



Reflections of an Expert Group on future Internet Innovation

Work Programme 2016-17 Consultation

Net Innovation Workshop, 3 July 2014

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1. Introduction

As part of preparations for the Work Programme 2016-17, Unit E3 'Net Innovation' of the Directorate-General for Communications Networks, Content and Technology (DG CONNECT) organised a workshop in Brussels on 3 July 2014.

Prior to the meeting, experts from the Net Innovation community – entrepreneurs, academic researchers and intermediaries – were invited to submit a short (two-page) position paper setting out the main developments and trends in relation to the digital innovation space and suggesting ways in which the Unit might address such issues under the ICT Work Programme 2016-17. These papers then formed the starting point for the discussion at the Workshop, during the course of which the ideas were tested and developed further.

Six experts attended the meeting, as listed in Annex 1. This Workshop Report draws from the Experts' individual position papers and from the discussion during the meeting.

2. Trends and Opportunities

Entrepreneurship is a driving factor in digital innovation: Innovation today is open to everyone. Continuously decreasing barriers in developing and applying digital technologies have given birth to a grassroots net innovation movement of unprecedented scale. In the new digital space, innovation happens through direct and ongoing interaction between creators and users in a form of 'open heart operation'. Small and agile companies, especially, are in close contact with users and have the means to create better products, successfully gathering immediate feedback for the next generation of products and services. In the future digital economy, this 'Innovation through Entrepreneurship' (ITE) will not be confined to consumer markets and verticals but will shift across sectors, enabled, in particular, by the Internet of Things.

Successful ITE involves three consecutive stages: an Innovator, who has the original idea; a Founder, who has the guts to try and bring the idea to market; and the Entrepreneur, who scales the initial product to form a sustainable business. These three stages each need specialised support and need not necessarily involve the same people.

At the end of the day, entrepreneurship is a question of scale: thousands of companies need to be created and most of them will fail in order for the few to succeed. Europe's size and diversity is an asset for entrepreneurs, but the lack of a truly integrated market makes it difficult for companies to scale effectively.

The Internet of Things is a major driver of innovation...: The massive growth in the number of connected and smart devices continues. According to a recent study conducted by Microsoft¹, Europeans now own an average of ten IP-enabled devices, reflecting how consumer devices such as games consoles, hybrid TVs and set-top boxes are increasingly smart. In the next few years, an even greater array of smart devices, terminals, machines (and even robots) will be at users' disposal and the Internet of Things (IoT) will change from novelty to normality. Already, the traditional distinction between 'network' and 'device/terminal' is starting to blur as the functionalities of the two become

¹ <http://www.microsoft.com/eu/our-digital-lifestyle-a-world-of-opportunities.aspx>

indistinguishable. Shifting the focus from the network to the terminals makes evolution possible at the micro scale: it costs less, scales more gracefully, and leads to immediate revenues. Innovation in terminals is much faster than in network equipment and is viral. This creates a volume and an economic market that will drive investment outside of the network infrastructure boundary and stimulate the advent of new communications paradigms.

...and will facilitate fully immersive, smart experiences: Moreover, this shift will bring real potential for fully immersive, smart experiences to be delivered to European citizens and businesses, opening new markets. However, Europe has already lost its competitiveness in smartphone operating systems and hardware: we must ensure that we do not lose out in these new future markets too.

The systemic nature of innovation calls for coordination: Whereas Internet 1.0 centred around individual platforms, and Internet 2.0 was about connecting users to those platforms, Internet 3.0 will be aimed at innovating entire systems of society, industry and public services. Successful innovation will no longer depend on optimising individual technologies but on *coordinating* the huge range of stakeholders, systems and services involved.

Increasingly, innovation happens at the confluence of emerging technologies, leading to the development of new industries. Progress is more likely to occur when cross-disciplinarity is encouraged. Strategies would include importing ideas from broad networks and diverse communities, and creating an environment conducive to deep cross-collaboration.

