] See https://www.nature.com/articles/d41586-019-01565-0.
[94] See https://eit.europa.eu/our-communities/eit-innovation-communities.
[95] See https://www.science-diplomacy.eu.
[96] European Commission (2017). "Tools for an EU science diplomacy." Brussels (available at: https://publications.europa.eu/en/publication-detail/-/publication/e668f8cf-e395-11e6-ad7c-01aa75ed71a1).

Coordination and Support Actions	Research and Innovation Actions
Capacity building on science diplomacy and science advice	Identify and address knowledge gaps with traditional projects or the creation of knowledge hubs (e.g within Joint Research Centre of the European Commission)
Documentation and strategic communication of successful science diplomacy initiatives	The science of science diplomacy (what works?), understanding drivers and barriers
Coordination of science diplomacy actions between Member States and EU level	Regional studies on knowledge societies and their interrelations
Creation of general and thematic science diplomacy knowledge networks (e.g. climate, health, oceans, etc.)	
Creation of knowledge exchange interfaces and platforms between research and foreign policy communities (secondments, pairing schemes, fellowships)	
Support for scientific diaspora networks outside of the EU	
Closer alignment with the Scientific Advice Mechanism (SAM) and other bodies to provide input on key science diplomacy issues	

Ideas for mainstreaming Science Diplomacy in Europe:

Science diplomacy could be mainstreamed throughout the Horizon Europe work programme, for example:

- as part of 'Reinforcing research and innovation systems';
- as part of Cluster 2 with a special emphasis on 'democracy', 'transformations' and 'relations with third [i.e. non-EU] countries';
- by identifying topics with science diplomacy dimensions or potential, for example conflict prevention (e.g. water diplomacy, climate refugees) or anticipating technological developments that will impact or disrupt international relations, security, defence, etc. (e.g. cyber security, artificial intelligence);
- through a geographic approach to science diplomacy in calls for tender addressing cooperation with specific partners.

Additional actions within and beyond Horizon Europe include the following:

- A European science diplomacy centre/observatory/knowledge hub to foster a European science diplomacy strategy and dedicated research and capacity building. It might be part of the Commission structure.[97]
- Consideration of broader impacts. Just as projects are encouraged to consider broader impacts in their dissemination and exploitation plans (e.g. societal impact, dissemination to the public, involvement of cities and regions), Horizon Europe projects could also be asked to identify foreign policy dimensions and interfaces.
- Science diplomacy within missions and large-scale initiatives. All partnership initiatives and missions (as well as EIT, FET flagships, etc.) could be encouraged to develop international cooperation and science diplomacy strategies.
- A European science diplomacy conference could be organised as a stand-alone networking event or to strengthen the science diplomacy dimension of existing conferences such as ESOF and European R&I Days.
- Coordination of a European science diplomacy network as a stand-alone instrument or to strengthen the science diplomacy dimension of existing platforms such as EURAXESS.

[97] See https://sciencebusiness.net/news/new-look-eu-research-department-aims-overcome-bureaucratic-silos.

- Implementation of a science diplomacy booster for common dissemination or exploitation mechanisms for Horizon Europe specifically targeting research projects interfacing with foreign policy.

- Launching of a European science diplomacy award to highlight and recognise specific initiatives that contribute to European science diplomacy.

5.7 Conclusions

Science diplomacy should be included as an element of the global strategy on the EU's common foreign and security policy and reflected in an updated strategy for the EU's international cooperation in research and innovation. Using science more broadly as a soft power instrument will strengthen the EU's excellence, attractiveness and competitiveness, as well as supporting its external policies, including enlargement, neighbourhood, trade, security and development.

EU science diplomacy would benefit from the establishment of innovative platforms, mechanisms and training initiatives targeting the multi-level and multi-stakeholder ecosystem. These actions should aim to equip the European foreign policy and research communities with tools to work more closely to jointly address global challenges, with improved synergies with the actions of Member States, including analysis and mutual learning, structured policy coordination and the involvement of more partners from around the world.

An essential goal of the EU's science diplomacy should be to strengthen its role in global multilateral initiatives and investments in solutions to global challenges. At a time when other countries are withdrawing from global agreements, it will be key for European soft power and leadership to reinforce international commitments such as the UN Convention for Climate Change, the Convention on Biological Diversity or the 2030 Agenda for Sustainable Development.

Horizon Europe should embed a strategic focus on European values in international cooperation activities. Scientific and technological developments in Europe should respect privacy and ethical standards and reflect on their intended and unintended political, economic and societal consequences, particularly for disruptive technologies.

Europe and other regions face common challenges in a variety of fields, ranging from food and water scarcity to micro plastics and climate change. Developing effective solutions to these problems is too complex and too costly to be done by any one country alone — therefore research and innovation actions require international cooperation that often intersects with foreign policy goals. But when reflecting upon science diplomacy objectives, the EU should carefully consider and strategically communicate its explicit and implicit elements. Labelling a project, programme or policy as science diplomacy is a strategic choice that must take into consideration both research and foreign policy goals and the potential risks involved.

6 Reflections on Member States' Experiences with Mission-oriented Policies

Teresa Riera Madurell

6.1 Background

In May 2018, the European Commission published the results of a global mapping of the most relevant ongoing mission-oriented research and innovation (R&I) initiatives of 28 Member States and a selection of non-member countries in seven thematic areas. The inventory includes government-led (55%), private sector-led (16%) and hybrid (public–private) initiatives (29%)[98]. Out of the 137 initiatives, 44 mission-oriented R&I initiatives and 18 deep case studies have been selected[99].

The publication includes detailed descriptions of (1) background, origin, mission and ambition; (2) formation process; (3) technical and political feasibility; (4) governance: organisation, management and coordination; (5) resources and budget needs/availability; (6) holistic policy mix to support mission-oriented R&I initiatives; and (7) embeddedness of and connectivity with related initiatives at regional, national, supranational, and global levels.

Thematic reports were also published describing challenges, ambitions, content, scale/scope and outreach of the initiatives and identifying similarities and lessons learned within the theme[100].

Impacts expected from the mission-oriented approach and potential reactions to the shift of EU R&I policy towards mission orientation are also assessed by the European Commission. For this, Member State R&I funding mechanisms and their level of reliance on European funding are also studied.

Although all the initiatives analysed in the case studies are ongoing missions, for which the final results and implications are still to be realised, some partial conclusions and lessons learned are given, providing a useful insight and practical advice for the future. Preconditions and governance structures are identified as key elements to facilitate the mission's design and implementation and the achievement of its objectives.

