Information and Communication Technologies (ICT) in Horizon 2020

Recommendations of the CONNECT Advisory Forum (CAF) for ICT in work-programmes 2014-15 of Horizon 2020

July 2013

Executive Summary

This document summarises the findings and recommendations of the three working groups put in place by the CONNECT Advisory Forum to comment on the orientations for the ICT work-programmes in Horizon 2020.

The mandate and the composition of the CAF are given in annex. The group met several times in plenary configuration and in working groups over the period February to June 2013.

The attention of the CAF was primarily focused in the **ICT** theme under the **industrial leadership** in enabling technologies (LEIT-ICT) priority of Horizon 2020 and also the contribution of ICT to the 7 **societal challenges** that are part of the final version of Horizon 2020. In addition the CAF decided to discuss the role of "**innovation**" as a central and cross cutting dimension of Horizon 2020.

The **Industrial Leadership in ICT** working group (LEIT WG) proposes to orient activities towards the achievement of a few concrete flagship developments (Airbus-like examples). A reinforcement of innovation-oriented activities that take account of market demand is considered to be fundamental to achieve this goal. They suggest that a more in-depth understanding of value-chains of the various ICT sectors should be developed and that funded proposals should lead to critical mass and economies of scale using the most suitable instruments.

It is suggested that attention is also devoted to the legal, financial and other conditions for H2020 actions addressing not only participation rules but also greater emphasis on exploitation of results (IPR, venture capital, etc.).

The position paper from the **ICT and Societal Challenges** working group (SC WG) underlines that societal challenges should be drivers for ground breaking ICT research and innovation. The importance of user/people orientation, inclusion and trust is highlighted. It is proposed that multi-disciplinarity be a fundamental feature of research and innovation activities that address societal challenges. They recommend the development of activities that, given their horizontal nature, should cut across several societal challenges.

The working group on **ICT Innovation** (Innovation WG) pleads for a renewed understanding of innovation that goes beyond the traditional "waterfall" model and addresses more elaborate paradigms (Open and Disruptive Innovation, Social Innovation...) with a greater involvement of user communities. However it underlines the need for simple and flexible instruments that respond to the needs of smaller players in order to achieve success. In order to adequately assess innovation potential, the criteria to be applied should be made very clear to proposers and evaluators in the work programme. The importance of the legal framework supporting innovation is also highlighted.

A number of **cross-cutting issues** emerged from the position papers – they concern not only technological aspects such as security, Internet of Things, embedded systems but also methodological aspects such as user engagement and digital social sciences/humanities, financial/legal issues and concerns with

programme implementation (evaluation procedures, grant agreement management).

A number of **common issues** were **addressed** by each of the **three position papers** which means that there is some degree of overlap. But this is also an expression of the salience of some these issues. Among these the emphasis placed in the framework conditions (legal aspects, IPR, access to finance, flexibility in the design of the funding schemes and projects) deserves special reference as it would facilitate a wider participation in Horizon 2020, bringing in new players - not only individual participants but also the eco-systems where larger and smaller organisations work together. Another salient point is the need to include activities that promote and support the take-up and adoption of project results including not only test-beds, demonstrations and pilot lines but also the support of entrepreneurial ventures exploring the results of EU-funded projects in ICT. Another point strongly noted, especially in the innovation and societal challenges groups was the importance of combining expertise not only across ICT topics but also in the sectors addressed by societal challenges, including social sciences and humanities. This is seen as essential to develop a better understanding of the human and societal dimension of technological development.

Horizon 2020 - **Industrial Leadership in ICT**

Recommendations of the CONNECT Advisory Forum (CAF)

The CAF working group on industrial leadership in ICT analysed and discussed DG CONNECT orientations for the work-programme 2014-15 of ICT challenges under "Leadership in Enabling Industrial Technologies" of Horizon 2020.

From this analysis it became clear that these orientations build on a solid and well established set of assumptions about the future of development of the sector across the ICT sectors addressed by the following six challenges:

1) Components and Systems

2) Next generation computing

3) Future Internet, network infrastructures and cloud computing

4) Digital content

5) Robotics

6) Micro and nano-electronics, Photonics

The evidence supporting the overall orientations would nonetheless gain in establishing more clearly the strategic goals to be attained across these ICT challenges and how they could be attained. The following set of recommendations is an attempt to respond to this question. It will be complemented with a background document commenting on specific aspects of the approach proposed for the individual ICT challenges listed above.

Recommendation 1
Develop and strengthen EU industrial leadership in ICT resulting in a flagship achievement by 2020

It is clear that ICT plays a central role as one of the enabling technologies needed to sustain European competitiveness in the 21st century. However, we lack more compelling demonstrations of this centrality and how ICT effectively drives the development of European industrial capability – something that was achieved with European success stories like GSM or the Airbus. It should be possible that by 2020 such flagship example emerges as an important outcome of ICT research and innovation in Horizon 2020.

Recommendation 2
Shifting investment from predominantly research projects towards innovation-related activities (at least ... % by 2015) with a strong user involvement

The perception amongst several EU actors of the ICT industry is that the main focus of financial resources available at European level, especially trough the EU programmes is focused on research driven activities. Even if it is difficult to make an accurate comparison given the limits of current definitions of "research" and "innovation" EU competitors such as US and China in their R&D policies are increasingly favouring nearer to the market activities. Another reason for this approach is the realisation that development cycles of new technologies are increasingly shorter.

Innovation in this context must be understood its broadest sense – i.e. activities that go beyond the strict definition of technological innovation and include also new business models that may result from the ability of ICT to reengineer business processes, do not limit to well established business cases and address also the use of ICT to meet social needs of all kinds – education, community development, citizens engagement - and strengthen civil society.

The desired evolution towards higher levels of technology readiness means that increased attention should be placed in exploring all the mechanisms to strengthen the involvement of users and address important issues such as technological and organisational scalability, industrial and market feasibility. This translates into an extensive use across all the ICT challenges of instruments supporting not only prototyping but also large scale test-beds, pilot installations and pilot lines. Previous experiments with "living labs" and subsequent developments with Future Internet use-cases should be used as a point of departure for more elaborated user-oriented projects (e.g. research farm).