The outlook is one of **extremely interaction-intensive environments** where there is a permanent and seamless mix of online and real world user experiences/behaviour, business offerings/transactions, and societal processes/frameworks. This overlay of virtual and physical realities will be enabled by four technology strands:

- 1) 'Layered' and 'augmented reality' interfaces (by smartphones, wearables, etc., including so-called smart watches and smart glasses);
- 2) Continuous data exchange between users and the surrounding physical world (by low-cost sensor networks and context-aware applications);
- 3) Ubiquitous connectivity and computing power (by technologies such as cloud computing and 4G mobile);
- 4) Real-time access to intelligence about both virtual and physical processes and events (by open, linked and big data technologies and processes).

Co-creation within smart systems: Since the technologies are not mature, and many dimensions and parameters need to be explored, there is a need to facilitate experimental and real-life (yet coordinated) environments and platforms. Large-scale future internet deployment and big data capabilities will combine to achieve not just smart services but **smart systems** that are co-created by different system entities working together (including users, large & small businesses, public bodies, technologies, and legal frameworks).

SMEs and cities should be key stakeholders in these large-scale systemic innovation programmes; i.e. enabled as co-innovators and not just adopters of technology. In Finland, for example, the six largest cities are working together in a project focusing on system redesign. Each one takes responsibility for a particular problem area and uses its links to other cities to experiment with and rollout solutions.

Increased 'softwarization' in networks promises new Internet-based innovation: Software's contribution to innovation is well known: in many industries (not only ICT) software adoption is accelerating rapidly the pace of innovation and improving competitiveness, by optimising processes

and reducing costs. Today, increases in performance of ICT, tumbling hardware costs and availability of open source software are creating the conditions for a change of paradigm in the design and operation of networks and service infrastructures. Many network elements (e.g. routers and switches) and network functions (e.g. middle-boxes) can now be 'virtualized': i.e. replaced by software running on logical resources such as virtual machines. This is opening the way towards the creation and development of new ecosystems. Software-defined Networks (SDN) and Network Function Virtualization (NFV), as well as Cloud Computing and Cloud Robotics, are all early indicators of this 'softwarization' trend.

What the experts called "the softwarization of networks" has profound implications for industries such as telecommunications, as the threshold for new entrants will be drastically reduced. New Software-Defined Operators (SDOs) would have their main software networks and service platforms fully developed, executed and operated in software (in the Cloud) and would just need to 'borrow' basic hardware resources from infrastructure providers. This would bring dramatic cost reduction (both capex and opex) compared to traditional operators².

'Softwarization' will also play a key role in 5G, the future ubiquitous, ultra-high bandwidth infrastructure currently under discussion. 5G will be the first instance of a truly converged infrastructure, integrating IT and networks resources, and where wired and wireless communications will be indistinguishable. It will become the 'nervous system' of the digital society and economy, and help address 'Grand Challenges'.

Such developments are both a threat and an opportunity for Europe. Softwarization will create the ideal condition for pursuing new service paradigms, such as 'Anything as a Service' (AaaS), exploiting the myriad of intelligent terminals, devices and machines. More and more intelligent machines and robots, operated and controlled through 5G and cloud, will allow the creation of new ecosystems and new forms of industrial and agricultural production and distribution³ (e.g. new models for decentralized micro-manufacturing; new means of delivering public services; support for ageing and healthcare; and new sustainable ICT ecosystems). The impacts for society will be significant, but it calls for a profound integration of areas such as robotics, 5G, Cloud Computing and Big Data.

The Internet's migration into the physical space is driven by people. The *Internet of Everything* is also the *Internet of Everyone*. Human agency is crucial in the deployment of the Future Internet in physical space. The commonly used 'Internet of Things' emphasizes the role of 'things' over that of human agency, even though things (and data) only acquire meaning through their use. Human agency gives the internet its richness through the affordances⁴ on offer in the many ways in which people interact with and contribute to their environment (through things, places and activities). The 'Internet by All', or Allnetnet⁵ as one expert referred to it, touches all areas of human activity and everyone within the network has the potential of contributing content to it.

