KK-AI-12-001-EN-C

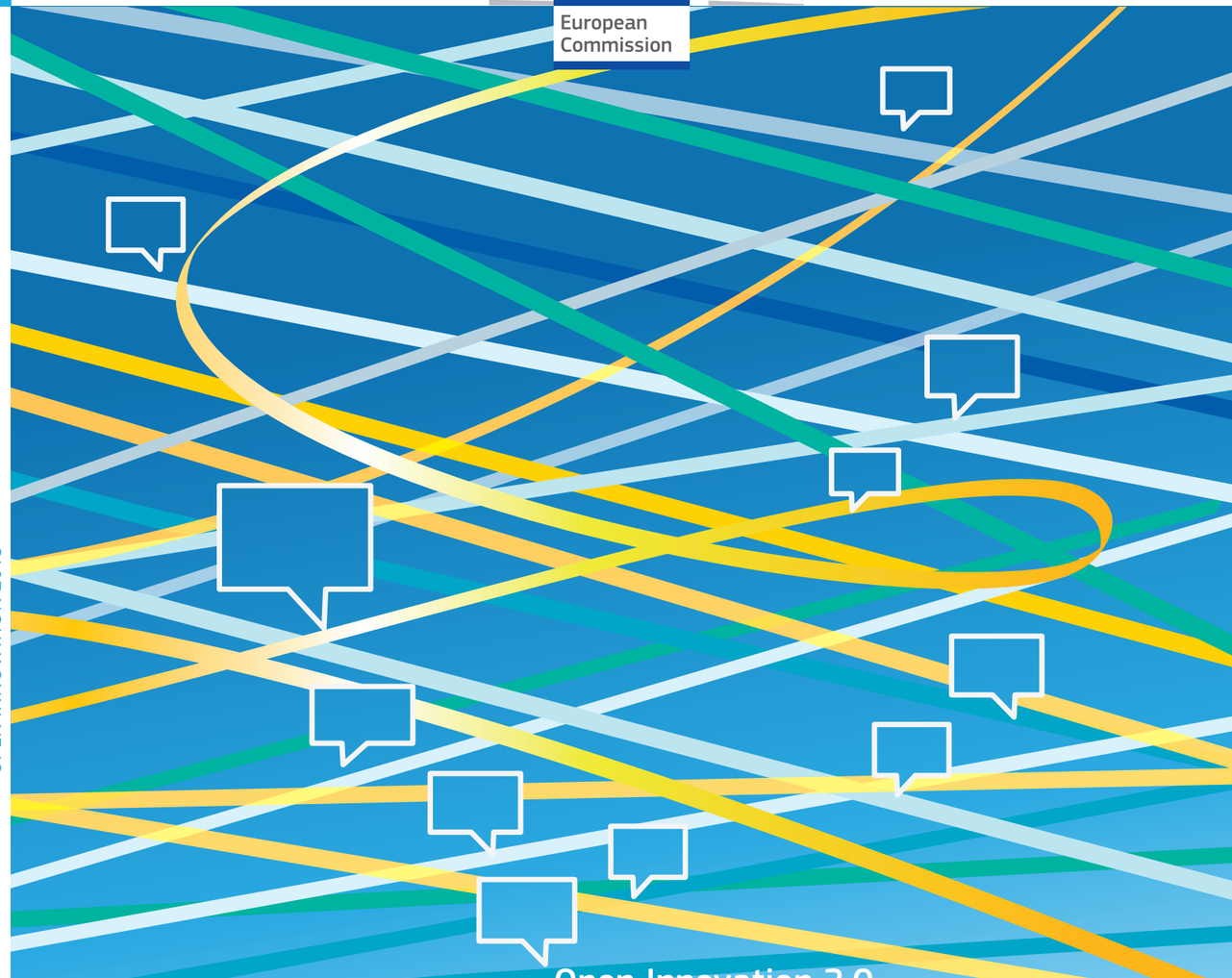
Publications Office

doi 10.2759/87245

ISBN 978-92-79-25864-0

OPEN INNOVATION 2013

European Commission



Open Innovation 2.0

# Open Innovation

## 2013

*Communications Networks, Contents and Technology*

## HOW TO OBTAIN EU PUBLICATIONS

**Free publications:**

- via EU Bookshop (http://bookshop.europa.eu);
- at the European Union's representations or delegations. You can obtain their contact details on the Internet (http://ec.europa.eu) or by sending a fax to +352 2929-42758.

