

# CAF's recommendations for H2020's work program 2018-2020

**CONNECT ADVISORY FORUM  
ICT Horizon 2020 Advisory Group**

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## Introduction

The H2020 program is well underway – the midterm review is being performed, and the planning of the work programs for the years 2018-2020 is on the table of the Commission.

As a reflection on the current state of affairs in and around Europe, the Commission has highlighted a number of themes that it wants to emphasise in its policies and research & innovation programs: (i) (Increase in) sustainable development & climate related research & innovation (R&I); (ii) Digitisation in all enabling technologies (LEIT) and societal challenges; (iii) (Strengthening) international R&I cooperation; (iv) Resilience to crises; and (v) Market generating innovations.

One could argue that the CAF should focus on the second theme, but further analysis shows that the existing research & innovation programmes in ICT have relevance and impact outside of the boundaries of traditional EU ICT research: digital transformation of business using e.g. platforms has proven to impact heavily on the creation of innovation and new jobs; the societal discussion on artificial intelligence, robots and cyber security requires a subtle balance of its ingredients to realise resilience instead of turmoil and large-scale anxiety, the international impact of EU ICT requires careful consideration (5G with Asia, Cyber Physical Systems with the US, Digital Economy with China).

**The CAF has chosen to focus its advice on the strategy to effectively reinforce the use of ICT in the various Societal Challenges, thereby touching on most of the above themes. With four short papers on Innovation, Platforms, Cyber Security, and Digital Infrastructure, and a report on Cyber Physical Systems that was endorsed, CAF has five cornerstones at its disposal that deepen key trends and game changers in society and economy.**

**The recommendations in this paper re-iterate earlier advice, based on new reflections on the results of the H2020 program.**

During meetings with the Chairs of other Advisory Groups, it became clear that ICT and Digital is a vast subject, where some structuring is needed. Moreover, having CAF's recommendations for the WP16-17 in mind, it was noticed during these meetings that most of the advice was still relevant. This does not imply that the earlier advice has not been incorporated. A lot of attention has been paid to e.g. internet-of-things.

However, it takes time to implement and digest the advice, and the recommendations that were kept have quite often a close relationship with other application domains (Societal Challenges), where digitisation is visible, but not fully-embraced. The game-changing properties of digitisation make treatment in a well-established domain an intricate task. Thus, transdisciplinarity<sup>1</sup> is stressed: we argue that H2020 should put more emphasis on the interplay between people, technology and business in most R&D&I-projects, a focus that would need to be also reflected in the composition of the research team. CAF also keeps stressing the importance of *trust* and *cyber security* – and this clearly relates to people and activities that make people in general trust in, and control over new ICT-based solutions, and digitisation of society and business at large.

### Transdisciplinarity

For improved chances to successfully address the complexity of European societal challenges, EU research and innovation actions require a trans-disciplinary approach.

As opposed to cross- (applying knowledge from one discipline onto another), inter- (investigating an area of knowledge that falls between two disciplines), and multi-disciplinarity (each discipline investigating their specialist area as part of a larger problem), transdisciplinarity addresses complex problems from several disciplinary perspectives to gain a holistic view.

<sup>1</sup> See textbox on 'transdisciplinarity'.

## Trends and game changers

### Trends

In its “ICT beyond 2015” paper the CAF identified a number of ICT-related trends. These trends have a clear and visible impact on business and society, and can easily be traced back in most of the societal challenges.