² More specifically, this could create a split of roles of current Network and Service Providers (NSP) into "Software-Defined NSP" (SD-NSP) and Infrastructure Provider (IP). An SD-NSP is an operator owning software networks and services platforms, i.e., platforms whose functions (ranging from L2 to L7) are fully developed, executed and operated in software, in the Cloud and/or in the exchanges (centralized vs distributed). SD-NSPs "borrow" hardware resources (e.g. just antennas, L0-L1 transmission and processing power) from IPs. Essentially, an SD-NSP looks like an OTT (over-the-top) provider.

³ 'The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies', by Erik Brynjolfsson and Andrew McAfee, 2014

⁴ 'A quality of an object or environment that allows someone to perform an action'. <http://www.macmillandictionary.com/open-dictionary/>

⁵ The "Allnetnet" was coined by Lubna Dajani in 2014: see <http://allnetnet.org>

Traditional innovation assessment frameworks can lead to solutions that are over-engineered. The Technology Readiness Levels (TRL) framework, often used for assessing the deployability of innovations, has its origins in NASA space programmes of the 1980s. NASA projects bear an extremely high level of risk and hence resulted in the familiar nine-point scale. However, not all – and arguably very few – technologies need to be so mature before being deployed to the market. Indeed, such a conservative approach can lead to solutions that are ‘over-engineered’. A creative platform, such as *SoundCloud*, for example, could be deployed at TRL3. For a potential investor, a large number of early adopters, and the related substantial datasets, have often proven to be sufficient incentives for investment and acquisition in early stages of development (TRL3 to TRL7).

Consultations within the CONNECT Advisory Forum (CAF)⁶ have led to a proposal for a new set of guidelines based on Market Adoption Readiness Models (MARLs). MARLs are readiness levels which measure:

- 1) The level of risk implicit in any technology (e.g. medical technologies placing the patient at high risk versus a creative music application like SoundCloud above);
- 2) Number of potential Early Adopters (e.g. low risk experimental platforms can attract a large number of early adopters if they are perceived as adding value);
- 3) Potential to yield data (e.g. Early Adopters can in some cases generate a considerable amount of valuable data already at early stages of deployment); and
- 4) Technology readiness.

Mass participation will be a key feature of the Future Internet landscape. The involvement of users in the internet space has progressed from the role of validators to being active participants in the creation of content. Increasingly users invest to the extent that they are not just creators but also curators. According to a Google study in 2013, 90% of ‘Generation C’ are regular content creators and 60% are content curators. Of these, 39% are aged 35 and above, dispelling the myth that creators are typically young people in their teens or 20s. Thus, regular content creators include a large number of professionals, an increasing number of whom generate income by creating content.

Many of these content creators begin to monetise their created assets and become microcompanies. Hence, the rise of content creators is contributing to the rise of content-related business models based on ideas of the Sharing Economy, where the platform takes a small cut (typically 10-20% of profits), while the rest is wealth generated collectively by platform contributors. Currently, some of the fastest growing technology platforms are those which enable mass participation, such as the taxi and ridesharing app Uber⁷, and the artist promotion site Bandcamp⁸.

Mass participation in the Future Internet turns citizens into service providers, product makers, manufacturers, and decision makers, contributing to both business and community platforms. Such models will be enabled by data-driven applications in physical space, and supported by business models which prioritise **data transparency** (clarity of information on availability and cost), **choice** (options on how and when to contribute) and **trust** (if the participant doesn't generate profit, the platform doesn't either),

⁶ CONNECT Advisory Forum for ICT Research and Innovation, an advisory body of DG CONNECT. <http://ec.europa.eu/digital-agenda/en/connect-advisory-forum>

⁷ [http://en.wikipedia.org/wiki/Uber_\(company\)](http://en.wikipedia.org/wiki/Uber_(company))

⁸ <http://en.wikipedia.org/wiki/Bandcamp>

Research for Convergence

Innovation needs to be supported through multidisciplinary research in areas of high potential impact. These include:

- **Inclusive design:** Aiming to better understand the key factors for the use of digital interfaces, particularly for user groups that utilise digital devices at low frequencies. For this, we need to encourage a deeper integration of the fields of Human Computer Interfaces (HCI), (experimental) psychology and engineering design. The work is expected to have a positive impact on the breadth of use of future interfaces and public digital services.
- **Learning technologies:** Aiming to achieve a better understanding of the challenges of massive online participation in (tertiary) education, such as Massive Open Online Courses (MOOCs). These advances will de-risk the development of MOOCs, increase university participation in digitising their services, and promote educational net innovation in the private sector.
- **Public digital service design:** While there are existing incentives to promote and drive the design of digital services in the public sector, these are not grounded in a systematic understanding of public digital services. Instead, they are often built on the pillars of generic digital service design and hence leave many critical issues unaccounted for. Advancements in these fields will increase the rate of adoption of public digital services and strengthen a growing business ecosystem that supports them.
- **Semantic Web implementations:** A topic where it would be timely to re-evaluate the impact that large, systematic and well-structured research programmes could have. These might include extending existing solutions, (such as FOAF, WordNet or eagle-i.net), or the conception of entirely new, extended definitions of the Semantic Web. The impact on net innovation is less direct, but has potential to be long lasting. With significant advancements in the Semantic Web, a whole new generation of web technologies could develop and an active innovation culture could grow up.

Other areas with the potential for multidisciplinary research, such as privacy and data standards, are discussed below.

3. Key Issues

Experience under the PPP

Platforms are key to the future of the digital space: they are the 'Lego bricks' of the 21st century, providing the building blocks for the smart systems that will shape our world. The Future Internet PPP is an important development in this respect and has made (and continues to make) significant contributions. In particular, there has been clear progress on standards and APIs, and concerted support for SMEs. The Phase 3 accelerator projects, which are just being launched, represent a major escalation in the PPP's roll-out activity. Around €80m is being channelled across 16 projects involving over 1000 organisations, predominantly SMEs. These SMEs and Web entrepreneurs will apply FIWARE enablers in a whole variety of local ecosystem contexts.

Sustainability will be a key issue for this to happen. The PPP has to find means to **incentivise third parties** to bring new generic enablers to the platform, so as to keep it fresh and relevant. In particular, IoT-oriented enablers are required in order to extend the functionality into the Internet of Things (see below).

Cross-domain working (e.g. between travel and health) will allow common issues to be explored and help break down the 'silo mentality'. It could make particular contributions in view of the major integration issues around 5G (identified above).

Another factor in sustainability will be to **ensure that the openness ethos of the current platform** is maintained and exported into other projects and initiatives. All APIs related to the platform should be under open terms. Academic projects, for example, should have an API as part of their deliverables, so there is something for entrepreneurs to hook into. Making public data layers available to entrepreneurs through APIs is a well proven model and should be promoted. Corporates opening their patent portfolios also provides useful assets for entrepreneurs and startups.

One criticism of the current FI PPP is that it has been too supplier/technology centric. The initiative has been driven by large companies who have used it as a platform to implement the generic enablers they consider most important, with too little input from users. **An alternative approach** would be for users – such as cities and SMEs – to have a more prominent role from the outset, defining the enablers and functionalities they require for particular use cases. Indeed, a structure can be envisaged where cities, rather than companies, would be the platform's founding bodies. These should not just be 'leading cities', who are already embracing the smart city agenda, but also satellite cities and others who are starting down that road. Most likely it would be the leaders, however, that would get the ball rolling.

Having cities (and regions) on board will be key to the PPP's sustainability. As a platform, it has the potential to be **the 'operating system' for municipalities in Europe** and has to be marketed to them as such. Wide adoption, as under the Phase 3 projects, with smart cities and entrepreneurs collaborating will be essential for long term viability. SME collaboration can be particularly effective in addressing interoperability, as SMEs naturally seek interoperable solutions.

User-led approaches will be crucial in tackling 'Grand Challenges'. We have to start from real-world problems and build the ecosystems and new business models necessary to solve them. This could involve the user-led approach to platforms described above; or cities could set challenges to industry for them to address.

Entrepreneurship

Entrepreneurship's role in innovation has already been highlighted. In terms of **conditions for entrepreneurship**:

- Very small seed funding, for the stage before entrepreneurs are ready to approach angel investors, is in short supply (i.e. around €5-10k)
- Physical proximity to other startups remains vitally important, offering entrepreneurs peer support and the ability to cross-pollinate ideas. The Factory Campus in Berlin and various startup hubs in London's Techcity cluster are examples of this. Space for fast-growing companies remains a major issue in Europe, however. Municipalities should be encouraged to recycle their redundant real estate.
- Early stage help is a key requirement, in areas such as law and taxation. The idea of 'incubators' is rather unattractive however, as it implies a model dependent on accessing professional commercial services from outside: much better for service providers to work in collaboration with incubator companies.