6.2 Mission Thinking as a Precondition

Thinking in Mission Terms

Some important preconditions for the success of mission-oriented R&I initiatives were given in the reports by the European Commission mentioned above (most

[98] European Commission (2018). "Mission-oriented research and innovation - inventory and characterisation of initiatives: final report." Brussels.

[99] http://www.jiip.eu/mop/wp.

[100] For the reports, see: https://ec.europa.eu/info/publications/mission-oriented-research-and-innovation-policy-depth-case-studies_en.

at national and regional level)s, but some reflections (on current research and innovation culture) inspired by different Member State contributions can be added.

Mission thinking in science and innovation can be defined as the capacity to connect research and innovation to solve the concrete problems necessary to tackle the great challenges that affect people in their daily life.

It is not a question of solving disconnected problems, one after the other, but of the ability of direct research and innovation inspired by the multiple social and technological challenges we have and, at the same time, of directing economic growth in a more meaningful way.

If the great challenges are identified in the sustainable development goals (SDGs), they should inspire concrete problem-solving initiatives (such as missions). On the one hand, missions are more specific than challenges, but on the other hand they are much broader than a specific technology or sector. They require the involvement of many different sectors and many different actors that have to work together on different solutions.

Mission thinking requires an analysis of the current research and innovation culture and the unintended barriers it poses for adoption of mission-oriented practices. The process of identifying the specific missions that must be addressed in order to progress in the right direction towards a common objective is crucial. It is the first step but it is not at all easy. Neither are the necessary shifts to address the process of R&I, by researchers and innovators, by governments, in the R&I institutions and in the R&I systems themselves.

Mission identification process

Today's challenges gathered together in the 17 SDGs are very complex as they are complicated interactions of social, political, economic and technological issues that not only require different sectors to work together, but also increased citizens' engagement. As Felipe González, the former Prime Minister of Spain, said many years ago: it is easier for human beings to land on the moon than to end hunger on Earth.

Challenges are well known, but identifying the proper missions requires multidisciplinary expertise, open collaboration, a global approach, integrity and the involvement of all stakeholders. An interesting example from the United Kingdom, directly connected to SDG numbers 8, 9 and 12, is mentioned by Mazzucato in her article 'Mission Thinking: A Problem-Solving Approach To Fuel Innovation-Led Growth'[101].

The United Kingdom government launched an industrial strategy to support not only sectors, but also those problems facing the UK society. As those problems were numerous, they were framed in terms of three key challenges. Then the

[101] See https://www.socialeurope.eu/mission-thinking-a-problem-solving-approach-to-fuel-innovation-led-growth.

Institute for Innovation and Public Purpose (IIPP) launched a new Commission on Mission Oriented Innovation and Industrial Strategy (MOISS) with the aim of transforming those challenges into the necessary missions to help to reorganise the UK's domestic industrial policy by providing new opportunities for economic growth towards a more meaningful direction.

Mission thinking also requires the following to be taken into account.

Fundamental research and mission-oriented research and innovation are not two separate worlds

Although innovations do not necessarily arise from the progress of fundamental research, the history of science shows that major discoveries rely on high-quality fundamental research. This reaffirms and guarantees the central place of fundamental research and academic freedom in the mission-oriented research and innovation approach.

Due to their capacities and position, researchers must be conscious that they play an important role in achieving the SDGs. In addition to producing knowledge, they have a great and special responsibility to contribute to providing responses to societies' expectations and needs and the enhancement of economies' competitiveness.

On the other hand, fundamental research also benefits from being part of mission-oriented projects. By connecting with the most pressing needs of society, dialogue between fundamental science and society improves, and the R&I system as a whole moves closer to the citizens. Consequently the social value of science and the interest of citizens in science might increase, which could make the R&I system stronger.

As Mazzucato states in her report 'Mission-oriented R&I in the European Union. A problem-solving approach to fuel innovation-led growth'[102], missions are not about prioritising applied research and innovation over basic fundamental research, which will continue to be funded by instruments like the European Research Council. Rather they are a new way to frame the conversations between the two, galvanising new forms of collaboration.

At EU Member State level, for example, France[103], has defined national research and innovation strategies, trying to establish a general framework for these exchanges with the ambition of putting research and innovation at the heart of society and economy. Its success in managing this depends on the expertise of researchers. Therefore, researchers should be trained and encouraged (even with financial incentives) to establish the necessary link between their role as producers of knowledge and their responsibility to contribute to finding answers

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[102] Mazzucato, Mariana (2018). "Mission-Oriented Research & Innovation in the European Union." Brussels (available at: https://ec.europa.eu/info/sites/info/files/mazzucato_report_2018.pdf).

[103] French Ministry for Higher Education and Research (2010). "National Research and Innovation Strategy." Paris (available at: https://cache.media.enseignementsup-recherche.gouv.fr/file/S.N.R.I/28/7/ SNRI_rapport_general_GBdef_158287.pdf).

to the great global societal challenges that affect humankind through mission-oriented research and innovation projects.

Mission thinking also requires also the following to be taken into account.

New directions for economic growth and a new role of public policy in the economy

Mission-oriented public investments create new technologies and sectors that did not exist before. This requires the shaping and creation of new markets rather than just fixing the already existing ones. According to Kattel et al.[104], in such a new context, the role of public policy in the economy should also evolve: traditional public policy intervention has to be complemented with a more active intervention in market shaping and creation. Such policies may involve structural changes to the economy.

Major challenges, such as the transition to a low carbon energy system, the adaption of the welfare state to deal with an ageing population or the urgent need to rethink our cities according to pressing citizens' needs, are complex problems that require radical innovations and also the redefinition of the paths of many areas of the economy.

As Mazzucato states, economic growth has a rate but also a direction and, in order to create a new direction (such as green energy or a new welfare state for an increasing aging population) one requires the creation and shaping of new markets, not just correcting existing market failures[105]. Such change requires new efforts by both private and public sectors, as well as an important role for civil society. The role of the state is key here since it is the only institution with the power to shape markets and direct economic activity in socially desirable directions — 'missions' — to achieve publicly accepted outcomes, as Vogel explains[106].

Governments (local, regional, national) should (1) be open to promoting legislative changes to remove the existing barriers to the mission-oriented approach; and (2) actively invest along the whole innovation chain from fundamental research to supporting enterprises willing to innovate and helping innovative firms to scale up through, for instance, procurement policies. Moreover, organisations involved in this mission-oriented approach must themselves be restructured in order to increase their competitiveness in the achievement of the missions.