1. **Internet of Things (IoT)** is a set of products, services and processes that virtualises the real-world things for digital processing. The outcome of IoT is a fine-mazed network of sensors and actuators that can interact with digital systems and applications and is susceptible to internet business models. Depending on the instance, the fine-mazed network can be very simple or extremely complex, very local or globally orchestrated. The sources of information can be anything from tags, sensors, embedded systems, and existing databases to human agencies. An essential ingredient is scalable connectivity, locally and globally.
2. **Making sense of big data:** over the past 20 years, the digitalisation of business, public administration, science and society has caused more and more machine- and human-created data and thus the opportunities and challenges of Big Data. Big data capture, integration, and most importantly analytics have changed sciences (physics, genetics, medicine, geo-sciences, geo, psychology, communication) and finance (high-volume trading), more recently also the whole infrastructure of commerce and social networks. Predictive Analytics enables us to go beyond descriptive data analysis towards prediction or even prescription in the sense of real-time data-guided decision automation. The integration of “Things” as actors in the Internet via massive and innovative sensors, actuators, and real-time reactivity will cause another order-of-magnitude data explosion with challenges and implications for businesses, users and society that we have yet to understand and deal with.
3. A combination of the above trends deserves an entry on itself: the development of smart **Cyber Physical Systems** where labels such as **robots** and **artificial intelligence** can also be used. This comprises a large area of developments<sup>2</sup>, ranging from smart machines for manufacturing to self-managing harbours to cognitive robo-pets for improved educational opportunities to robots providing in-home personal assistance for improved quality of life with lower human resource demands.
4. Technological advances make it possible to interact in a **tactile** way with distant objects – in combination with developments in wearables, including glasses, and neuro-stimulation, this will fuel the trend of **augmented reality**. It will be the interface between real and virtual worlds, as well as communities, selves and knowledge. Important application domains are training and education, service maintenance, and health care.
5. **The quantified self:** the human as social sensor and as a source of data. A blend of the first three developments can be framed as the ‘all-ternet’, a term coined by Lubna Dajani [allternet.org], “where all people, products and places are connected and addressable at any instant in time”. Another phrase that has been used in this respect is ‘the internet of living things’, which also points to the challenges of the convergence between biotechnology and ICTs, which increasingly implies a digitisation of the human body and in more philosophical-ethical sense the blurring boundaries between humans, machines and

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<sup>2</sup> See also the separate CAF-endorsed report on Cyber Physical Systems.

nature.<sup>3</sup> This is the beginning of a new chapter in history, where technology is seamlessly humanised into everyday life. This has great implications. The ‘individual self’ understood as an autonomous, disconnected and almost atomistic entity does not fit in anymore with the hyperconnected era we are currently living in. Individuals are in every sense ‘relational, hybrid selves’: in every way connected to others, to technologies and to nature. Human freedom can only be understood in a relational, contextual sense, which for instance has implications for the rethinking of privacy law, regulation, and responsibility: privacy beyond the protection of individual freedom and conceptualised in a more (hyper)connected and contextual way (See for instance: Helen Nissenbaum (2010) Privacy in Context. Technology. Policy and the Integrity of Social Life). It also implies that the understanding of the digital communities and platforms through which ‘relational selves’ are connected to each other is key for the future development of H2020.

6. **Participation in design** (or ‘innovation from the edge’): to an increasing degree, individuals take creative and business roles in design processes. Participatory design is an approach to design that actively involves all stakeholders (e.g. employees, partners, customers, citizens, end users) in the design process to help ensure the result meets their needs and is usable. In general, platforms that are able to manifest this power of the community, or power of the crowd, can provide buying power, production power, financing power, democratic power ... User-driven innovation is a crucial part of the Open Innovation 2.0 paradigm and is also a key lever for adoption because users co-create solutions that meet their needs. Jean Claude Burgelman from the European Commission correctly identified that the user has moved from being an object of research in the innovation process, to being a contributor, and on to being a co-creator of the innovative outcome. The innovation process is being turned on its head and the EU Open Innovation and Strategy Policy Group report on the socio-economic impact of open service innovation has conceptualised this as the reverse innovation pyramid. Rather than innovation being something that is done for a user, the user participates in the innovation process as well as profiting from its outcome.
7. **The role of platforms:** traditional value chains are expanding, and new players are entering the scene, including B2C and B2B platforms that have increasingly revolutionised traditional industries, starting in media industries and trade, and quickly followed by others, such as transportation, housing, innovation, health care, etc. The sheer scale of some of these platforms, especially in the B2B-area, has created a momentum that is completely changing the market dynamics, through penetration and concentration of traditionally separated market segments. New types of partnerships and eco-systems are forming, and new dynamics between users, businesses, platforms and innovators are developing. Some of these new dynamics are disruptive, some may discourage innovation and competition, others may provide a rich potential for a much richer eco-system potential.
8. Finally, we observe that in many economic domains **ICT developments** technically **lower the boundaries** to enter a market – the digital (energy, agri-culture, manufacturing ...) company that rocks the boat of the established order. This offers also opportunities for these established players. ICT developments further integrate value chains that spread across Europe and the world. Therefore, current fragmentation on legal, IPR protection, venture

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<sup>3</sup> See the Online Manifesto that has been published for DG Connect by a group of experts, headed by Luciano Floridi: <https://ec.europa.eu/digital-single-market/en/onlife-manifesto>

capital and public support for innovation frustrates a fast scaling up of European SMEs, necessitating Europe's need for a *digital single market (DSM)*.