Recommendation 3
Strengthen the role of European actors / industry in the relevant value chains and support the development of business eco-systems

A typical problem exhibited by Europe is the difficulty in sustaining a significant presence of EU-based actors in those sectors of the ICT industry that present the largest potential for growth. This presence is not only limited in quantitative terms but also qualitatively when analysing the whole value chain, ranging from the more research-oriented activities to the development and delivery / manufacturing of advanced services and products of high economic value.

The analysis of the most successful examples of innovative and highly competitive industrial sectors has shown that business eco-systems play an important catalyst role in the creation and development of these value chains. More concretely the geographic co-location of a critical mass of interconnected companies (e.g. large, established SMEs, start-ups) and other institutions (universities, public research) results in almost decisive competitive advantages in terms of economies of scale, easier access to information and proximity between suppliers and customers leading to reduced transaction costs.

The role of industry in the programme design and implementation should be further reinforced. This may take several forms: providing tools allowing for a more systematic involvement of relevant industry actors in the identification of

relevant research and innovation objectives, establishing mechanisms allowing to delegate some implementation aspects (building on the example of JTIs), having as natural corollary an increase of industrial participation in the programme above the levels of FP7-ICT.

> ## Recommendation 4
> ### Focus on the existing / emerging ICT clusters better positioned for successful development and growth favouring critical mass and economies of scale

Despite the value of the classical Porter analysis of industrial clusters, more recent developments[1] have shown a further development of this concept with the emergence of the clusters of innovation. The successful examples of these clusters build on the ability to combine the competitive advantages presented above with a high degree of mobility of the human capital and inherent tacit knowledge networks, an agile and flexible approach to the entrepreneurial process including aspects such as technology commercialisation, business model experimentation and market development. The constituency of these clusters also exhibit an inherently global perspective, exploring various possibilities of collaboration between suppliers and customers but also among emerging competitors across the world to gain critical mass around formal or informal standards and customer solutions.

Europe disposes of a stock of knowledge and industrial capabilities in a number of ICT sectors such as telecommunications, industrial robotics, integration of systems, mechatronics, micro-electronics. For these sectors as well as for emerging domains such as big data and creativity it is essential to build on the existing capabilities to develop EU's longer term competitiveness. Promoting a more efficient use of resources (capital, knowledge, skilled workforce) and build on the lessons learned from successful ventures is a condition to maximise the impact of investments in these sectors.

Clusters of clusters could be a solution whereby local clusters of companies and research organizations drive local projects in a decentralized way. Innovation should be targeted locally, research on a higher level. The EC should facilitate the interaction between research organizations and facilitate connections between local innovation clusters. This approach could be integrated with regional funding. As there are start-up incubators in every country, EC should aim at bringing them at the EU scale, e.g. by giving them more fire-power, or by publishing calls targeting incubators, or by granting them access to research results. This also provides a link to the web entrepreneur part of the research challenges that can provide instruments to support these clusters.

> ## Recommendation 5
> ### "Industrial leadership in ICT" must adopt and adapt the mix of implementation instruments that are best suited to deliver its goals

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[1] See Engel, J; Palacio, I – "Global Networks of Clusters of Innovation – accelerating the innovation process" Business Horizons, 2009

The goals pursued by industrial leadership in ICT can only be achieved if the implementation framework is capable of delivering a certain number of essential features. These include notably the following:

- lowering the upfront barriers to participation especially for non-traditional players;

- explore to the extent it is possible the opportunities for delegation in the implementation of the programme;

- favour a greater flexibility in the formulation of the objectives and promote a culture of responsible self-management in the implementation of the projects with emphasis on outcomes and impact;

- better reflect in the design of the processes for evaluation and review of projects the concepts of "risk" and "reward" and enlarge the actual recruitment base of experts involved;

- impact (business rational, exploitation path, sustainability) should be not only the decisive factor for ranking proposals with a similar score but an aspect shaping the whole evaluation process;

- improve the balance between specificity and openness in the design of the work-programme awarding more space to open topics and different degrees of granularity in the definition of objectives (e.g. translation tools. vs. big data)

- further develop an effective use of public procurement[2] exploiting its potential to act as a catalyst in the development and deployment of new ICT products and services

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Recommendation 6

An adequately funded Support Action should support entrepreneurial ventures in ICT emerging from EU funded projects (dialogue with sources of private funding, legal issues – IPR, …)

Resources available from Horizon 2020 while non-negligible are not sufficient to address all the funding needs. Developments such as pilot lines represent huge investments requiring the commitment of private funding. In addition to this the renewal of EU's ICT sector must be accompanied by stimulus to entrepreneurship.

Horizon 2020 can play a positive role in mobilising of private sources of funding such as venture capital, crowd-funding and crowd-sourcing, business angels. Previous attempts of putting in place instruments geared to incentivise these actors such as the RSFF were certainly well intentioned but its actual impact

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[2] PCP - pre-commercial procurement and PPI- procurement of innovative solutions

remained limited, given the lack of a clear articulation with programme objectives, lack of a clear strategic drive and an apparent lack of response to the actual needs of the industry actors (large companies and SMEs)

A wider set of approaches should be explored such as crowd-funding, seed money (translated into tax credits), to further stimulate venture capital / entrepreneurial spirit amongst the promoters of proposals and facilitate their dialogue with providers of private funding to ICT research and innovation.

Recommendation 7
Promote a more coordinated view of relevant public policies and associated funding instruments

Horizon 2020 offers an opportunity to influence the development of European wide agenda supporting EU leadership in key ICT domains. However to deliver on these objectives it is essential to develop a more comprehensive view of the challenges faced and how to tackle them.

Among the various issues identified that need attention are the constraints imposed by limits to state-aid and competition rules which were often conceived having in mind primarily EU's internal market and do not pay enough attention to the global nature of ICT markets and the need to support EU actors and allow them to gain scale and overcome the limitations of national / regional markets.