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[104] Kattel, Rainer/Mazzucato, Mariana/Ryan-Collins, Josh/Sharpe, Simon (2018). "The economics of change: Policy and appraisal for missions, market shaping and public purpose." IIPP WP 2018-06, London (available at: https://www.ucl.ac.uk/bartlett/public-purpose/sites/public-purpose/files/iipp-wp-2018-06_1.pdf).

[105] Mazzucato, Mariana (2015). "From Market Fixing to Market-Creating: A new framework for economic policy." Working Paper 2/2015, ISIGrowth (available at: http://www.isigrowth.eu/wp-content/uploads/2015/11/working_paper_2015_2.pdf).

[106] Vogel, Steven K. (2018). *Marketcraft: How Governments Make Markets Work*, Oxford University Press, Oxford.

Mission thinking requires a conviction that…

Taking risks and failing is a path to success

Although a good proportion of mission-oriented projects have helped to give direction and energy to innovation systems and made business investment easier by reducing uncertainty, not all missions succeed.

Projects run by the United States Defence Advanced Research Projects Agency (DARPA) are good examples for this[107]. Throughout its history, the agency has achieved some spectacular successes like the internet and GPS but also failures like the mechanical elephant. *New Scientist* magazine has come up with an interesting list of DARPA projects, running from successes to failures, as well as 'could be' successes of the future[108].

But failures are part of the innovation process. In the 1980s, DARPA launched a billion dollar initiative to develop artificial intelligence. The agency invested in everything from computer vision to thinking computers that could help military pilots fly aircraft. The programme was shut down after less than a decade and branded a 'failure' at the time. Today some of the technologies DARPA invested in, like voice recognition, are widely used in the commercial sector (iPhone's Siri, for example, was a spinoff of a DARPA project).

Europe also provides interesting examples. According to Mulgan, the Concorde airplane is an object lesson in how the wrong kind of mission can distort funding and policy[109].

The first and last generation of Concorde became outdated before a new model was put in place, with no sound advances made over its main two problems: price (to make the flight more economical) and noise (which was extraordinary, which meant it could only fly over water). Both the increase of the oil price (as a consequence of the unforeseen first oil crises of 1973-1974) and the shift in global business travel towards Asia made Concorde less competitive. On 25 July 2000 one of the aircraft crashed few minutes after take-off. Just one year later, Concorde was authorised to fly again. Finally, the terrorist attacks of 11 September 2001 precipitated its disappearance as fewer people wanted to fly on Concorde. The last flight took place on 24 October 2003. Supersonic passenger travel ceased to exist just 27 years after its inaugural flight. However, although Concorde was not an economic reality, its technological value is still there. It was, in fact, a plane ahead of its time, by far the most superior aircraft, making daily flights for nearly three decades, and airline passengers have been cruising at subsonic speeds ever since.

Today, as Asia becomes increasingly central to the world's economy, business travellers need a way to get to Asia quickly from both Europe and America. Because of that, the number of companies trying to solve Concorde's

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[107] See https://www.darpa.mil/attachments/DARAPA60_publication-no-ads.pdf.
[108] See https://www.newscientist.com/article/dn13907-fifty-years-of-darpa-hits-misses-and-ones-to-watch.
[109] See https://www.nesta.org.uk/blog/mission-oriented-innovation-seven-questions-search-better-answers.

shortcomings (reduce the fuel burn and emissions and reduce or eliminate the sonic boom) for both commercial airliners and business jets is increasing. NASA is currently working with Lockheed Martin on an experimental quieter supersonic aircraft, with a delivery date in 2021[110].

You only fail when you stop trying. Learning from failures is essential to progress. Yet today's culture places such a strong emphasis on excellence that admitting to failure of any kind is avoided. Thus, many opportunities to learn from and transform failure are missed. In the Mack Centre conference, 'Learning from Failure in Innovation: Turning Setbacks into Advantages', featured speakers from a wide spectrum of fields — from healthcare to toys — shared what they had learned from paying attention to failures and taking risks on new ideas that at first glance may seem counterintuitive[111].

Innovators have to be trained to know that a failure is often a driving force behind success, and to learn from failures. Developing a culture of learning in addition to stressing excellence helps to break down the resistance to looking at and learning from mistakes.

Open and multidisciplinary research and innovation are essential

Mission thinking requires an open and multidisciplinary approach to problems in a complex world. There are countless examples of how bringing together openly multiple disciplines has produced breakthrough solutions that almost certainly would not have been found by focusing on a single area. Open and multidisciplinary approaches are essential to address environmental problems. Solutions to climate change problems are good examples of situations requiring complex syntheses of ideas from a vast set of disciplines including natural sciences, engineering, social sciences and humanities[112].

An open and multidisciplinary approach has a great potential to also address the complex, multidimensional challenges of an ageing Europe. Biomedical research is already multidisciplinary, incorporating medical sciences, physics, chemistry, bioengineering and information technology. However, to ensure a truly holistic approach, it needs to be expanded to include open studies on topics like climate and security[113].

Moreover, an open and multidisciplinary approach is essential to tackle mission-oriented R&I projects. Scientists who can offer their specialised expertise on multidisciplinary thinking and openness will be more successful in helping to solve complex problems and then opt to participate in mission-oriented projects.

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[110] See https://www.popsci.com/concorde-anniversary-future-of-supersonic-flight.

[111] See http://fliphtml5.com/thnh/aunb/basic.

[112] See Middleton, Beth (2011), Multidisciplinary Approaches to Climate Change Questions. 10.1007/978-94-007-0551-7_7.

[113] Scientific Panel for Health (2016), Vision on Better Research for Better Health, May 2016 (available at: https://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/SPH_VisionPaper_02062016.pdf).

Enhancing the skills, capabilities and knowledge of human resources is crucial for the development of open and multidisciplinary thinking and subsequently for the success of mission-oriented projects.

As work on projects usually takes place within an institutional framework, organisations themselves have to be prepared to make the transition to an open and multidisciplinary R&I culture as easy as possible, making their services and human resources suitable for accommodating an open and multidisciplinary workflow. This includes, for instance, ensuring a suitable academic composition of committees to evaluate open and multidisciplinary projects.

Consequently, policies should promote world-class training programmes on open and multidisciplinary approaches in European research and innovation, especially for young scientists. This would help to develop and acquiring the appropriate skills to understand and successfully participate in mission-oriented projects.