**Priced publications:**

- via EU Bookshop (http://bookshop.europa.eu).

**Priced subscriptions (e.g. annual series of the *Official Journal of the European Union* and reports of cases before the Court of Justice of the European Union):**

- via one of the sales agents of the Publications Office of the European Union (http://publications.europa.eu/others/agents/index_en.htm).

EUROPEAN COMMISSION

# Open Innovation 2013

2013 Directorate-General for Communications Networks, Content and Technology

**Europe Direct is a service to help you find answers to your questions about the European Union**

**Freephone number (*):**

**00 800 6 7 8 9 10 11**

(*) Certain mobile telephone operators do not allow access to 00 800 numbers or these calls may be billed.



More information on the European Union is available on the Internet (http://europa.eu).

Cataloguing data can be found at the end of this publication.

Luxembourg: Publications Office of the European Union, 2013

ISBN 978-92-79-25864-0

doi:10.2759/87245



*Printed in Luxembourg*

PRINTED ON ELEMENTAL CHLORINE-FREE BLEACHED PAPER (ECF)

# Contents

# Foreword

Welcome to the fourth edition of the innovation yearbook, co-published with the Open Innovation Strategy and Policy Group (OISPG). This Open Innovation 2013 yearbook is intended to provide stimuli for thoughts and actions in the field of service innovation, especially related to the information and knowledge society.

The core function of the yearbooks has not changed, but the evolving context has led to a change in the name of the yearbooks: starting as Service Innovation yearbooks and now continuing as Open Innovation yearbooks. The drive for open innovation ecosystems, platforms and processes that enable stronger interaction between all stakeholders, namely private, public, people and, often, even NGO actors, is common throughout the series. The triple helix (public–private–people partnership) has grown into a quadruple or even penta–helix aiming for sustainability, both in economic and societal terms.

In the European context, open innovation is now used as a synonym for modern, highly dynamic and interactive processes. Linear and sequential mindsets are slowly changing to be more opportunistic, more daring and more action-oriented. We need to move from having 'perfect plans for yesterday' to an innovation culture which fosters experimentation and prototyping in real-world settings. This new innovation culture leads to simultaneous technological and societal innovation and encouragement. We need to be daring and also experiment with disruptive approaches as gradual improvement does not properly reflect the potential that the omnipresent, fast-developing ICT provides for parallel innovations.

Real-world settings with experimental approaches turn the user into a co-creator in the innovation process, instead of just being a recipient of the services or products. The new role of the user is an advantage as feedback on what is successful and what is not can be discovered very rapidly: this enables solutions which create real value to move faster and more successfully. 'Failing fast' means that we are also less likely to fail in the big things because corrections to the innovation pathway are easier to take on board at the earlier stages.

This scalability of success, and the possibility to multiply it, is the critical element that shapes the market for future knowledge-intensive services and products in Europe. We have, compared to other regions of the world, the unique asset of the most advanced and demanding users (be they citizens or user industries). That valuable component in the innovation process needs to be reinforced in our approach. We need to move from innovation clusters to innovation ecosystems with a new kind of mental approach. Co-creativity and well-designed processes reduce friction between the different processes that support innovation. This also includes the legal and policy frameworks which need to cut red tape and, at the same time, create a safety net for innovation by experimentation.

I wish you all inspiring reading of this Open Innovation 2013 yearbook! I hope it stimulates new thinking and creates ideas on how to move towards frictionless innovation systems in Europe.

Bror Salmelin
Advisor, Innovation Systems
European Commission,
Directorate-General
for Communications Networks,
Content and Technology

# Introduction

The objective of our Innovation yearbook 2013 is to create a manifesto and platform for sustainable growth enabled through Innovation 2.0. Our goal is to build towards a collective vision/ambition and leverage our collaborative intelligence and muscle to create a virtuous circle of sustainable growth which enables new services, sustainability, improved quality of life and new jobs.