The alignment of procurement rules (especially PCP and PPI) and effective deployment of EU-wide standards are also important instruments to support EU ICT companies in developing the economies of scale needed to strengthen their competitiveness in the global markets.

EU structural and regional funds mobilise significant financial resources and offer opportunities for policy coordination between Member States and at EU level that could be further exploited to promote capacity building in terms of digital infrastructures and innovation initiatives. This is especially useful to support the creation / reinforcement of innovation clusters and human capital as described in recommendations 3 and 4.

Recommendation 8
A deeper understanding of the human and societal dimension of technological development across all the ICT research and innovation activities of Horizon 2020 is needed

The CAF acknowledges the importance of promoting the analysis of the socio-economic and human aspects of the proposed technological developments – i.e how technological research and innovation will address the societal and human impacts - including not only ethical and normative aspects but more broadly the assimilation of technological developments by organisations as well as individual citizens. This needs to take place both, under the scope of the research carried out but also in the form of independent research efforts.

Technology is normative in the sense that it guides human behaviour. Insofar, to be socially acceptable and practically feasible technologies that influence behaviour must also be informed by the normative and ethical rules that determine human conduct and social interaction. Vice versa, legal rules must be

informed by a better understanding of the technological conditions. Privacy by design is one example thereof: it is impossible to include "privacy by design" without defining what privacy is, as privacy is a normative concept. When regulating aspects of privacy, however, it is equally important to understand which legal solutions are technological feasible, and what the role is that technology can have in protecting and advancing privacy.

Across all the ICT challenges and especially when dealing with topics such as robotics, cloud computing, big data, or internet of things there are important societal aspects involving privacy, fundamental rights, ethics. These are elements of an even broader and pressing discussion about the acceptance and acceptability of technology by citizens and its impact in the way people work, interact, socialise that would be good to discuss. However, instead of having this as a totally separate activity we believe that the best approach would be:

- to identify for each challenge what are the pertinent digital SSH issues that need to be addressed in that specific context

- identify which would be the activities that effectively would benefit from a programme-wide analysis

- combine a top down approach – eg development of common methodological frameworks to privacy, ethics, regulation – and a bottom-up view i.e. meta-analysis / consolidation of the work carried out in specific contexts – i.e. ownership of data in cloud computing, privacy in sensor networks

ICT in Societal Challenges of Horizon 2020

Recommendations of the CONNECT Advisory Forum (CAF)

DG CONNECT's document "H2020 Draft Orientation for ICT in Societal Challenges" discusses cross-cutting issues in the societal challenges mostly on a technical level. The CAF would like to **augment** this view with a **functional** perspective on the role of ICT in the various challenges. This functional perspective stresses economical, transformational and social innovation, made possible by ICT. Moreover, by taking this perspective as a starting point, it may serve as a **design principle** for innovations in information and communication technology, i.e. a useful link to LEIT.

There are a certain number of general principles that according to the CAF WG should shape the approach of ICT to the Societal Challenges of Horizon 2020. These principles presented in the current pamphlet will be complemented with a background document describing the role of ICT in each of the Societal Challenges of Horizon 2020.

Principle 1

Societal challenges should drive ground-breaking ICT research and innovation

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Societal challenges are important driving forces for new technological developments. Our claim is that most of the challenges are so-called ill-defined problems, where both the problem and the solution are unknown at the outset of the problem-solving exercise[3]. This is as opposed to "tame" or "well-defined" problems where the problem is clear, and the solution is available through some technical knowledge. H2020 should facilitate ground-breaking developments within and across each of the domains mentioned in the societal challenges, thereby drawing advantage from both the latest insights from information and communication technology research and innovation.

The various functions of ICT need to be emphasised: they are able to *improve* current ways of working [efficiency], they are able to *connect* different domains, enabling *collaboration* [economy of scale and scope], and they can *change* the game [transformation]. Drawing advantage from ICT does not mean 'taking current ICT for granted', but challenge domain specific solutions and domain specific processes and business models using the functions above.

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[3] Beinecke, Richard. "Leadership for Wicked Problems." The Innovation Journal 14.1 (2009): 1-17.

Examples are patient-centric care, the combination of health and food industry to empower prevention of various diseases, FareShare to fight food poverty and food waste, energy efficiency as most sustainable energy resource, intelligent cars and drivers to make cities more reachable and more viable, …

CAF therefore advises that Horizon 2020 enables the societal challenges to become drivers for ground-breaking and sustainable solution-oriented ICT research and innovation.

Principle 2

A people-oriented approach to ICT

Using ICT to meet societal challenges requires an integrated approach that takes three main perspectives into account. The first is the focus on technology and what technological innovations may enable (see above). The second is the focus on society and the societal and institutional frameworks in which technology may be applied. The third, and not the least important is the people-oriented approach.

In order to use ICT to meet societal challenges, ICT must actually be used by real people in their capacity as citizens, clients, customers, patients, professionals, decision-makers etc. Better understandings of the relations between technology, practice and people, on how people approach and use technology viz. ICT, how the use of ICT is situated, and of how people interact with each other and the technology, is important for all the societal challenges.

For example, using ICT to enable smarter tools for energy consumption requires knowledge of how people in different cultural, institutional and private settings use energy and their motivations for changing their patterns of usage. And, implementing new smart information systems in health care may fail unless the new systems are built on knowledge on how different groups of professionals and patients operate in their situated environments.

CAF therefore advises that in all societal challenges, an explicit emphasis on building on knowledge relevant for understanding the situated use of ICTs should be included.

Principle 3

Trust is essential

An important aspect of a people-oriented approach to ICT is to develop a better understanding of *trust*. People's trust in technology viz. ICT services and tools is essential for the degree and way people eventually make use of the technology.

The importance of this is growing as ICTs and information systems have enabled a redefining role of expertise. With information shared in social networks, the

roles of authority has changed. The new circumstances of what affects people's trust and under what conditions people trust services and information systems, authorities, corporations, peers or even crowds is crucial for understanding how ICT can be used for meeting societal challenges.