6.3 Smart multilevel governance structures as a necessary coordination to achieve the mission objectives

High-level mission-oriented body

France's President Emmanuel Macron, in a speech at the Sorbonne University, proposed the creation of a European disruptive innovation-funding agency modelled on DARPA. DARPA projects are strongly mission-oriented and take on high-risk projects tolerating failure as an accepted part of the mission of driving breakthrough scientific progress in a short period.

The idea of setting up a big disruptive research organisation working perhaps not on defence (as DARPA does), but on the most urgent global challenges, like health or climate change, can be seductive[114]. However, Stian Westlake, the Executive Director of Policy and Research of NESTA, pointed out that there are two major problems to be taken into consideration when setting up a DARPA-like agency:[115]

(1) **Risk tolerance**. For every successful DARPA project, there are dozens that do not succeed. Of course, all potential innovations carry the risk of failure and, as pointed out in the previous section, taking a risk is a path to success but can also be an expensive business. What is the level of risk we are ready to accept as Europeans?

(2) **Scale.** A big part of the reason DARPA works is not only its size but also the size of the system within which it works. Certainly DARPA is big in terms of budget (it spends about USD 3 billion a year), but the EU framework

[114] See https://sciencebusiness.net/framework-programmes/viewpoint/how-bring-macrons-vision-european-innovation-agency-life.

[115] See https://www.nesta.org.uk/blog/the-quantity-theory-of-innovation-policy-or-why-you-probably-dont-need-a-darpa.

programme for research and innovation is even bigger (about EUR 80 billion for Horizon 2020 and EUR 100 billion proposed by the Commission for Horizon Europe for 7 years). Notably DARPA is not only big in itself, but it is connected to the overall US defence procurement budget (which is USD 600 billion) and is next to a constellation of other funding bodies, such as the Office of Naval Research, so if DARPA misses something, other funders can intervene.

When you are huge, you can make big bets with the certainty that one or two will probably succeed and that the investment will be rewarded many times over. You can attract talent according to the size of your ambition. But that might not be efficient for the EU. An alternative, more practical body is suggested by Stian Westlake in 'If not a DARPA, then what? The Advanced Systems Agency'[116].

A mission-oriented body is necessary to tie together all research and innovation policy efforts, to encourage radical innovation and to be closely connected to long-term strategic plans. It should be a high-level body, possible even created at the level of the European Commission President as political endorsement is crucial for the body to be able to work effectively.

Although political support is essential, more elements are necessary. In the Apollo project[117], for example, in addition to the support and visionary nature of President Kennedy, who promoted it, a good selection of excellent professionals and a good organisational structure were crucial for the success of the programme: it was developed in a record time of one decade, it was necessary to coordinate the work of about 400 000 people and it surprised the world with its result. A coherent and committed machinery is essential for the success of the mission.

Multidisciplinary mission-oriented R&I labs: skilled human resources, infrastructures and funding

Mission-oriented projects that are suitable for fulfilling their objectives need to be developed in R&I institutions, with access to specialised equipment and world-class facilities, where interdisciplinary teams of skilled scientists and engineers from academia, governments and industry develop well-funded mission-oriented projects decided according to the EU's R&I strategy to solve some of the world's great scientific challenges.

Although the word 'laboratory' evokes images of white-clad scientists who make chemical mixtures in test tubes and perform basic research, the United States' national laboratories[118], are, in reality, highly applied, 'mission-oriented' organisations that are crucial for the development of national science and innovation policy.

[116] See https://www.nesta.org.uk/blog/if-not-a-darpa-then-what-the-advanced-systems-agency.
[117] See https://mrgorsky.wordpress.com/2014/02/13/el-programa-apolo-ejemplo-de-gestion.
[118] See https://www.energy.gov/national-laboratories.

At EU Member State level it is interesting to take into consideration the working paper 'Restructuring in France's innovation system: from the mission-oriented model to a systemic approach of innovation' by Dosso[119]. From the analysis of the cases above, a mission-oriented lab governance structure should be appropriate:

1. to assure the health and vitality of science and innovation activities and programmes in meeting the mission responsibilities of the laboratory;

2. to assure that their programme execution meets sponsor mission requirements;

3. to assure that an environment of collaboration, openness, freedom of expression, scientific integrity and excellence is maintained;

4. to ensure recruitment and retention of a premier R&I workforce;

5. to facilitate the achievement of excellence in the management, productivity and performance of the laboratory operations and assist the labs in the adoption and implementation of appropriate performance-based measurement and continuous improvement processes.

Members of a mission-oriented lab governance structure should be mainly mission-thinking experts according to the characteristics described in the previous section. According to Mazzucato: 'Missions should be broad enough to engage the public and attract cross-sectoral investment; and remain focussed enough to involve industry and achieve measurable success'[120].

Innovative Industry Partnerships

Mission-oriented EU R&I laboratories could play a critical role (through mission-oriented projects) in building the EU's innovation capacity and driving the EU economy. For that to happen, it will be crucial to promote collaboration with industry by developing innovative models of partnership focused on R&I's societal benefits and on the modernisation of the related industry sectors and markets.

The next EU R&I framework programme, Horizon Europe, combines science and innovation under the same umbrella, as Horizon 2020 did, spanning topics from frontier science to support for start-ups and partnerships with industry. Parts of it may be implemented through European public–private partnerships (PPPs) in one of the three forms foreseen in the regulation.

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[119] Dossi, Mafini (2014). "Restructuring in France's innovation system: from the mission-oriented model to a systemic approach of innovation." LEM Working Paper Series, 2014/06 (available at: https://pdfs.semanticscholar.org/5185/dca3b71b81d79a93912839c92993a49c1ff1.pdf).

[120] Mazzucato, Mariana (2018). "Mission-Oriented Research & Innovation in the European Union." Brussels (available at: https://ec.europa.eu/info/sites/info/files/mazzucato_report_2018.pdf).

The mission-oriented approach offers a new opportunity for identifying new strategic partnerships and reviewing the adequacy of the existing ones[121]. If partnership with industry is essential for mission-oriented projects, a stronger coordination with PPPs has to be established.

Citizens' engagement

Mission-oriented labs could play an important role in promoting citizens' engagement and their crucial practical role in the development of mission-orientated projects. Citizens' engagement in policymaking and the design of public services has been widely analysed. Participatory governance provides opportunities for citizens to play an active part in shaping their world, particularly in science and innovation policies[122].