### Game changers – tipping points as the onset for transformation

A number of scholars have worked on the timing of innovations, or better, how can the right timing turn an ordinary opportunity into an onset for transformation, a radical innovation. Examples are Joseph L. Bower and Clayton M. Christensen (*Disruptive technologies: catching the wave*, 1995) and Marcie J. Tyre and Wanda J. Orlikowski (*Windows of opportunity: Temporal patterns of technological adaptation in organizations*, 1994). The cross-cutting developments mentioned in the previous section have all their own rate of change. When the timing is right, and a combination of developments crosses a certain threshold, or tipping point, transformation can start. Can we identify a number of combinations that have the potential of 'game changer'?

### Hyper-scalability

Digitisation changes the industry dynamics, especially in terms of how businesses scale (= positive marginal return with respect to resources). New "hyper-scalable" businesses based on digital services and digital products have emerged, where the marginal return increases according to Metcalfe's law. Initial examples are from gaming and entertainment, but with IoT making the real world susceptible to digital tools and ways, the new industry dynamics will eventually find its way to realm of traditional businesses and whole society.

While technology is an important enabler, the really disruptive effect results from the hyper-scalability effect of "data" applications – where adoption by user communities (being these individual users, business users or even larger communities – e.g. industrial applications) is the determining factor for success. While the current Internet already has made inroads into the lives of citizens and also that of businesses and organisations, this penetration will increase in scope and depth due to IoT. Not only will new application fields be opened up, but also the penetration of processes, environments and actions by ICT will increase. The range of "things" that will be sensed, tracked, and manipulated through IoT will truly be overwhelming. It will span from microscopic and even sub-microscopic entities (bacteria, nanobots, etc.) to macroscopic objects. The digital shadows, the data, of these "things turned into devices", will be – like real shadows - quite different compared to its original, and might be manipulated depending on the context. For instance, while for a shipping company whole containers usually constitute the finest scale of granularity and thus "things", the individual pieces of products in such a container constitute "things" for the receiving retailer and also the end-customer. This entire container with contents will be creating and receiving data and possibilities for applications which we have not even imagined at this moment.

### IoT-based transformation of industries

Over the past two decades, European companies, in particular SMEs in traditional engineering and production sectors have attempted – sometimes with great success – to adapt their business models and human resources to the new requirements of embedded software and modern IT-based engineering tools. This process which is far from finished everywhere in Europe, is now overlaid with the advent of the Internet of Things, where the sensing, actuation, and standardised Internet communication – what some call the fourth industrial revolution ("Industry 4.0", or Smart Industry) - again completely changes the opportunities and threats for all these companies, users and society irrespective of their size. Opportunities include optimisation across individual devices and

enterprises, traceability of products, remote maintenance, etc. as well as new Internet-based product-accompanying services and thus broadened business opportunities and value-added services for consumers. Threats include additional network-based security risks for company IP; new forms of market power based on data rather than assets; abuse of that power; and market entry of large scale monopolistic players who enter industrial domains such as fashion, home automation or automotive from the Internet side. It will be crucial for European competitiveness and industrial future to strengthen the innovativeness and companies of not just the “pure” ICT industries but also software- and network-intensive “user industries” especially at the SME level for this step.

### Market Adoption Readiness Levels

There is a major distinction between ICT applications which can drive the EU economy quickly and competitively in the global market, and the traditional techno-centric discourse which largely relies on the concept of Technology Readiness Levels (TRLs). The TRL model is driven by the degree of maturity requested from technology and is particularly suited to its original context, as developed by NASA in the 1980s. The NASA model typically deals with high-risk technologies, carries high development costs, is aimed at few end users, and yields important user data only after final deployment.