We need a collective vision and architecture of a new sustainable Europe. Important elements of this are contained in President Barroso's Europe 2020 strategy and the related flagship initiatives towards a smart, inclusive and sustainable economy. A supporting vision, 'Digital Europe' and related ideas have been developed by the Intel Labs Europe team and collaboration partners across Europe and presented at the annual Intel European Research and Innovation Conferences which have had a theme of building a smart, inclusive and sustainable society.

In parallel, the EU Open Innovation Strategy and Policy Group has been monitoring, developing and evolving a new paradigm and set of methodologies, which we call 'Innovation 2.0', to help achieve broader-scale innovation benefits that leverage and benefit broad sets of stakeholders. In the Innovation 2.0 paradigm, we identify distinct characteristics which leverage diverse concepts and practices including the principle of shared value (Porter and Kramer), open innovation (Chesbrough), co-creation (Ramaswamy), high expectation entrepreneurship (Formica et al.) and triple helix innovation (Etzkowicz). We believe that the effective collaboration of governments, academia, industry and citizens working together can drive structural changes and improvements far beyond the scope of what any one entity can achieve on its own.

Looking forward, we believe an important development could be a shift from linear value chains to sustainable value cycles (Haque) which more intensely recycle resources to produce services, products and ecosystems which are built to last longer, without compromising resources, the environment or communities.

In synergistic alignment with the goals of Europe 2020, we hope this Innovation 2.0 yearbook can provide examples of best practice which, when synthesised and practiced, can provide a blueprint and design patterns for a sustainable Europe which can then act as a beacon for the rest of our global society.

Professor Martin Curley
Chair, EU Open Innovation Strategy and Policy Group
Vice-President and Director, Intel Labs Europe,
Intel Corporation

# Acknowledgements


| Last name | First name | Company/organisation | E-mail |
|---|---|---|---|
| Aarts | Emile | Intelligent Lighting Institute, Eindhoven University of Technology | e.h.l.aarts@tue.nl |
| Costello | Gabriel J. | Galway-Mayo Institute of Technology | Gabrielj.Costello@gmit.ie |
| Curley | Martin | Intel Labs Europe and Innovation Value Institute, National University of Ireland, Maynooth | Martin.G.Curley@intel.com |
| de Lama | Nuria | Atos Research and Innovation | Nuria.delama@atosresearch.eu |
| den Ouden | Elke | Intelligent Lighting Institute, Eindhoven University of Technology | e.d.Ouden@tue.nl |
| Distinguin | Stéphane | faberNovel | Stephane.distinguin@fabernovel.com |
| Dombowsky | Paul | Ideavibes | paul@ideavibes.com |
| Donnellan | Brian | Innovation Value Institute, National University of Ireland, Maynooth | Brian.donnellan@nuim.ie |
| Erkinheimo | Pia | TIVIT Ltd (the Strategic Centre for Science, Technology and Innovation in the Field of ICT) | pia.erkinheimo@tivit.fi |
| Keeling | Mary | IBM | mary.keeling@ie.ibm.com |
| Komninos | Nicos | Aristotle University of Thessaloniki, Urban and Regional Research | komninos@urenio.org |
| Kulkki | Seija | Department of Management and International Business, Aalto University School of Business, | seija.kulkki@aalto.fi |
| Kune | Hank | Educore | hankkune@educore.nl |
| Launonen | Pentti | Aalto University, Center for Knowledge and Innovation Research (CKIR) | pentti.launonen@aalto.fi |
| Markkula | Markku | Aalto University Finland, Committee of the Regions | markku.markkula@aalto.fi |
| Pallot | Marc | Centre for Concurrent Enterprise, Nottingham University Business School | Marc.pallot@9online.fr |
| Salmelin | Bror | European Commission, Directorate-General for Communications Networks, Content and Technology | bror.salmelin@ec.europa.eu |
| Sargsyan | Gohar | CGI Group Inc., Adviser, Future IT and Amsterdam University of Applied Sciences | gohar.sargsyan@cgi.com |
| Sashinskaya | Maria | IBM Belgium | sashinsm@be.ibm.com |
| Schaffers | Hans | Center for Knowledge and Innovation Research (CKIR), Aalto University | hans.schaffers@aalto.fi |
| Schulze | Corinna | IBM Europe | corinna_schulze@be.ibm.com |
| Turkama | Petra | Center for Knowledge and Innovation Research (CKIR), Aalto University | petra.turkama@aalto.fi |
| Valkenburg | Rianne | Intelligent Lighting Institute, Eindhoven University of Technology | a.c.valkenburg@tue.nl |
| Edited by: | | | |
| Honka | Anni | European Commission, Directorate-General for Communications Networks, Content and Technology | anni.honka@ec.europa.eu |