In relation to the mission-oriented approach, Mazzucato states: 'The issue of public engagement and missions is crucial because of the symbiotic nature of the relationship between the two. Missions provide a straightforward explanation to the public of how diverse, and sometimes difficult to understand, developments in research and innovation contribute to a better society. In addition, the potential impact of missions is much higher when they inspire and engage widespread support'[123].

An EU constellation of world-class mission-oriented research and innovation institutions (that could be called mission-oriented R&I Labs) might be identified and reorganised according to previous recommendations.

Mission-oriented research network

Missions require organisational capacity and leadership. With this in mind, the IIPP has also formed a new network — called the Mission-Oriented Innovation Network (MOIN)[124] — dedicated to the study of how such organisations work.

The MOIN Founding Partners are a select group of leaders and key members of teams from a diverse set of public organisations — from public banks to innovation agencies to strategic design units. The emphasis of the network is on developing new organisational capacities and capabilities needed within public organisations in order to enable them to establish missions collaboratively, and to foster the experimentation process necessary for welcoming multiple bottom-up solutions. Key to this process is the creation of new ways to both create and

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[121] See https://sciencebusiness.net/framework-programmes/news/eu-makes-its-pitch-member-states-12-research-missions-and-13-industry.

[122] Chwalisz, Claudia (2017). "Citizen engagement in politics and policymaking: Lessons from the UK." Populus, London (available at: http://www.populus.co.uk/wp-content/uploads/2017/07/Citizen-Engagement-Report-002.pdf); European Commission (2016), Citizen Engagement in Science and Policy-Making, JRC Science for Policy Report (available at: https://ec.europa.eu/jrc/communities/sites/jrccties/files/mc10_rio_sio-lopez_mobility_reading.pdf).

[123] Mazzucato, Mariana (2018). "Mission-Oriented Research & Innovation in the European Union." Brussels (available at: https://ec.europa.eu/info/sites/info/files/mazzucato_report_2018.pdf).

[124] See https://www.ucl.ac.uk/bartlett/public-purpose/news/2018/mar/iipp-launches-its-global-mission-oriented-innovation-network-moin.

evaluate public value, which can, amongst other things, aid ministries of finance to evaluate the dynamic spillovers created by mission-oriented innovation outside the static cost–benefit framework.

6.4 Conclusions

The basis of this chapter is a study by the Joint Institute for Innovation Policy (JIIP), Joanneum Research, Tecnalia, TNO, VTT and the Danish Technological Institute (DTI)[125], prepared for the European Commission, which contains an exhaustive collection of the mission-oriented initiatives. Some of the most representative ones are analysed with the aim of extending the lessons learned to implement this new orientation at European level.

The study identifies the crucial preconditions and governance structures necessary to facilitate mission-oriented initiatives design as well as the implementation and achievement of related objectives. Based on this, the present chapter attempts to continue reflections on these two important elements.

Although mission-oriented initiatives are very diverse and there is no single approach for every one, this chapter tries to highlight those aspects that could be part of a common framework, with essential characteristics for this type of initiatives to have the desired impact and success.

Mission thinking is identified as an essential common precondition: actors involved in any mission-oriented initiative should have the ability to orient research and innovation to solve the concrete problems necessary to tackle the great challenges that affect people in their daily life. Such capacity is identified in this chapter as 'mission thinking', that is the capacity of thinking in mission terms. It includes, among other characteristics:

- being convinced of both the important role of fundamental research in the mission-oriented research and innovation approach, and of the benefits of fundamental research being part of mission-oriented projects;

- understanding that the role of public policy in the economy should also evolve towards a more active intervention in market shaping and creation and that such policies may involve structural changes to the economy;

- being conscious that failures and taking risks are often driving forces behind success in the innovation processes, as learning from failures is essential to progress;

- developing an open and multidisciplinary thinking essential to address problems in a complex world.

[125] European Commission (2018). "Mission-oriented research and innovation - inventory and characterisation of initiatives: final report." Brussels.

Mission thinking is a prerequisite for being successful in the process of identifying the specific missions that must be addressed in order to progress in the right direction towards solutions to grand challenges. It is also necessary for researchers, innovators and governments to carry out the necessary shifts in the research and innovation processes, in the R&I institutions and in the R&I systems to tackle mission-oriented projects.

Having clearly defined and empowered governance structures responsible for its success is crucial to implement, coordinate and direct each mission. Missions are so diverse that no single detailed governance structure can be considered to be suitable for all of them. The most appropriate governance structure depends on the nature and scope of the mission, on the stakeholders to be involved and on the cultural, geographical, political and technological ecosystem in which missions emerge. But some common characteristics can be identified.

Evidence shows that successful governing structures for missions at EU level should be different from those used by the R&I institutions in the past, as new actors and new roles emerge to contribute to the policy objectives in different and complementary ways.

It is also reasonable to think that well-structured governance should be supported by high-level political guidance, involving various policymaking levels and different scientific advisory boards. That is why a high-level EU mission-oriented body is proposed in the previous section, to tie together all research and innovation policy efforts, to encourage radical innovation and to identify missions necessary to tackle societal challenges in close connection with long-term EU strategic plans. It should be a high-level body, possible even created at European Commission President level, as political endorsement is crucial for the body to be able to work effectively.

Specific missions could be carried out in mission-oriented labs, which are considered the R&I institutions best suited to fulfilling the missions' objectives. They would have access to specialised equipment and world-class R&I facilities. They would be places where skilled mission-thinking teams from academia, governments and industry could develop the well-funded mission-oriented projects decided according to the EU R&I strategy.

A mission-oriented lab governance structure should assure that science and innovation activities and programmes fulfil the mission execution and funding responsibilities of the laboratory, and that an environment of collaboration, openness, freedom of expression, scientific integrity and excellence among the staff prevails in the lab. It should also facilitate excellent management, productivity and performance of the lab operations and ensure a continuous improvement processes. Mission-oriented EU R&I labs would also promote collaboration with industry and citizens' engagement in mission-oriented projects.

An EU constellation of world-class mission-oriented research and innovation labs might be identified and reorganised as a network (the Mission-Oriented Research and Innovation Network) for better cooperation and exchange of good practices.

To summarise, the following conclusions can be drawn.

- Excellent mission-thinking experts should make proposals to convert challenges into missions in a way that ensures that the most appropriate missions to tackle a specific challenges are selected and funded.

- Researchers participating in mission-oriented projects should be trained and encouraged to develop their role as producers of knowledge together with the responsibility to contribute to solving the great global societal challenges.

- Governments (local, regional, national) should promote legislative changes to remove the existing barriers to the mission-oriented approach, and should actively invest along the whole innovation chain from fundamental research to supporting enterprises willing to innovate.