The motivations of founders across Europe can be very different (e.g. between Berlin and Athens). We need a much **better understanding of social, economic and cultural factors** in entrepreneurship.

Large corporations have a role to play in Europe's entrepreneurship ecosystem. They can shape the landscape in important ways, by supporting innovation in the European market and helping to ensure a level playing field at international level. In-kind support to startups (such as Amazon's offer of its AWS platform) can also be valuable. Corporates need to recognize these responsibilities and be given incentives to act in the right way.

Why should entrepreneurship issues be studied within Net Innovation? Essentially, it is because of the Horizon 2020 programme's ability to reach Web entrepreneurs on a large scale. Such entrepreneurs are delivering early stage services that will shape the future of the web, such as IoT and mobile services. Local accelerators (as now being launched in FI PPP Phase 3) are essential in order to demonstrate such services in a local context and strengthen the fledging infrastructure. One means could be through encouraging interactions and exchanges between early stage projects (e.g. accelerators in London, Athens and Berlin).

There are also **opportunities for tools and apps to help entrepreneurs**, for example in tackling the challenges of internationalising their business. Living Labs have proved very successful in allowing SMEs to explore innovation opportunities abroad. The concept should be expanded with stronger emphasis on cross-border innovation and entrepreneurship.

Stimulating mobility and exchanges is another challenge, for both companies and tech clusters. 'Silicon Valley Comes to the UK' is a massive annual networking event for American and British startups: there is no exchange on a similar scale either within Europe or between Europe and the US. The biggest obstacle here is not money but time – having many key people take a whole week out.

New Ways of Doing Innovation

Innovation today happens across boundaries. Thus, a key success factor is the ability to bring different communities together, combining knowledge and insights in different areas. These **multi-disciplinary communities** should be based around people 'in the field' and be facilitated by access to the funding necessary to further their ideas. There should be follow-ups after idea generation, so that companies can see they are valued by the extent to which they engage with the community.

Prizes/competitions (both open and challenge based), **workshops** to pitch ideas, and **mentoring** by in-house experts are all valid approaches to help build the community. Physical meetings ('brains in a room') are to be preferred over virtual ones, especially in the early stages where trust is still being established.

Challenge-oriented approaches are a useful way of ensuring that innovation fully reflects user requirements and experiences. This applies also to 'Grand Challenges', i.e. societal issues. The aim should be significant (order of magnitude) improvements in products, services, processes or business models, and to ignore any current legal constraints.

We have to involve organisations that can **accelerate exploitation**, bringing results to the market depending on readiness levels. For instance, angel investors could be invited to provide match funding for projects.

With a potential budget of around €50-80m, Net Innovation has limited resources given the size of the challenge. This should be used to **seed funding from other instruments**, such as the European

Structural and Investment Funds, where significant budgets are available for these sorts of developments (e.g. smart cities).

Privacy as an Enabler

Privacy will be a critical factor in the development of future systems. At present, the notion of privacy has negative connotations: the public thinks of it as something to which they are 'entitled', while at the same time there is a lack of understanding of the value and potential of privacy-enabling technologies. We have to empower and educate people rather than scaring them, and stress that privacy is essentially about **managing consent**.

Privacy is not just an enabler of systems but also a **personal trade-off/choice**. People actively decide how much privacy they are prepared to give away in particular circumstances. On social media, for example, which is seen as low risk, they may concede a lot of relatively trivial personal details; when it comes to health or financial applications their standards are much higher. We need tools that inform and support people in making these choices, as well as better insights into the choices people make. For instance, large-scale experiments with these tools could be setup in the consumer/work context to investigate how people use them and the trade-offs they make. Such an approach links to existing work on Collective Awareness Platforms for Sustainability and Social Innovation (CAPS)⁹.