Applications which are quick and competitive economic drivers require development which considers adequate business models, user engagement, and societal aspects. This implies that new models are needed as guidelines particularly for EU Innovation Actions. One of the proposed models<sup>4</sup> is the "Market Adoption Readiness Levels" (MARLs). In addition to the technology readiness levels parameter, this model requires the assessment of *three* further value parameters: users (numbers of potential early adopters and values associated with feedback loops), data (potential quantity and value of data generated by the system and user interactions at each stage of the process) and the level of risk (assessment of benefits or adverse impacts of the technology on early adopters in various stages of the process). This MARLs model is strongly motivated by the disruptive nature of IoT, but is used more widely.

For example, creative applications are extremely low on risk, cheap to run, easy to understand and can get millions of early adopters, even as experimental proofs-of-concept (examples from the music industry include Spotify and SoundCloud). 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 (traditionally classified as TRL3 to TRL7). In the creative applications sector therefore, the market is extremely agile, with development of applications being cheap and typically low risk, and great potential of investment and acquisitions through clearly demonstrable social and economic benefits in early stages.

### Individual and societal adoption – the need for (cyber) security and trust

This game changer could have been described as a trend as well, or as a critical requirement. However, seen as an opportunity, the business that gets this right will transform competition<sup>5</sup>.

Over the last couple of decades, ICT has spread tremendously. ICT is used in all areas of society, from the public sector and private enterprises, and far into the personal or even intimate sphere. This massive individual and societal adoption of ICT has changed the game for ICT research and

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<sup>4</sup> See for a more in-depth discussion of innovation models in a digital era the CAF short paper on Innovation.

<sup>5</sup> See also the separate CAF short paper on Cyber Security.

innovation and requires approaches that are much more user driven and sensitive to user's demands and concerns. In developing and providing ICT services and applications, we can to a large extent presuppose that users, in terms of public and private organisations as well as individuals, are already ICT literate and willing to embrace services that answer their needs or desires. At the same time, an increasingly important factor for technology take-up is the users' trust in the service or application as well as the broader institutional and societal context (e.g. trust in institutions such as companies, governments, regulators, but also laws and guaranteed freedoms). If devices and services do not sufficiently respect the autonomy, dignity and privacy of the users, or the security and efficiency of the organisation, the technology might fail. Devices and services have to fit in with specific contexts of use, and affordances and values that are important to users in these contexts, and society more broadly.

Another factor that may inhibit broad acceptance of ICT devices and related service is their resilience. Dependability of devices and related services is crucial but hard to achieve due to the increased complexity of ICT systems involving a myriad of devices and IT services build on top of them. In this way, Europe, because of its size, diversity and cultural richness, could benefit of a powerful and diverse early adoption of many of the innovations developed within the H2020 program.

#### (Digital) platforms manifesting the power of the crowd

The last game changer is related to the first mentioned in this section, namely hyper-scalability. Because of its specific mechanism it deserves an entry on its own<sup>6</sup>.

Enterprises that leverage the power of platform business models have grown dramatically in size and scale over the past decade<sup>7</sup>. No longer the sole domain of social media, travel, books or music, platform business models have made inroads into transportation, banking and even healthcare and energy. Platforms are now active in North America, Europe, Asia, Africa and Latin America. Some platforms are household names such as Amazon, Apple, Google and Alibaba. Others have emerged more recently or hail from parts of the world that get less attention such as Rakuten (Japan), Delivery Hero (Germany), Naspers (South Africa), Flipkart (India) or Javago (Nigeria). Platform ecosystems are gaining ground through the digitalization of products, services and businesses processes and in the process are reshaping the global landscape.

Platform companies can disrupt traditional businesses but also contribute important economic benefits. They have been significant drivers of productivity, which has been achieved in a number of different ways. One source of productivity has been achieved through highly efficient matchmaking. E-commerce marketplaces like eBay provide one example. Professional networks like LinkedIn provide another. Platforms have also driven productivity by supporting more efficient asset utilisation. The ability of platforms to better utilise houses, cars, workspaces among other assets, has spawned considerable interest and passion around the potential of the so-called "sharing economy."<sup>8</sup>

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<sup>6</sup> See also the separate CAF short paper on Platforms.