- Research and innovation institutions involved in mission-oriented projects have to be restructured in order to increase their competitiveness in the achievement of the missions.

- Innovators have to be trained to know that a failure is often a driving force behind success, and to learn from failures. Developing a culture of learning, besides stressing excellence, helps to break down the resistance to looking at and learning from mistakes.

- Training programmes on an open and multidisciplinary approach to research and innovation should be promoted, especially for young scientists, so that they can acquire and develop the appropriate skills to understand and successfully participate in mission-oriented projects.

- A high-level mission-oriented body should be created at European Commission President level, as political endorsement is crucial for the success of missions.

R&I institutions suitable for fulfilling mission objectives (mission-oriented labs) should be organised with world-class R&I facilities, skilled mission-thinking teams and a proper governance structure to assure that science and innovation activities and programmes fulfil the mission execution and funding responsibilities of the laboratory. An EU constellation of such world-class mission-oriented R&I institutions should be promoted as a tool to improve the EU's global competiveness through the mission-oriented approach.

7 Entrepreneurial Universities and Innovation Ecosystems

Daria Tataj, Esther Real, Christopher Tucci, and Teresa Riera Madurell

7.1 Introduction

The issues of entrepreneurial universities stem from the converging interests of many actors. On the one hand, there are the reflections of policy advisers on how to foster an open innovation ecosystem across Europe to create an environment conducive to economic prosperity and social wellbeing. On the other hand, there is the strategic task of senior university leaders charged with strengthening the knowledge transfer activities of large public universities.

The RISE reflection started with a recognition that despite inspiring the bottom-up projects coming out of the emerging learning spaces in Europe, (including start-up communities, new collaborative spaces, FabLabs and emergent makers' movements and meet-ups) there is a widespread assumption that 'excellence' is not part of innovation. Innovation is often seen as a substitute for technology-driven solutions, and the notions of entrepreneurship, entrepreneurialism and the concept of an entrepreneurial university trigger mixed views in many milieus both on and off campus.

These innovative spaces are part of a changing paradigm of education — or rather learning — in the 21st century. As in many other sectors of industry and society, the disruption enabled by digital technologies, and to a growing extent by artificial intelligence and big data, leads to new approaches to both study and work. New organisational patterns and public–private partnerships are emerging. We are witnessing the need for new business models and funding schemes for institutions and organisations that ought to maximise the impact of the knowledge they produce and diffuse. In this context, both top-down policies and bottom-up strategies must take into account the at times radical changes, discontinuities and hybrid models in the education sector linking brick-and-mortar with virtual and digital.

Since disruption can quickly spread across a system, policymakers and university leaders face a similar challenge: how to respond with more agility, flexibility and speed to surf on this wave of change rather than being inundated by it.

7.2 A university perspective

Transforming a traditional research-driven university into an innovation-driven entrepreneurial institution is a global — and not Europe-specific — challenge. However, this process becomes more challenging for universities in Europe because of their long legacy and hence inevitable path dependence, and the increasing average age of professors. With this trend, institutions have become even less inclined to take risks, adapt and change radically. Could policies and strategies be redesigned to bring more disruption, innovation and discontinuity by empowering young leaders to accelerate change? Certainly they could and they should. Students and young researchers want to do things in a different

way; they follow a different career trajectory than previous generations. In many cases, becoming a full professor has become more competitive and, with a shrinking number of students, new opportunities for life-long employment have become scarcer than ever. Younger academic professionals increasingly realise that their future lies in their own hands and not in the hands of an invisible state paying monthly salaries and benefits continuously throughout their careers.

There are cities and regions in Europe where universities have become quite successful in embracing the multidimensional social and economic changes. Barcelona, Eindhoven, Kraków or Cluj in Romania provide good examples of how entrepreneurial universities interact with the local ecosystem and cater talent-fuelling local growth. But there are many more examples where universities have not managed to respond to the challenges. The measures of success or failure are quite clear: brain gain or brain drain; employment growth or decline; investment inflows or outflows. Immersion in the diverse European innovation ecosystems shows common challenges faced by the leadership of local universities. These challenges oscillate around three main areas.

Firstly, **how can European universities become a magnet for talented students and researchers**? The uncertainty and unpredictability of our times drives the demand for both knowledge and the economic and societal impact this knowledge can create. To what extent can the focus on knowledge transfer, innovation and entrepreneurship become a strategic advantage in the global competition for talent? The question is how to leverage the existing frameworks of the European Research Area and European Higher Education Area for this purpose.

Secondly, **what are the emerging trends that will intensify global competition facing European universities?** Academic institutions in China, India and South America have developed their knowledge assets and institutional capacity for knowledge production, often from their experience with and exposure to European universities. How can these European universities maintain and strengthen their position as a reference for the emerging leaders in their disciplines rather than suffer from a brain drain as other knowledge ecosystems develop?

Thirdly, **how to bridge a European policy with a university's daily operations?** How can policy be translated into practice when there are so many different types of universities, in the areas of technology, science, medicine, visual art, the humanities and social sciences? In many cases innovation starts or is championed in specific units of these institutions like ICT departments of engineering schools or entrepreneurship centres at business schools. Knowing that interdisciplinary projects, in both research and in innovation, often lead to superior results, how can we create interfaces for collaboration across universities? How can we lead a strategic transformation of universities, which by their nature are conservative and hierarchical with structures and incentives designed to preserve rather than challenge the status quo? In practical terms, what incentives are needed and what disincentives should be removed to convince academics that the so-called 'third mission' is

not a separate mission but rather an integral part of the changing identity of universities in the 21st century?

Transforming European universities to remain research focused and at the same time developing a new focus on innovation will be welcomed by many in society. Shortage of talent is often quoted as the key barrier to growth by business leaders. Looking at the public scene, there is more and more need for social, political and cultural innovation. Engaging students and young researchers with industry and society in a new, more open and collaborative way is not easy. It requires more relationships and connections in the local innovation ecosystems. It also requires university professors to be allowed and rewarded (and not penalised) for exploring new models of business–academia–society collaborations, strengthening knowledge transfer activities, commercialisation of intellectual property and the creation of start-ups. Involving the latter in collaboration with universities is probably the most challenging and, at the same time, vitally important aspect of this transformation. Small firms are often at the forefront of radical, disruptive innovation and new technologies. They have the potential to become the glue connecting industry, academia, cities and governments, helping all members of an ecosystem to innovate better, faster and more collaboratively.