For example, if people are to use advanced ICTs to promote traffic safety by interacting with the performance of cars, this requires a strong degree of trust by the drivers.[4]

CAF therefore advises that aspects of trust are built into H2020s approach to the societal challenges, and to view trust improvement as a design principle for ICT research.

Principle 4

Users as producers

Enabled by ICTs, we are experiencing a fundamental shift in how services are developed and provided. As users are increasingly contributing to service development, the relations between producers and consumers are shifting. This implies that both business models and service provision is changing in fundamental ways.

For example; in media, user generated content is not only dominating in social media such as Facebook and YouTube, but also in established media outlets that include their readers' and viewers' contributions. In technology development, users are increasingly creating and re-innovating technologies and practices such as software development, 3D printers etc. In the future we may envision new patterns of peer-to-peer care services, energy saving, food monitoring etc.

CAF advises that we need more knowledge of how to build quality into the new systems, how to approach authority in these systems, and how to manage public information from health care services, energy providers, or public institutions.

Principle 5

Integration must meet specialisation

Our modern society has turned efficient because of specialization. By applying proper standardisation and focussing on our core business, our economy is a combination of specialists.

Although efficiency, increased through specialisation, has brought us prosperity, specialisation also challenges the social function in our society. A checkout

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[4] See also Smart Cities EIP and Future Internet PPP.

operator at the supermarket does not feel responsible for the products he is selling. The citizen seeking medical advice meets specialists informing about their area of expertise, not an integrated approach towards the individual. Integration efforts such as smart grids fail because there is hardly any systems-understanding available. The chains have become too long, that is where we have lost the plot. Ultimately it is all to do with the prisoner's dilemma or self-interest[5].

We discussed at (1) the fact that today's societal challenges are ill-defined, wicked problems – they cannot be solved by specialised companies because they will provide a partial solution, based on their only rationality. Therefore, we need a broader systems understanding. We need to integrate and balance the various specialisations. This integrated and balanced view should provide solutions that give real, durable solutions; integrated services will empower citizens to make choices that will fit with their life style, in the short and long run.

CAF advises that integration must meet specialisation in Horizon 2020. ICT enables specialisation, but should also be designed to enable stronger systems-understanding and more integrated approaches in service development and provision. Horizon 2020 should pay more attention to integral value cases when addressing the societal challenges, and avoid specialised business cases.

Principle 6

An inclusive an flexible society

An inclusive society goes beyond providing everyone with the right ICT skills. With a growing level of unemployment, and at the same time a declining group that can perform the necessary work and pay for the social welfare, it's time to rethink the participation of everyone to our society. How can you be of value, how can we find knowledgeable people?

The current descriptions of the societal challenges are technocratic, and an attractive vision of a viable inclusive society is lacking.

ICT increases flexibility and has enabled the outsourcing of e.g. call centres to low-income countries. On the other hand, the quality is under pressure and many people are liked to be helped by someone that relates more easily with them, e.g. a local. The same flexibility can be used to enable just that.

Experts are leaving their jobs because of retirement – how can we capture their know-how, how can we use it more widely, can this be the basis of peer-to-peer education? Citizens can share their stories on the city, consumers can share their opinion about services and products [social sensors], to provide trust to new users.

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[5] Baken, Nico. "Synergy between sectors, preparing a new value case", in Smart City Dynamics (editor: Heidi van Beurden), pp. 38-44, 2011

CAF advises to reposition the user not only as a passive consumer but as an active participant in various solutions to societal challenges.

Principle 7

Multidisciplinarity and ICT

ICT is ubiquitous in culture and society. Using ICT to meet the societal challenges involves complex questions. We need to develop insights not only of individual situations, but also of more systemic understandings. This requires different perspectives and knowledge from several disciplines.

For example, research on advanced technologies and systems must be combined with research on institutions and organisations; regulation and policy; communication and mediation; interaction in the working place and in the home; anthropology and ethics etc etc.

It is highly important that H2020 takes the need for multidisciplinary into account. The societal challenges and the knowledge needed to meet the challenges should guide future calls, not disciplinary borders.

Principle 8

Cross sector challenges require cross-cutting approaches

The issues highlighted in this document are cross-sectorial. They are not related to any one specific societal challenge in H2020, but represent important advice on how to approach ICT across the societal challenges and thereby across sectors.

This also implies that technology and knowledge developed under one of the societal challenges may be important in other societal challenges or other sectors.

For example, information systems developed for enabling interoperation of traffic monitoring systems may be used for energy monitoring. Telepresence technologies for learning can be used for elderly care. Open platforms solutions may involve SMEs and third parties in multipurpose knowledge repositories.

CAF therefore advise that some calls for proposals are developed across the societal challenges. Further, instruments should be developed so that technologies and solutions developed to meet one of the societal challenges may be reused in other domains.

Principle 9

ICT in Horizon 2020 – beyond Societal Challenges

The societal challenges put forward by H2020 require ICT research within a number of areas. This has to be coordinated with ICT research in Excellence of Science as well as the development of ICT technology within Industrial Leadership.

CAF advises that the following areas are given particular attention given their importance for cross sector challenges:

- The need to deal with a multitude of platforms, operating systems, browsers and associated application ecosystem. This is challenging for both users and producers of services. An integrated approach to interoperability between different platforms and systems will increase efficiency (economies of scale) and market adoption (critical mass effect).

- Interaction and interaction design. Human interaction is central for the adaption and use of new ICT-based applications, new devices, etc. This is especially important in order to support elderly, handicapped and/or sick people and people that are not familiar with ICT-based technology. Research within gesture-based interaction, augmented reality, voice-base interaction, etc. are examples of relevant subjects.

- Coordination, communication and telepresence. Technology for coordination and communication between people. This includes improved technology for telepresence that goes beyond todays video conferencing systems

- Digital security – already highlighted in the Orientations paper

- Internet-of-things – already highlighted in the Orientations paper

- Embedded systems – already highlighted in the Orientations paper

ICT Innovation in Horizon 2020

Recommendations of the CONNECT Advisory Forum (CAF)

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<u>Recommendation 1</u>

H2020 must build on an updated understanding of innovation

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FP7 was known for getting relevance to research from industrial actors. We need to find the new concepts defining H2020, in order to maintain intellectual and industrial leadership. What characterizes innovation in the 2000s, and particularly the ICT sector, is that innovation is increasingly open and takes place in flexible ecosystems of both industrial and social actors.