<sup>7</sup> Some of this text is adapted from "The Rise of the Platform Enterprise", Peter Evans and Annabelle Gawer, CGE paper series No.1 2016.

<sup>8</sup> "The rise of the sharing economy: On the Internet, everything is for hire," *The Economist*, March 9, 2013.

## Recommendations

Let us recap the primary goal of this advice. The CAF has chosen to focus its advice on the strategy to effectively reinforce the use of ICT in the various Societal Challenges, thereby touching on the themes of digitization, international cooperation, resilience to crises and market creating innovations. With four short papers on Innovation, Platforms, Cyber Security, and Digital Infrastructure, and a report on Cyber Physical Systems that was endorsed, CAF has five cornerstones at its disposal that deepen key trends and game changers in society and economy.

In its 'Beyond 2015' paper, CAF identified priorities within the existing LEIT research areas, thereby stressing the development of an additional 'software'-program line which spans all ICT recommendations:

- Software for advanced computing systems
- Software for Cyber Physical Systems
- Secure Software Engineering
- Software Development Paradigms for Big Data Management

The recommendations in this paper re-iterate the advice, based on new reflections on the results of the H2020 program.

## STIMULATING THE INNOVATION ECO-SYSTEM

### **Realising**

- a. that technology transfer to SMEs and engagement with users happens especially at a local scale,
- b. that digitisation enables business to test the market and reach out to users in an early stage, and
- c. that access to finance is a life-line for scale-ups,

For the Programme 2016-2017, **the CAF advised DG CONNECT to**

1. create (e.g. with a specific call) Competence Centres – using legal forms like ERICs – and one-stop-shops for developments within the various key areas, notably IoT and big data, for an SME to find the technology, the development processes, and test beds, and harmonize this effort with existing instruments such as Coordination Actions, Support Actions, Marie Curie Training, and give focus to each of these instruments.

These Competence Centres were also to play a role in connecting SMEs with other key partners in the innovation ecosystem, in particular large companies as engines to bringing products and technologies to the market. Thus, these Competence Centres were intended to disseminate the knowledge of IoT / big data application creation processes by organising workshops, seminars, master classes, and by making use of existing infrastructure at hot spots. As part of DEI, this advice is currently reflected in the support for Digital Innovation Hubs, which include discussions of best practice with several successful examples of such centres.

**In addition, CAF advises DG CONNECT to**

2. effectively deploy innovation within Europe based on the principles of Open Innovation. In particular, CAF recommends the creation of MARLs - Market Adoption Readiness Levels - to enable fast deployment of innovation to Early Adopters for a maximum impact on European economy. Current guidelines focus only on TRLs - Technology Readiness Levels. New guidelines amplify TRLs with guidelines that assess risk, data yield and Early Adoption.

3. better utilise creative drivers for the seeding of innovation. Creative drivers of innovation address societal challenges through problem-solving, discovery, experimentation and play. They range from individual to group creativity with a balance of constraints and freedoms between them. Goal-oriented creative drivers benefit from a greater focus and rapid development due to tight deadlines. Open-ended experimentation facilitates unexpected discoveries and disruptive innovation. In particular, it is recommended that any innovation policy which wishes to harness creative drivers has distinct funding streams for both goal-oriented and open-ended experimentation.

4. create dedicated EU innovation funding mechanisms. CAF recommends to leverage the impact of Innovation Ecosystems by creating a European Innovation Fund (50-100 M€), to stimulate innovation, economic activity and job creation. Rather than create separate instruments, this fund should cover the entire innovation value chain, from research to market.

Key instruments for leveraging the impact of innovation include assessment criteria for evaluating project innovation potential, effective project development checkpoints, update of administrative practices, effective monitoring, tax incentives for investors and start-ups, and a unified strategy through the European Innovation Council<sup>9</sup>. (For further information, please refer to the Innovation Paper.)

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<sup>9</sup> For further information, please refer to the Innovation Paper.