Horizon Europe refocuses European policy thinking and instruments strongly from research to innovation, from challenge to mission, from 'knowledge triangles' to innovation hubs. Research and innovation is increasingly recognised as a top political priority for the European Union, along with security and economic stability. In this context higher education policy is key; for the millennial generation, for startups, for social enterprises and for the self-employed, universities should become more nurturing environments. For this, they must capture two coinciding trends: to become more open to the world and more mission driven at the same time.

7.3 A policy perspective

In 2018, stimulating entrepreneurial ecosystems around universities has become one of the hottest topics in the fields of science and technology policy, regional development economics, entrepreneurship, urban studies and innovation management. Interest in this issue began with the rise of Silicon Valley and the role that Stanford University played in its development[126]. Over the last decades, technology transfer has been seen to play an increasingly significant role in stimulating innovation and economic development[127]. Previous studies put an emphasis on the scope and quality of technologies generated

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[126] cf. Saxenian, A., (1990). "Regional networks and the resurgence of Silicon Valley." *California management review*, *33*(1), pp.89-112; Saxenian, A., 1996. *Regional advantage*. Harvard University Press; Kenney, M., 2000. *Understanding Silicon Valley: the anatomy of an entrepreneurial region*. Stanford University Press; Bresnahan, T. & Gambardella, A. (Eds.), 2004. *Building high-tech clusters: Silicon Valley and beyond*. Cambridge University Press.

[127] Siegel, D. S., Waldman, D., & Link, A. (2003). „Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study." *Research policy*, *32*(1), 27-48.

within leading and mid-range universities[128], or the role of supportive local communities[129], or the presence of science parks and incubators.

However, the Stanford model has been shown to be difficult to replicate. Despite the potential benefits of university technology transfer and attention from urban, regional and national policymakers, it seems that many areas and their universities struggle to develop effective ecosystems.

Based on the insights of the RISE Open Innovation Group workshop held in Barcelona, the following issues need to be tackled.

- One thing that needs to change is the academic culture, which almost universally rewards research output, but rarely rewards creative teaching.

- How can we convince academics that the 'third mission' is important? What would be an adequate incentive system to accelerate the transformation towards an entrepreneurial university?

- Basic and applied research (not product development) are still, with good reason, the main focus of universities and will be for the foreseeable future.

- Other factors include enabling network effects, a need to change organisational culture and facilitate multi-disciplinarity, a focus on aggregate value process and social value/impact generation, an entrepreneurial mindset at all levels, integrating the experience of the students into the process and balancing financial and social incentives as regards changing the incentive structure for professors (which are now still measured according to published papers, possibly the number of students, etc.).

The RISE discussion on entrepreneurial universities as transformational agents driving an ecosystem change was about the difficulty of addressing this problem and the need for a consistent vision and policy at all levels, including the European, national, regional and local. Most geographic areas around universities want more engagement with academia. Overall, geographic proximity to universities allows new ventures to gain access to a skilled workforce, laboratories and relevant expertise[130]. Some university characteristics associated with spin-off formation are well established in the literature, such as intellectual eminence[131], faculty quality[132], and scientific

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[128] Wright, M., Clarysse, B., Lockett, A., & Knockaert, M. (2008). "Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries." *Research Policy*, *37*(8), 1205-1223.

[129] Degroof, J. J., & Roberts, E. B. (2004). "Overcoming weak entrepreneurial infrastructures for academic spin-off ventures." *The Journal of Technology Transfer*, 29(3-4), 327-352.

[130] Bercovitz, J., & Feldman, M. (2006). "Entreprenerial universities and technology transfer: A conceptual framework for understanding knowledge-based economic development." *The Journal of Technology Transfer*, *31*(1), 175-188.

[131] Di Gregorio, D., & Shane, S. (2003). "Why do some universities generate more startups than others?" *Research policy*, 32(2), 209-227.

[132] Powers, J. B., & McDougall, P. P. (2005). "University startup formation and technology licensing with firms that go public: a resource-based view of academic entrepreneurship." *Journal of Business Venturing*, 20(3), 291-311.

productivity[133]. At the same time, it is also increasingly recognised that some university-level factors influence the founding environment[134] and, in turn, affect the rate of academic entrepreneurship.

Traditionally, university academics are characterised as being interested in pursuing some combination of the three Fs: fame, fortune and freedom, in other words publications, citations, prestige and professional awards[135]. This collides with the requirements of university output, which has shifted from being a pure 'public good' knowledge regime to a more 'academic capitalist' knowledge regime[136]. In this context, these are the relevant questions we continue to pose.

- How can policy nudge European universities to improve their curriculum across the board to increase awareness of innovation and entrepreneurship?
- Should we be concerned only with 'research universities' or could entrepreneurship come as an alternative to research?
- Most of the sources of conservatism stem from the promotion and tenure process for professors. What kinds of European policy instruments could circumvent or change promotion processes?
- What kinds of steps should be taken to encourage open innovation spaces to connect with universities, and vice versa?

In this perspective, all ecosystem activities may help universities to become an anchor tenant in their regional context and contribute to local growth by mobilising knowledge, talented people and firms[137]. This means that university technology transfer is much more complex and multifaceted than patenting activity and new venture creation, since it also includes knowledge spillovers and teaching activities. Consequently, the role of entrepreneurial universities is broader than just generating and transferring knowledge[138], since they might provide adequate entrepreneurial environments for students, academics and

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[133] Van Looy, B., Landoni, P., Callaert, J., van Pottelsberghe, B., Sapsalis, E., & Debackere, K. (2011). "Entrepreneurial effectiveness of European universities: An empirical assessment of antecedents and trade-offs." *Research Policy*, *40*(4), 553-564.

[134] Beckman, C. M., & Burton, M. D. (2008). "Founding the future: Path dependence in the evolution of top management teams from founding to IPO." *Organization Science*, 19(1), 3-24; Bercovitz, J., & Feldman, M. 2008. Academic entrepreneurs: Organizational change at the individual level. *Organization Science*, *19*(1), 69-89.

[135] Dasgupta, P., & David, P.A., (1994). "Toward a new economics of science." *Research Policy* 23, 487–521; Merton RK. 1973. The Sociology of Science: Theoretical and Empirical Investigations. Chicago: Univ. Chicago Press.

[136] Slaughter, S., & Rhoades, G. (2004). *Academic capitalism and the new economy: Markets, state, and higher education*. JHU Press. Chicago.