The observation that innovation is increasingly open refers to the development where innovation is no longer happening in in-house R&I departments, but rather by other firms or in collaboration with firms or social groups. We used to have an abundance of cheap labour, but now we are faced with the abundance of global geniuses that should be utilized to the fullest. The networks of actors contributing to innovation may be described as flexible ecosystems. There is not, necessarily one dominating firm, but rather an ecosystem in which actors interact and form different networks depending on their needs. These actors are not necessarily only industrial actors, but also users and social groups.

The development speed of innovation in such flexible ecosystem is increasing and the role of public research is limited by its longer time spans. Especially TRL model is no longer applicable, due to the speed of innovation. Product releases are done daily and yesterday's basic research is tomorrow's product.

Horizon 2020 must live up to the expectation of the "from research to retail" concept espoused by Commissioner Geoghegan Quinn. A key structural action will be to develop a "European Innovation Ecosystem". H2020 should develop a new "milieu" that supports and enables networks of innovation ecosystems to incubate and thrive.

Horizon 2020 should actively favour projects that exhibit quadruple helix innovation, where governments, industry, academia and citizens actively co-create together to drive structural changes which go far beyond the scope of what any one organization can do by itself.

Horizon 2020 should move beyond Open Innovation to Open Innovation 2.0 which is not about individual organizations but about co-creation enabled through deeper networking and involvement of all actors across the value chain.

Open Innovation 2.0 is about recognizing that the unit of effectiveness is the "innovation ecosystem".

CAF recommends the report from the Open Innovation 2.0 conference (Dublin Castle, May 20,21 2013) be used as a significant input for refining the Horizon 2020 approach and instruments.

> **Recommendation 2**
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> **H2020 must have simple and flexible instruments for supporting innovation**

The inherent differences of innovations projects when compared to traditional research projects demand other approaches and instruments. One of the obstacles to supporting innovation is that application processes for project funding are often long, time consuming and on a yearly basis only. In addition, when a project has been accepted, the flexibility with respect to changing scope or priorities (allowing for fast failing, iterations and pivoting) is limited and adding new participants is often a complex process. Large multinational consortia, which favour traditional funding allocations, require significant management overhead and time consuming internal agreement processes, whereas major innovations tend to be created by small and focused teams.

Therefore, innovation measures in Horizon 2020 should be based on

- facilitating **faster decisions** and project implementation cycles, e.g. by using a rapid stage-gate process for problem oriented innovation – this could be helped as well by decentralized governance processes (see also recommendation 8 below);

- providing **more flexibility and agility** in changing partner setup, project scope, and priorities;

- acknowledging the inherent risk of innovations by e.g. providing incentives to **accept early failure of projects** (see also recommendation 5 below);

- promoting **innovative ecosystems**, e.g. by fostering platforms, networks, innovation centres and extended periods of co-located project work;

- fostering match-making with industrial partners – large industries but as well SME's - for the exploitation of research results;

- promoting **outcome-driven, small and focused consortia**.

Recommendation 3

Instruments must meet the needs of smaller players

The role of smaller companies in innovation and particularly in disruptive innovation cannot be underestimated. There is much to be said that the relative performance of Europe versus the United States can be attributed to the fact the Europe has not had the eco-system (SBIR, venture capital, entrepreneurial culture, integrated market) that has allowed research-intensive smaller players to capture new emerging markets and become global leaders. Horizon 2020 should ensure that all of its instruments are open and attractive to these companies. CAF therefore suggests the following measures:

- Define a requirement for project consortia to include smaller companies reflecting an **eco-system** where **larger and smaller companies work together** in building a joint value-proposition to customers

- Implement a **two stage-application processes** to reduce wasted time for applications without increasing time to contract

- Minimize the red-tape with respect to project management overhead, simplify the reporting and other administrative requirements

Time-to-market and speed are important drivers for smaller emerging players in the market and the instruments should be adapted to that need, where needed through decentralization and distributed decision-making (e.g. through project calls within projects or centres of excellence that get assigned certain programs).

Recommendation 4

Innovation instruments must include social innovation

Horizon 2020 has a clear social orientation and aims to meet the large societal challenges of our time. In order to do this, more social and cultural initiatives are necessary in which people move on their own will.

Innovation instruments in Horizon 2020 should open up for innovation projects in which the aims are primarily social and not immediately profit-oriented. Inclusion of non-profit organisations in consortiums should be positively assessed. Innovation in which governments, industry, academia and citizens work together to drive structural changes may provide exceptional results. Careful and nontrivial calculations of profitability should be supported: a too simple-minded approach to economic return can easily lead to misleading conclusions, especially in complex situations. Aims can be social, but can generate entrepreneurial ventures or reduce loss.

A prime societal goal is long-term sustainability with its ecological, financial and political dimensions. In a general sense this goal is eminently "profitable". Nevertheless, social innovation is badly needed for solving this (and any other similar) problem, because of two key challenges; one being spatial (how to resolve conflict among diverse players at any one time) and temporal (how to pursue long-term goals reliably, given the time-limited mandate of democratic governments).

Recommendation 5

Instruments must promote risk-taking and disruptive innovations

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ICT-related innovations are sometimes disruptive. New technologies, new products and services, new business models or ways of organizing enabled by ICT may disrupt established markets. As coined by Clayton Christensen, disruptive innovations typically underperform in established markets, but are cheaper, simpler, smaller, and, frequently, more convenient to use. Over time, they become competitive also in the established market. Music streaming and IP telephony are examples of innovations that initially had a lower quality than established products services. These were aimed at fringe markets, but gradually improved and changed the mainstream markets.

Good companies that listen to their best customers and continually improve their services often fail when confronted with disruptive innovations. It is important that H2020 is not caught in the same dilemma.