# Executive summary

This yearbook Open Innovation 2013 (with the subtheme 'Open Innovation 2.0') follows the series of Service Innovation yearbooks published in 2009–10 and Open Innovation 2012. The yearbooks have three complementary parts: (i) policy development; (ii) trends and weak signals in service innovation; and (iii) insight into cases and open innovation development in countries and regions.

The purpose of the yearbook series is to stimulate thinking and discussion on modern innovation processes and practices, and to share best experience of real cases, making the implementation of the new paradigms easier and faster.

This year's edition highlights two main perspectives: firstly, the disruptive nature of Open Innovation 2.0 and, secondly, the nature of open innovation ecosystems which are fostering jobs and sustainable growth. There are many examples of modern ecosystem thinking in this year's yearbook, both in smart city contexts as well as regional contexts.

The first part of this yearbook describes the new innovation and research policy approach to the forthcoming Horizon 2020 framework, namely the mash-up and holistic approach, new innovation-supporting instruments such as open and disruptive innovation, SME instruments as well as more take-up-oriented innovation procurement-oriented instruments.

The challenges for these open innovation ecosystems is in the leadership and common desire to be attractive to all kinds of players from large to small, in strong and trusted interrelationships.

The innovation processes need to provide high connectivity across the ecosystem (including society), to be open to fostering interaction and joint growth in an organic, non-predetermined way. This opportunistic approach can be called an 'organicsational approach', combining the organisational and organic aspects.

Can these ecosystems be created by a control approach, or do we need to have a more catalytic, encouraging approach? The latter is what will be seen in the European Commission's Horizon 2020 activity. Martin Curley et al. speak about modern approaches to innovation ecosystems and develop interesting metrics and conceptual frameworks based on the practical experience and theoretical studies. In an attempt to provide a description and taxonomy of Open Innovation 2.0, the key characteristics of the emerging Open Innovation 2.0 paradigm are described. The goal is to help innovation practitioners and academics achieve results from innovation which are more predictable, probable and profitable and to drive innovation impacts far beyond the scope of what any one organisation could achieve on its own.

Distinguin's article discusses the challenge of new entrepreneurship and argues that an entirely new approach in Europe is needed. In the article, the author poses well-justified questions to remove the barriers for fluid creation of new entrepreneurship in the connected world. This would require a holistic perspective including policy and legislation support and increasingly also fluidity for the seed capital market.

The second part of this yearbook focuses strongly on open innovation ecosystems. The context of smart(er) cities is interlinked with open innovation both conceptually and through examples in real settings. The challenge is change and transformation towards a smarter city, which is more participative, inclusive and empowering, instead of an imaginary ideal future vision.

There is strong evidence that open innovation in smart cities will drive jobs and growth significantly forward. The innovation ecosystem, in the spirit of Living Labs, brings forward the quadruple helix model where the citizens have a strong say in the innovation process. Thus, it creates, for example, the market for personalised, but modular, services constantly at the pace enabled by ICT development. This, in turn, is crucial when we look at the success rate of innovation in real-world settings, and likewise for the innovation speed and scalability.

In the article by Kulkki, the collaborative innovation ecosystem concept is discussed together with practical approaches. This article discusses Europe as an innovation Union and calls for new forms of strategic collaborative action that implies integration of research and innovation instruments and public and private actors for collaborative RDI and entrepreneurship. The public sector has a strong driving

role in the creation of these open innovation environments, as well as to drive the 'rules of the game'. The public sector has strong purchasing power and is also responsible for delivering a broad range of services to the citizens and the business world. In the article by Turkama et al., the role of the public sector is also well highlighted through practical examples. Public sector innovation is increasingly recognised as an essential mechanism for maintaining the quality and scope of services whilst reducing costs. Cross-sectorial collaboration and coordination is increasingly seen as a solution to the most pressing social problems. While public sector innovation holds great potential, it still has many barriers and challenges that require further research and experimentation.