[137] Feldman, M. (2005). "The locational dynamics of the US biotech industry: Knowledge externalities and the anchor hypothesis." *Research and technological innovation* (pp. 201-224). Physica-Verlag HD.

[138] Audretsch, D. (2012). "Entrepreneurship research." *Management Decision*, *50*(5), 755-764.

staff to explore/exploit entrepreneurial activities[139], according to several innovation policies in most countries[140].

Drawing together the university and policy perspectives, these are the ideas that need to be pondered:

- funding entirely new universities at the European level that would be designed with entrepreneurship and innovation in mind, akin to what Skolkovo Institute of Technology originally attempted to do but at a larger scale;

- awarding prizes for universities, to at least give incentives to administrators, or even certification of universities, along with funding to help them to become more entrepreneurial and more engaged with the local ecosystems, in order to achieve the certification or win the prize;

- giving portable professor grants (or prizes for current professors) that would reward innovation and entrepreneurship activity, including curriculum development, rather than research output: if these grants/prizes were large enough and selective, they could eventually also be seen as prestigious and desirable by a larger number of academics;

- related to the above, establishing endowed professor positions that would be reserved for academics making a significant impact on innovation: these could be co-funded by industry and regions;

- providing 'training' for university presidents/deans/administrators to build awareness of different ways of measuring impact whereby the administrators could come together in a forum and discuss how to change the systems of incentives in ways that could benefit everybody, for example, excellence in two out of three of research, teaching and ecosystem engagement, with representation on tenure committees for all three activities;

- giving extra funding, not simply as a prize but perhaps in some kind of longer-term funding, to universities that meet different innovation targets, or better still (in terms of changing incentive systems) to universities whose professors on average meet certain innovation targets, such as spinoff companies, curricular innovations, local employment growth, representation on company boards, participation in product development teams or other engagement measures;

- broadening the scope for entrepreneurial universities away from purely technological innovations so as not to simply reward technical universities oriented toward spinoffs but to reward all different ways of engaging with the ecosystem and contributing to economic growth.

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[139] Guerrero, M., & Urbano, D. (2012). "The development of an entrepreneurial university." *The journal of technology transfer*, 37(1), 43-74.

[140] Wright, M., Hmieleski, K. M., Siegel, D. S., & Ensley, M. D. (2007). "The role of human capital in technological entrepreneurship." *Entrepreneurship Theory and Practice*, *31*(6), 791-806.

7.4 Towards an ecosystem impact through social innovation

Universities are key players in the generation of knowledge and skilled human capital to serve as resources to communities and, thus, potentially sources of innovation and economic development.

In this context, it is clear that universities can have a great impact on economic well-being and innovative capacity. This applies not only to the territory where they are situated and, in consequence, to the productivity and economic growth of the region, but also to the EU as a whole, to meet its targets of being a competitive knowledge-based economy with more and better jobs and to tackle societal challenges. For this, the EU needs not only excellence in its universities, but also relevance.

This important role of European universities should be matter of academic and policy interest. It is especially relevant to explore how they can contribute to the development of social innovation and how cooperative relations between universities, businesses and public institutions, as well as dedicated policies, can improve universities' contribution to social innovation.

Although there are slightly different approaches to the term and its definition, social innovation can be defined as the capacity to develop new ideas (products, processes, services and models) that respond to the needs of society, while allowing new and better forms of relationship and collaboration. Its objective is to find solutions to social challenges and at the same time to reinforce the capacity of society to act. These are innovations which are social in their end (improving the well-being and quality of life of citizens) and in their means (improving society's capacity for action through education and training, and by establishing the proper information channels).

Case Study: Espais Emprèn at the UPC BarcelonaTech[141]

By Esther Real

Universitat Politècnica de Catalunya (UPC) BarcelonaTech is one of the largest technical universities in Europe with over 30,000 students, 3,000 teaching and research staff and an income of almost €60 million from R&D projects (2016). In Spain, it is the top university in terms of the number of projects funded through Horizon 2020. The university is a public institution of Higher Education and Research, specialised in the areas of engineering, architecture, sciences and technology, and has a strong focus on internationalisation, with a large number of international PhD and Masters students graduating each year.

In addition to carrying out basic research UPC closely looks how to apply its activity in industry and explores new ways how to build a more entrepreneurial culture on campus. The UPC puts the university research capability of the 200 UPC research and technological transfer groups at the service of the innovation in businesses, and deals with their technological needs, providing an integral

[141] *More at* http://www.upc.edu

and multidisciplinary technological service, thereby supporting the enterprise innovation.

It has collaboration agreements with over 2,600 companies and entities and has seen 12 technology-based startups established in the last year. Its innovation and entrepreneurship activities are spread across its campuses and include the Science and Technology Park of the UPC, the Espais Emprèn, the KIC Innoenergy node at Campus Nord and European Space Agency Business Incubation Center (BIC) in Castelldefels Campus. It integrates entrepreneurship into engineering education through different collaborations as the one with ESADE, IED, and CERN.

Moreover, nowadays it is widely recognised that the engine of innovation lies also, and significantly, in society and not only in technological processes, which were undoubtedly the driving force of innovation in the industrial era. Therefore people and society should be considered as important sources of innovation and hence social innovation is also intended to improve their training as important players in the innovation process.

It is also important to highlight that social innovation is an interdisciplinary field that demands a global vision since the most important economic and social challenges to be addressed require innovation that crosses the sectoral and administrative frontiers. For example, responding to the ageing of the population requires changes ranging from legislation on employment and pensions to new models of care for the elderly, including self-management and new types of housing.

Moreover, social innovation covers a wide range of areas, from the development of new models for caring for children and the elderly, for the health system or for education, to new models of cities that provide new and better solutions to mobility, a more efficient use of energy and limited resources, better safety, a reduction of carbon dioxide (CO_2) emissions, trade, tourism, information and communication among others, and developing, in turn, new ways of working and relating, and new models of governance.

All this requires, at the same time, a cultural change towards a culture based on trust, creativity, risk, knowledge and training, as an indispensable requirement to foster entrepreneurship and the new business opportunities that social innovation offers.

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The message of Commissioner Carlos Moedas during the Research and Innovation Days in Brussels, in September 2019, at the very end of his mandate was: "Research and innovation are the cornerstone for Europe's prosperity. We should continue to build awareness and advocate for making research and innovation the very top of the EU's political agenda."

This publication of the RISE group resonates very well with the call of the Commissioner. Building on the earlier work of the group, it provides insights on science diplomacy, citizens' engagement, disruptive technologies, procurement for innovation and mission-oriented policies.

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