H2020 should promote projects that involve risks and evaluate risk positively in its evaluation criteria. It should encourage projects where the roadmap from project idea to mainstream markets is unclear and where the proposed idea is in opposition to the interests of established market actors.

Instruments that could be considered for this purpose include:

- **Support to promising projects in their exploratory phase**, before the business model or the market potential is clear.

- Support not only to projects, but also to units with **more distributed decision-making processes** that can include partners as the innovation process develops.

- **Prizes** as a supplement to project support.

Recommendation 6

Horizon 2020 must have transparent criteria for evaluation of innovation potential

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In order to promote a transparent evaluation of the innovation potential in projects, more transparent criteria must be developed. Such criteria will serve as guidelines for how to address innovation in RDI-projects and be of value for the evaluation process and its legitimacy.

A schema can be developed that is similar to the one used in the evaluation of research projects. A schema should cover the nature of possible ideas for innovation, the business potential, the representation of innovation and business competences in the consortia, and how innovation is addressed in the work plan. The applicability and weight of innovation as well as research criteria should be applied differently in the interval from research-oriented innovation proposals to market-oriented innovation proposals and in different instruments.

It is important that business understanding is an integrated discipline as part of a multi-disciplinary team, and this should be reflected in the reviewing team.

Peer reviewing based on consensus has a tendency to support low-risk projects. Horizon 2020 should support **excellence in innovation** (as well as research) and a transparent schema for promoting high-risk however visionary innovation projects should be developed – and this should be communicated to submitters of proposals.

Recommendation 7

Legal framework must facilitate innovation

Legal rules and regulation can be both an obstacle and a facilitator for technological development and innovation. It is important that the legal framework is constantly being monitored upon and that when necessary it is adjusted to meet the technological and innovation ambitions of Europe. To this end, the Horizon 2020 instruments should also promote legal innovation.

Legal innovation involves identifying bottlenecks where national or European rules are obstacles to innovation and if necessary adapt new legal measures. A special focus should be placed on:

- Today's IPR-system may be an obstacle to innovation in collaboration and open innovation schemes.

- Regulation for project funding in the EU may prevent flexible arrangements necessary to promote more open and disruptive innovation.

- New regulations should be considered that make it mandatory for government institutions to spend X% on innovation activities.

Recommendation 8

Multidisciplinarity is necessary

Horizon 2020 should look to achieve the De Medici effect where disruptive breakthroughs occur at the intersections of disciplines and domains. Too often programs have been defined from a narrow technology-push perspective and are targeted at one specific academic discipline. Both within the technology domain it is crucial that sub-disciplines work together (e.g. computing and networking experts) but also across disciplines. The societal challenges that have been put forward by the H2020 program should be translated into more specific technology challenges (e.g robotic MD, Google glasses, self-driving vehicle, holographic presence) and tackling these challenges requires a multidisciplinary approach. This includes legal and regulatory aspects. This can also be achieved by developing different instruments than the classical projects (support for fellowships, creative incubators, multidisciplinary research centres such as MIT Medialab).

Taking an updated understanding of innovation into account, open innovation requires 1) technical solutions ensuring compatibility of pieces of innovation, 2) economic incentives and market places for them, and 3) social dimension for guiding the shared attention for the suitable problems. In the past EU-funded research has covered the technical and partly economic parts, but new instruments need to be developed for the social dimension.

In the projects is also crucial to include practical hands-on business development expertise in the project consortia (product marketing, distribution and sourcing knowledge). This could be achieved through entrepreneurs in residence at the research institutes for example. It should not take the form of a separate theoretical business modelling exercise but be embedded in the research team. The selection and evaluation teams of the projects should also include similar expertise (business development and/or venture capital experts).

Recommendation 9

The mechanisms of innovation must be better understood

The innovation process is not satisfactorily understood; hence Horizon 2020 should encourage more research on this. The important insight that innovations are embedded in an ecosystem must be complemented by the psychological, sociological and economic analyses of the actors embedded in this ecosystem. The knowledge thus gained must be shared widely. Innovation researchers and innovators must come together to cross-check and validate their understanding. Distilled principles should regularly be incorporated into programmes promoting innovation.

Recommendation 10

Innovation Success should be focussed on Adoption

Quoting Michael Schrage of MIT "Innovation is not innovator's innovating, it is customers adopting. The primary measure of success of a research and innovation project is whether customers have adopted the outcomes.
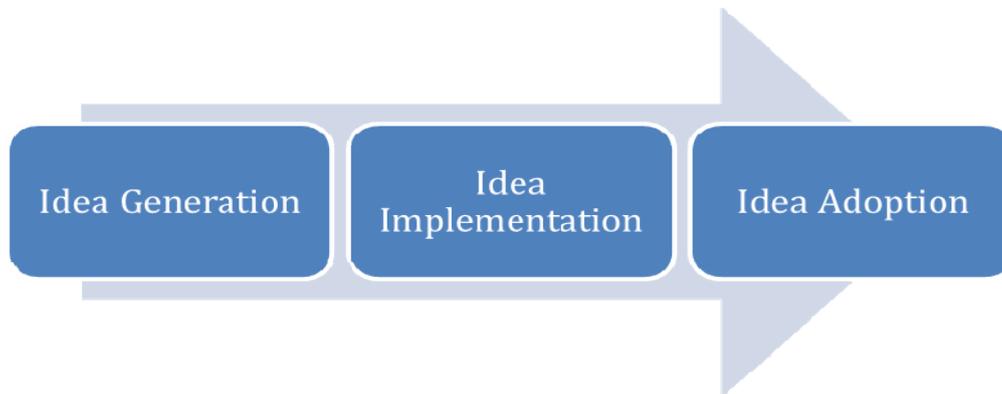
The Innovation value chain consists of three phases according to Birkenshaw et al, idea generation, idea implementation and idea adoption.

There is a continuum of effort across these phases of "hard, harder, hardest". However there is a paradox in that most of the EU funding is for the start of the innovation value chain – i.e. idea generation. We must shift the portfolio of funding more equally so that there is more targeted at the third phase adoption. This may require a re-look and a re-writing of state aid law.