This chapter provides a framework for thinking, debate and action on innovation models and practices in the public sector from both research and practical point of views. It explores the similarities and differences between much studied private sector innovations and the distinct factors in public–private innovation, and proposes a typology for better understanding differences in the innovation landscapes. Special emphasis is placed on transformative innovations with potential for broad societal and economic impact.

In the article by Sargsyan, open innovation is interlinked very strongly to entrepreneurship. Open services innovation is about engaging users as co-creators of the new services and eventual beneficiaries in terms of share-of-profit, users, IPR (intellectual property rights), shared ownership, etc. The digital future of Europe is highly dependent on the digital single market and citizens' participation in city, region and country governance. The digital entrepreneurs raised from these individuals have an essential role to play to boost the EU economy. The article shows how important open infrastructures and open innovation processes designed for co-creation and sharing are in creating entirely new kinds of entrepreneurial structures and wealth throughout society.

The Dutch case described by Aarts et al. on user contribution to lighting solutions clearly shows how a simultaneous win–win for creating better environments and new business approaches together creates economic and environmental sustainability.

We also have an interesting new opening in the water management area and open, participative innovation in the article by Keeling. It is foreseen that water will be one of the very critical resources in the near future and, therefore, this topic fits very well into the theme of a sustainable society seeking new solutions and approaches.

Open data is one of the important trends which can be used as an ingredient for very many innovative services. Open data is fostered by EU policies. However, to make data easily usable, semantic standardisation is needed and access must be ensured as widely as possible to data. The article by Schulze et al. illustrates the connected city, the entrepreneurial city and the creative city integrated by data flows across various traditional boundaries: the case of mobility in London is used as example of this.

Crowd(re)sourcing is described in the article by Erkinheimo et al. Practical examples on how crowd(re)-sourcing can and has been used in large companies give valuable hints of the implementation drivers and hinders of crowdsourcing. Europe is, for the moment, lagging behind, but catching up fast with, the leading regions — for example, the United States.

Open innovation in regional settings in the article by Markkula et al. describes how this new innovation approach is affecting the regional policies and related Horizon 2020 actions of the European Commission. As a practical context, the Espoo case is described. The Innovation Dynamo is one of the concepts developed, which can very fruitfully be multiplied and developed in other regions, together with innovation camps and new entrepreneurship Venture Garages as described in the article.

The article by de Lama interlinks the public–private partnership project on the Future Internet (FI PPP) with open innovation through Open Innovation Labs enabling the platform use for third parties.

Seeing the very rich contents of Open Innovation 2.0, this year one can also clearly see that open innovation is one of the key approaches to sustainable growth and it is also a driver for balanced societal development. The disruptive nature of Open Innovation 2.0 leads to new challenges also in the innovation-related activities both from process and environment perspectives. The forthcoming years will show how Europe is able to renew its innovation systems. Horizon 2020 will be crucial, interlinked with national and regional innovation systems. The decision-makers and leaders need to have the courage to look beyond the linear extrapolation of the past. Real innovation, by definition, is disruptive, as shown in this Open Innovation 2.0 publication.

Open Innovation 2.0: the next winner.

CHAPTER I

# Policy development

## 1.1. European Commission innovation strategies and support for innovation — why and how


### *Abstract*

This article describes the background and drivers of the approach the European Commission takes to foster research, development and innovation in a balanced way. The article elaborates the innovation approach from the open innovation perspective and highlights some of the new thinking to support the Europe 2020 objectives and, moreover, the Innovation Union objectives for European competitiveness, jobs and growth.


of society, namely demographics, energy and environment.

One of the flagships of the Europe 2020 strategy is the 'Innovation Union' which covers holistically the innovation process capturing all phases from very basic research to take-up of results. It even touches issues such as market creation by simultaneous societal and technological development.