## NETWORK OF PILOTS TO SPEED UP GAME CHANGE

### **Realising**

- a. that integral development of technology, business models, legislation and societal impact is of key importance to 'change the game',*
- b. that commercial take-up and broad (industrial) support of results of PPPs is a crucial factor for success,*
- c. that a drastic improvement in engineering efficiency is required as current state-of-the-art tools are not sufficient enough to master the increasing complexity of hyper-scalable and hyper-connected systems, and*
- d. that the gap (in terms of time and complexity) between engineering and business is still too big, this counts as well for large corporations. New concepts/business models are required for complex products in large scale (> 100 M€).*

*For the Programme 2016-2017, the CAF advised DG CONNECT to*

- 1. create a Network of Pilots – with Spearhead Projects (vertical applications) and Competence Centres (horizontal dissemination)*
- 2. define for each of the societal challenges of H2020 a ground-breaking project and bring a number of key players together from the business point of view, the technological point of view, the legal and ethical point of view, the user group and the societal groups involved. The target is to define projects to be developed in the next 2-5 years with a very clear but challenging target.*

*In addition, CAF advises DG CONNECT to*

- 3. improve the actual take-up and support of the results of the PPPs; apply directly 'market creating innovation-schemes', both existing and newly developed; define within the PPPs a clear plan how to quickly broaden the commercial support and user-take-up, using the lessons learned from the platforms short paper; improve the PPP instrument to give more room for (small scale-up) challengers. CAF recommends connecting the complete value chain from research to market within EU Innovation Ecosystems such as PPPs. In particular, CAF recommends support to Innovation Ecosystems with well-developed and established research, commercial and investment networks, so that each market Proof-of-Concept can be linked to commercial partners and investors already at early stages and avoid roadblocks of transfer of product to market.*

*Current involvement of SMEs in FI PPP is to be applauded, even if only at late stages, however it is recommended that SMEs are acknowledged as the driving force of Innovation Ecosystems. Methodologies to support Innovation Ecosystems include creation of interfaces from research results (APIs, GUIs and TUIs), Creative, Industry and Market Pilots, introduction of Innovation IP, Blockchain technologies and EU Innovation Ecosystem Certification<sup>9</sup>.*

## HUMAN CENTRED RESEARCH AND TECHNOLOGY

### **Realising**

- a. that societal, cultural and ethical factors play a key role in the successful design and take-up of products and services, and
- b. that research methodologies and practices in social sciences and humanities often differ considerably from those in technical studies

For the Programme 2016-2017, **the CAF advised DG CONNECT to**

1. create within the IoT and big data area and the application domains for these two research areas, such as Smart Industry / Industry 4.0 specific sub-calls that highlight participatory design and take into account the societal and cultural impact of various design choices and the conceptual, legal and ethical frameworks that may inform these design choices;
2. create specific support actions based on the intermediate results from research programs and PPPs, that address the social, legal, cultural and ethical factors (including gender) of the technological developments; these CSA / SSAs should constitute a mix of scholars from the social sciences and humanities (SSH), economists and technology experts from the running program;

**In addition, CAF advises DG CONNECT to**

3. stimulate capacity-building thereby focusing on symbiosis on SSH and technical sciences. In particular, the CAF recommends for that purpose to start sister projects (e.g. using the SSA-instrument) in selected areas where integration in one project will not bring the necessary reflections. This can typically be in areas where radical change requires in-depth reflections of opportunities, uncertainties, challenges and risks. The results of these sister projects should be used to update the course of e.g. the cPPPs.
4. stimulate the involvement of users from the beginning of the project and through all phases to the final product. This may be obtained through various methods for user-driven innovation, user-involvement, and participatory design. There are several disciplines within humanities and social sciences that may contribute to this, including anthropology, sociology, psychology, information science, philosophy of technology and ethics, law, media science, gender studies, etc. Furthermore the experiences until now with RRI (Responsible Research and Innovation) should be taken a step further in order to fully 'mainstream' RRI and SSH in the ICT-related parts of H2020; not merely as separate programs or actions, but as a key element of all ICT-research, and a serious engagement of applicants, evaluators and project officers.<sup>10</sup>

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<sup>10</sup>See: <https://ec.europa.eu/digital-single-market/en/responsible-research-and-innovation-ict-related-parts-h2020>

## PEOPLE, TECHNOLOGY, BUSINESS – TRANSDISCIPLINARITY AS THE WAY FORWARD TO FOSTER EUROPEAN LEADERSHIP AS WELL AS MEETING SOCIETAL CHALLENGES