Recommendation 11

Innovation in H2020: New application areas - new instruments

New application areas for the new instruments:
- Prizes
- Procurement

Instruments should also be open to funding the unexpected outcomes of projects.

ANNEX: CONNECT Advisory Forum (CAF) Working groups

The main task of the Advisory Groups is to give advice to Commission services on relevant H2020 objectives and scientific, technological and innovation priorities as well as on broader policies issues related to the Digital Agenda for Europe.

Most of the reflection and analysis regarding the orientations of the Horizon 2020 work-programmes will take place in dedicated Working Groups (WG). The resulting reports or position papers should feed into the broader discussion on orientations and on broader issues to be carried out in the plenary meetings.

Horizon 2020 related working groups

The Commission is expected to deliver its proposal for the Horizon 2020 work-programmes 2014-15 after the summer. This means that the dialogue with the advisory groups will be taking place in parallel with the discussion within Commission services. Under these special circumstances the CAF contribution will be more focused on the validation and refinement of "orientations" for WP2014-15 presented by the Commission and the discussion of its implementation.

In this context, following the discussion at the 1st meeting of the CAF it is proposed as immediate focus of its activities, the following three working groups (WGs):

- Leadership in enabling industrial technologies in ICT
- ICT in Societal Challenges,
- An ICT innovation-oriented agenda

An overview of the scope of the three proposed WGs is provided below. More details are available in detailed Terms of Reference in Annex.

- **Leadership in Enabling Industrial Technologies** (**LEIT-ICT**) should provide recommendations and comments on:
  - overall prioritization,
  - detailed R&D needs within the identified areas with an emphasis on prioritization ("why is it important to support this in 2014-15"?),
  - proposal for roadmap-based activities (PPPs, JTIs..),
  - cross-cutting activities 1/ within ICT LEIT (eg. IoT, Cyber-security..); 2/ Across the Programme (eg. CC KETs),
  - international Cooperation.

- **ICT in societal challenges**: should provide recommendations and comments on:
  - key ICT requirements and added value in Societal Challenges / Focus Areas,
  - detailed R&D needs within the identified areas with an emphasis on prioritization ("why is it important to support this in 2014-15"?),
  - building of synergies between LEIT and SCs/Focus Areas,

- links to policies (DAE).

- **Innovation** should provide recommendations and comments on:
  - past experience with innovation-friendly/SME-friendly instrumentation (eg. take-up measures, SME-scheme in content area in Ch4, ECHORD model...)
  - proposal for Open Disruptive Innovation scheme
  - proposed approach for SME instrument
  - proposed approach for PCP/PPI instrument
  - topics and implementation of Prizes
  - proposed approach to horizontal support to innovation

A first deliverable of each of the working groups above will be a position paper providing input on DG CONNECT's approach to work-programme 2014-15 for LEIT-ICT, the contribution of "ICT in Societal Challenges" and how to address the innovation dimension in ICT. It is crucial that these deliverables are made available by the **beginning of May 2013** to make sure that their input and ideas can be effectively integrated in the design of work-programmes for 2014-15 of Horizon 2020.

While this constitutes the most immediate outcome of the working groups, DG CONNECT proposes that they remain active supporting a deeper strategic reflection of the CAF about the priorities and implementation approach for the subsequent work-programmes (2016-17 and following years) of Horizon 2020.

The "excellent science" priority of Horizon 2020 is not included in this list of working groups above because this will be addressed in two specific advisory groups (FET and research infrastructures). However, the CAF is asked to consider in its analysis **how to develop the linkages and coherence of the ICT across all the three priorities of H2020**.

CAF Working Group on "Leadership in Enabling and Industrial Technologies in ICT"
Draft Terms of Reference

1. Membership (indicative)

Rob Hartman (chair); Giorgio Anania; Jose-Luis Angoso; Jean-Luc Beylat; Nicolas Demassieux; Wim de Waele; Mathew Finnie; Chris Hankin; Natali Heberger; Sabine Herlitschka; Maarja Kruusmaa; Lidia Lukasiak; Diana Mangalagiu; Jiri Zlatuska; J. Gyorkos (CAF chair)

2. Objective

The WG will prepare a position paper about the orientations for the Work Programme 2014-15 of the LEIT-ICT part of Horizon 2020. These recommendations are to be discussed and endorsed by the entire CAF group. This reflection should be pursued having in mind the preparation of subsequent work-programmes.

3. Context

Enabling technologies in ICT (LEIT-ICT[6]) constitute the core area of ICT in Horizon 2020 concentrating at least half[7] of the overall budget. Activities address the 6 thematic ICT challenges (components and systems, next generation computing, Future Internet, content technologies and information management, advanced interfaces and robots, micro- and nanoelectronics and photonics).

The preparation of the position paper of the CAF on Work Programme 2014-15 of the LEIT-ICT part of Horizon 2020 will need to take into account the particular context in which the WP will be prepared:

- The overall goals and actitiviy lines of the Specific Programme implementing Horizon 2020 for 2014-15
- The Strategic Programme as a general framework structuring the priorities for the work-programme
- The partnering activities that have been approved by the Commission in the meantime addressing the following areas:
  - Public Private Partnerships (PPPs): Photonics, Robotics, "Factories of the Future" (FoF) and "Advanced 5G network infrastructure for Future Internet"
  - Joint Technology Initiatives (JTIs): Electronic Components and Systems

4. Indicative scope

The WG report should indicatively cover (but not be limited to) the following:

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[6] Leadership in Enabling and Industrial Technologies in Information and Communication Technologies

[7] From the 80 billion budget originally propose by the Commission about 8 billion were expected to be assigned to these activities.