Table 1: The three main pillars of Europe 2020 [1]

| Smart Growth | Sustainable Growth | Inclusive Growth |
|---|---|---|
| Innovation<br>'Innovation Union' | Climate, energy and mobility<br>'Resource efficient Europe' | Employment and skills<br>'An agenda for new skills and jobs' |
| Education<br>'Youth on the move' | Competitiveness<br>'An industrial policy for the globalisation era' | Fighting poverty<br>'European platform against poverty' |
| Digital society<br>'A Digital Agenda for Europe' | | |

The focus is on a holistic view for innovation which integrates the various European Commission instruments and the national and regional actions, and reinforces the whole process on modern innovation. A strong systematic innovation approach is suggested to ensure the full impact of the merge and integration of societal and technological innovations.

### *European policy background*

The European Commission has defined it's objectives through the Europe 2020 programme building on the three main pillars described in Table 1 [1].

When looking more in detail at the various actions, we see that these actions, besides research and competitiveness, also tackle the grand challenges

What is important in the flagship of Innovation Union is that it integrates in its approach European, national and regional innovation instruments in a new way, also highlighting the transformation from linear to more parallel open innovation processes, even innovation ecosystems. That approach also leads to new seamless designs of the funding instruments under the forthcoming framework, namely Horizon 2020 and its related Connecting Europe Facility (CEF). At the time of writing this article, the discussion on the multi-annual financial framework (i.e. the budget) of the EU is still going on. Thus, I base the thinking and argumentation on the Commission proposals as well as the trends we see to change the whole innovation landscape.

Figure 1: Innovation Union commitments


In Figure 1, one can see the 34 Innovation Union commitments, which are all part of creating the new set of innovation instruments and ecosystems in Europe. Some of the instruments are more closely related to research funding, and some, for example, to the new regional policies. When analysing the objectives more in detail, we see how they are interdependent and some are clearly critical infrastructures for an innovation society with strong horizontal links across disciplines and the stakeholders.

Some instruments fuel innovation take-up and its wider deployment (e.g. No 17, Pre-commercial procurement). Some tackle special segments, for example the SME instruments (Nos 7, 11) as well as in so-called smart specialisation (No 24), where the regional strengths are the base for innovation activities.

It is also essential to inject new means for the innovation process and create interlinkages between the available instruments.

For the European Commission's Directorate-General for Communications Networks, Content and Technology, the Digital Agenda for Europe (DAE) is very important. It integrates policies, regulation and research by bringing forward the knowledge society for all. Actions range from infrastructure regulation to privacy and, of course, it sets research priorities as well. DAE actions can be seen as the critical enablers for innovation, jobs and growth in an inclusive society.

In the DAE, the following seven pillars are described, giving a good overview of the approach fostering innovation [2].

- Pillar 1: A vibrant digital single market
- Pillar 2: Interoperability and standards
- Pillar 3: Trust and security
- Pillar 4: Fast and ultra-fast Internet access
- Pillar 5: Research and innovation
- Pillar 6: Enhancing digital literacy, skills and inclusion
- Pillar 7: ICT-enabled benefits for EU society

To follow the progress of the various actions under the pillars (101 altogether), a scoreboard metrics has been developed. The scoreboard covers not only the topical aspects, but also monitors the various countries' actual situation on particular actions. This best practice sharing and benchmarking is a good tool to learn from each other. It also speeds up the general development by identifying the bottlenecks in the process.