Digital privacy can also be **an enabler for innovation**. A selling point of FIWARE is that it is an expandable, open and secure ecosystem, and these characteristics need to be extended into the privacy domain. Privacy is not currently a key priority in the PPP and should have a higher profile.

Privacy is also **a major business opportunity**. We have to de-risk how privacy can affect growth and create a market where privacy suppliers are accredited in Europe. This is especially challenging in view of interactions between an increasing number of devices all of which have access to our personal data. The introduction of wearable devices in areas such as healthcare will be one of many new challenges. We need greater say over what and who can share/access our personal data so that the end user (as citizen/patient/student etc) is in full control. So, we should develop **tools to enable people to manage privacy in a practical way**.

Legislation (e.g. data protection) is an important factor here and needs to keep pace with technological developments. Mass digitalization and 'softwarization' have the potential to create a situation where personal information is created, held and managed at a 'global' level, so proper legal frameworks should be put in place.

Data Standards & the Internet of Things

Europe could and should be a powerhouse in IoT, but is falling behind the US in key areas such as health and home automation. Net Innovation can provide **a strategic perspective** here, in particular in view of the FI PPP and 5G PPP: how can we create a new socio-economic development in Europe by exploiting these new technologies?

Specifically, there could be **major opportunities for Europe in stimulating the IoT app ecosystem**. As the recent CAF report notes, in the Internet of Things future value will be primarily in apps and

⁹ For projects see: <https://ec.europa.eu/digital-agenda/node/66639>

services. This requires three building blocks: platforms and APIs; manufacturers; and an application development ecosystem. A healthy ecosystem of IoT app developers will be essential in order to i) extract future value from IoT markets; and ii) ensure sustainability by maintaining and developing APIs within the community.

Thus, the goal should be to **create a physical apps marketplace in Europe for Europe**, in other words an *'iTunes for the IoT space'*. Building such communities will involve bringing in sectors such as tourism, media, creatives, and manufacturing as well as technologists. As noted above, a community platform can generally be maintained on around 10-15% of profits. The modus operandi should be *'short, sharp, quick'*; we cannot afford to spend two years developing perfect apps, we have to bring them to market quickly. The subgranting mechanism as experimented in the PPP would be suitable here.

FIWARE already has a few IoT enablers and these could be expanded as a first step towards a sustainable ecosystem. **The core platform's support for data standards, protocols and open APIs** should also be maintained. There is no need to be selective here. An organic ecosystem can have many APIs, some will be more successful than others: what matters is that they are open and available for the whole community to develop and share. Standards for data exchange, security and metadata will open up innovation opportunities for public organisations and SMEs.

Policy & Legal Framework

Innovation and related policies are mostly handled by the Member States. Despite this constraint, supportive actions could be pursued at European level. For example, a common definition of 'startup' could be adopted, as some entrepreneurs have recently proposed.

Calls for projects could be targeted at applying technology to **overcome existing obstacles and barriers in the Single Market**, particularly in service sectors (e.g. taxi services, online banking, and insurance).

There can be a tendency for governments (and the Commission) to over-regulate, as with concerns about Microsoft in the 1990s. But in the digital space players are transient: don't regulate Facebook or Google, just create the next one!

Similar competition issues to those encountered in relation to telcos are now arising in relation to key internet platforms, such as music and video streaming services. Thus, Europe's existing policy on **Net neutrality needs to be extended to platform neutrality**.

Net Innovation should be the place to ensure projects have tangible outputs, providing funding in small chunks and with frequent monitoring. The Phase 3 grants will be a first example of this. In addition, call information could be better presented. Venture capitalists' approach to communication with startups – long and short versions of documents, each colour coded – could be a useful model to follow.

4. Annex 1: Invited Experts

Pieter Ballon, iMinds & Vrije Universiteit Brussel

Michela Magas, Stromatolite.com

Antonio Manzalini, Innovation/Future Centre, Telecom Italia

Simon Schaefer, Factory Campus, Berlin

Patrick Wollner, Engineering Design Centre, University of Cambridge

Barbara Zambrini, BBC Research & Development

Meeting Rapporteur:

Mike Sharpe, MS Consulting & Research Ltd