1. A view on the assessment of technological and socio-economic trends that have an impact on the Programme orientation

2. <u>Recommendations / comments</u> on:
   - Overall **prioritisation of activities and topics** and the rationale supporting it (why support this area / topic in 2014-15)
   - Proposals for **roadmap-based activities** (especially PPPs and JTIs)
   - **Cross-cutting activities** within LEIT-ICT (Internet of Things and Smart Personal environments, Cyber-security; Social sciences for Digital Future, Digital Science)
   - **International cooperation** with relevant countries

5. Deliverables and milestones

May 2013:
- **Position paper on LEIT-ICT work-programme 2014-15**

Fall 2014
- Orientations for LEIT-ICT beyond 2015

6. Supporting information

- Excerpt of the Horizon 2020 Specific Programme dealing with LEIT-ICT
- Preliminary view of Horizon 2020 – LEIT-ICT orientations for WP2014-15 work-programme (internal DG CONNECT document)
- Strategic Programming document

CAF Working Group on "ICT in Societal Challenges"
Draft Terms of Reference

1. Membership (indicative)

Erik Fledderus (chair); Jose-Luis Angoso; Klaus Beetz; Stefana Broadbent; Martin Curley; Wim de Waele; Chris Hankin; Natali Heberger; Sabine Herlitschka; Sverke Holmgren; Matthias Jarke; Harald Lemke; Lidia Lukasiak; Ole Madsen; Diana Mangalagiu; Taja Storsul; Jiri Zlatuska; J. Gyorkos (CAF chair)

2. Objective

The WG will prepare a position paper about the orientations for the Work Programmes 2014-15 of the Horizon 2020 "Societal Challenges" reflecting the input and added value of ICT-related research and innovation.

3. Context

ICT plays a central role in the societal challenges addressed by Horizon 2020 (health and wellbeing, energy, mobility, climate, inclusion and security). ICT constitutes an essential tool not only for an accrued efficiency and effectiveness, but allowing for more fundamental changes in these sectors – hence becoming a driver for innovation and social transformation.

The preparation of the position paper will need to take into account the particular context in which the WP 2014-15 will be prepared:

- The overall goals and actitiviy lines of the Specific Programme implementing Horizon 2020 for 2014-15
- The role to be played by the Strategic Programme as a general framework structuring the priorities for the work-programme
- The partnering activities that have been approved by the Commission in the meantime addressing the following areas:
  - PPPs: "European Green Car Vehicle"; "Energy-Efficient Buildings" (EeB)
  - Joint Programme (JP): Active Assisted Living (AAL)
  - Joint Programming Initiatives (JPIs): "More Years Better Lives", "Urban Europe"
  - European Innovation Partnerships (EIPs): "Active and Healthy Ageing", "Smart Cities"

4. Indicative scope

The WG report should indicatively cover (but not be limited to) the following:

1. A view on the assessment of technological and socio-economic trends that have an impact on the Programme orientation

2. Recommendations / comments on:

   - Overall discussion of the added value of ICT for the achievement of the objectives each specific Horizon 2020 "Societal Challenge" (i.e. in which way ICT plays a key role in each societal challenge)

- **Concrete and specific activities and topics** and respective priorities (why support this area / topic in 2014-15)
- **Synergies / complementarity with** within research and innovation in LEIT-ICT
- **Links with policies** (e.g. Digital Agenda for Europe, European Innovation Partnerships)
- **International cooperation** with relevant countries

5. Deliverables and milestones

May 2013:
- Position paper on the role of **ICT in Societal Challenges** in work-programme 2014-15 of Horizon 2020

Fall 2014
- Orientations for **ICT in Societal Challenges of Horizon 2020** beyond 2015

6. Supporting information
- Horizon 2020 Specific Programme dealing with Societal Challenges
- Preliminary view of ICT in societal challenges - orientations for WP2014-15 work-programme (internal DG CONNECT document)
- Strategic Programming document

CAF Working Group on "Innovation in ICT"
Draft Terms of Reference

1. Membership (indicative)

Tatu Kojlonen (chair); Giorgio Anania; Jose-Luis Angoso; Klaus Beetz; Jean-Luc Beylat; Martin Curley; Nicolas Demassieux; Wim de Waele; Mathew Finnie; Natali Heberger; Sverke Holmgren; Matthias Jarke; Ole Madsen; Diana Mangalagiu; Taja Storsul; Jiri Zlatuska; J. Gyorkos (CAF chair)

2. Objective

The WG will prepare a position paper about the orientations for the Work Programmes 2014-15 of the Horizon 2020 focusing on how Horizon 2020 will contribute to deliver the innovation potential of ICT.

3. Context

This constitutes the centre piece of the new thinking brought up by Horizon 2020. With it DG CONNECT expects to respond to the call for greater agility, responsiveness and flexibility, finding ways of supporting new innovation models (non-linear, radical disruptive), higher risk and non-traditional players.

The position paper will need to take into account the particular context in which the WP 2014-15 will be prepared:

- Previous experience with innovation-related activities and instruments in FP7 and CIP (eg SME scheme, pre-competitive procurement, take-up measures) illustrated by concrete case studies (SME-scheme in digital content, ECHORD, etc.)

- The range of instruments available in Horizon 2020 (R&D projects, pilots, SME actions, pre-competitive procurement, prizes)

4. Indicative scope

The WG report should indicatively cover (but not be limited to) the following:

1. A view on the assessment of technological and socio-economic trends that have an impact on the Programme orientation

2. Recommendations / comments on:

    - Effectiveness of past instruments (i.e. to which extent have they delivered? What are their limitations? How these can be addressed?)
    - New approaches being developed in Horizon 2020 and how they are being supported:
        - **Innovation paradigms:** open, disruptive innovation, social innovation, public sector innovation, design and digital innovation
        - **SME-specific instruments; prizes**
        - **Pre-competitive procurement (PCP) / Public procurement of innovative solutions (PPI)**
    - Framework conditions: standardisation, intellectual property, digital entrepreneurship, clusters and innovation hubs
    - The role of **international cooperation** in ICT innovation strategies

5. Deliverables and milestones

May 2013:

- Position paper on the role of **Innovation in ICT** in work-programme 2014-15 of Horizon 2020

Fall 2014

- Orientations for **Innovation in ICT** beyond 2015

6. Supporting information

- Horizon 2020 Specific Programme dealing with innovation-related activities especially those dealing with risk finance and innovation in SMEs
- Preliminary view of Orientations for WP2014-15 work-programme (internal DG CONNECT document)
- Strategic Programming document