### **Realising**

*that the innovation processes are not the sole result of a technology push, but more the symbiosis of “technology”, “people”, and “business”*

### **the CAF advises DG CONNECT to**

- 1. Demand that projects are designed with a transdisciplinary approach so to adequately explore and consider the dimensions people, technology and business, from the outset*
- 2. bring in a user and societal perspective: both from an entrepreneurial as well as a scientific point of view – by including advisors, mentoring or adding support projects to existing programs; taking in full account the age and gender differences of the users;*
- 3. lead the way in demonstrating inter-connectedness by moving forward with inter-directorate projects.*

## USE RESEARCHERS' EFFORTS EFFECTIVELY

### **Realising**

*that many researchers in member states have to rely on EU-funding for their research*

*For the Programme 2016-2017, **the CAF advised DG CONNECT to***

- 1. aim for reducing the high oversubscription rate, wasting a lot of time and effort of European researchers. Make statistics of previous calls publicly available (especially acceptance rates) and give estimates of work effort required for preparing a proposal so that potential proposers can make informed decisions about their potential risks and benefits. Introduce it on websites and information days and other events for informing and attracting proposers.*
- 2. create a scheme allowing researchers to use their time and efforts most effectively in preparing European projects, e.g. through fast forward 2-stage procedures, etc. Aim for wider adoption of 2-stage procedures.*
- 3. introduce also focused narrow call themes, and integrate results on program rather than project level.*
- 4. keep focus on timely processing and efficient management of Innovation Actions, and the adoption of faster, more effective short-term initiatives, as exemplified by projects such as FIWARE Accelerator and CreatiFI, which deploy smaller sums of funding for initial experiments in more "agile funding" arrangements.*

## HUMAN CAPITAL

### **Realising**

*the need for European Human Capital as the critical success factor for the H2020 program, while strongly contributing to the employment growth and employability especially amongst those groups of population more severely touched by high unemployment*

#### **the CAF advises DG CONNECT to**

*1. strongly promote the “Science” vocations at earlier stages of education (primary and secondary schools, professional and university education) through specific educational programs and practical workshops together with scientific institutions and industry.*

*In particular, CAF is endorsing the proposals as put forward in many countries to integrate Computer Science, programming, etc. in elementary schools in order to give all people a basic understanding of ICT.*

*2. boost the societal relevance and valuation of the ICT scientific and technological studies and employment, promoting its relevance across disciplines as the core value for helping European re-industrialisation.*

*In particular, CAF recommends the development of an EU Ethical Framework, based on the principle of non-maleficence, function creep/non-dual use, transparency, the power of the individual, and privacy. The framework will evolve as societal changes and technology continue to develop.*

*3. develop the right ICT skills (eSkills) in a transdisciplinary manner in order to develop a qualified ICT workforce which can contribute support to industrial leadership, excellence in science and developing of European solutions addressing new societal challenges.*

*4. advocate the efficient promotion of ICT entrepreneurship among the different cultures and values of European countries as the more valuable asset for achieving H2020 goals. Relevant promotion through European ICT Innovation and Entrepreneur Awards could be of paramount importance and traction.*

*5. reinforce, promote and reward ICT students, researchers and professionals movements among European countries as it would create the right structure for a powerful human capital but would facilitate and promote the earliest adoption of European research and innovation.*

*6. give the gender aspect special attention in order to attract women to become more active in ICT and make better use of this pool of talents, considering that this group of population remains under-represented in ICT workforce, researchers and entrepreneurs.*

## INTERNATIONAL COOPERATION

### **Realising**

*that ICT is by nature global and ICT products and services address the needs of a global market where EU players must retain their competitive edge and innovation drive,*

#### **the CAF advised DG CONNECT to**

*1. pursue and further develop the international dimension of ICT in Horizon 2020 along the lines of the current work program by*

- partnering with countries that are recognised as major technological players for the next generation of products and services especially in areas such as networks and communications*
- exploring the opportunities for mutually beneficial joint arrangements with emerging economies which offer opportunities to promote the adoption of European technological platforms and develop new markets*
- give also consideration to developing countries (Africa, ASEAN) which constitute the markets of the future but also offer unsuspected opportunities to redefine the use of ICT in a context of frugal resources, hence driving innovation*

*2. in a context of limited resources international activities should focus on those topics and countries that present the best opportunities for impactful outcomes. The following list illustrates activities which are perceived as able to deliver high potential impact:*

- the global reach of developments in topics such as 5G, Future Internet, Internet of Things, cloud computing suggests joint activities in these topics with leading countries and areas of good potential,*
- enlarge the geographic targeting of current ICT activities of H2020 (Japan, Brazil) to a few more countries (e.g. Korea, Mexico) either on a country or on a regional basis (e.g. Latin America)*
- in developing countries (Africa and possibly ASEAN) support the co-development of ICT applications in areas with strong potential for high socio-economic impact (e.g. education and literacy, health, energy, mobility, entrepreneurship)*

## Annex I – Composition of the CONNECT Advisory Forum

The current members of the CAF for the two-year mandate of 2015-2017 are:

- **Ms. Elisabetta Addis (IT)**, Professor of Economy at University of Sassari, expert in Gender Studies
- **Mr. Konrad Banaszek (PL)**, Professor at University of Warsaw – Faculty of Physics
- **Mr. Thomas Bauernhansl (DE)**, Professor at Univ. Stuttgart and Fraunhofer-IPA
- **Mr. Klaus Beetz (DE)**, Vice-President for Innovation and Cooperation from Siemens AG
- **Mr. Jean Luc Beylat (FR)**, President Nokia Bell Labs France
- **Mr. Martin Curley (IE)**, Professor of Innovation, at the Innovation Value Institute, Maynooth University
- **Mr. Nicolas Demassieux (FR)**, Vice President of Orange Labs
- **Mr. Wim de Waele (BE)**, Chief Executive Officer at Eggsplore
- **Mr. Erik Fledderus (NL)**, CEO at SURF, professor of Wireless Technology at Eindhoven University of Technology
- **Ms. Valerie Frissen (NL)**, CEO at SIDNfonds, professor of ICT & Social Change at Erasmus University Rotterdam
- **Ms. Annabelle Gawer (FR)**, Professor of Digital Economy, University of Surrey
- **Ms. Felicita di Giandomenico (IT)**, Senior researcher at CNR / Head of the Software Engineering and Dependable Computing Lab
- **Mr. John Goodacre (UK)**, Director of Technology and Systems at ARM and Professor at Advanced Processor Technologies Group of the School of Computer Science of University of Manchester
- **Ms. Natali Helberger (DE/NL)**, Professor at the Institute for Information Law of the University of Amsterdam
- **Ms. Sabine Herlitschka (AT/DE)**, Chief Executive Officer of Infineon Technologies Austria
- **Mr. Matthias Jarke (DE)**, Chairman of Fraunhofer ICT Group and Executive Director of Fraunhofer FIT Institute for Applied Information Technology
- **Mr. Lucas Kello (EE)**, Senior Lecturer in International Relations and Director of the Cyber Studies Programme at the University of Oxford
- **Ms. Ariane Koek (UK)**, Artistic Director & Cultural Entrepreneur
- **Mr. Tatu Koljonen (FI)**, Director at EIT Digital Finland
- **Ms. Stefanie Lindstaedt (AT)**, Director of the Knowledge Technologies Institute at the Technical University of Graz
- **Mr. Ole Lehrmann Madsen (DK)**, CEO of the Alexandra Institute and professor at Aarhus University
- **Ms. Michela Magas (SE/HR/UK)**, Director, Stromatolite Innovation Lab and Co-Chair, Innovation Ecosystems, European Alliance of Internet of Things Innovation (AIOTI)
- **Ms. Diana Mangalagiu (RO/FR)**, Associate Professor at the Smith School of Enterprise and Environment at the University of Oxford and Professor at Sciences-Po
- **Mr. Javier Marti (ES)**, CEO / Director at DAS Photonics
- **Mr. Geoff Pegman (UK)**, Managing Director of RURobots Ltd
- **Ms. Tanja Storsul (NO)**, Director of Institute for Social Research, Oslo
- **Ms. Karen Wilson (US)**, Senior Fellow at Bruegel