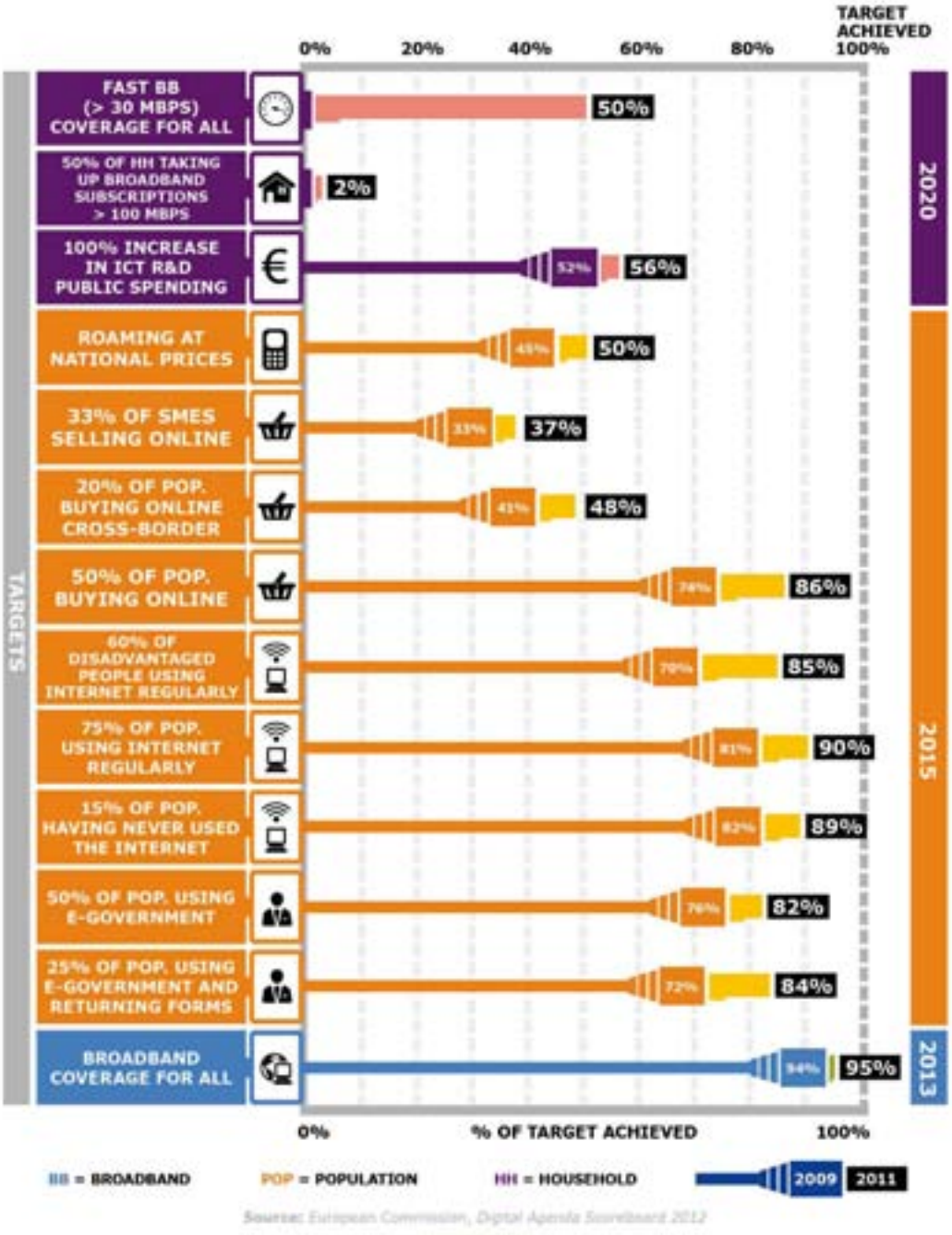
As can be seen from Figure 2 ([1]), the use of the Internet has developed relatively well, as has also the basic connectivity. The change from fixed networks to mobile broadband networks might

([1]) More information is available online on the DAE website, section Scoreboard (http://ec.europa.eu/digital-agenda/).

shift the development pace significantly when access will be more affordable and genuinely broadband in nature. Hence, for example, roaming for data is an important issue to lower the barriers for the use of modern and affordable ICT.

societal and development challenges. Due to the recent financial crisis, competitiveness and growth have risen in importance. This is well reflected also in the conclusions of the European Council of 1 and 2 March 2012 and is reinforced in the

Figure 2: Development of the use of the Internet [3]




The Europe 2020 strategy sets a very important policy agenda for the EU to better integrate its innovation actions on all levels and to solve

overall policy development during the past year. It reinforces the following objectives for the innovation agenda [4].

- 'Creating the best possible environment for entrepreneurs to commercialise their ideas and create jobs and putting demand-led innovation as a main driver of Europe's research and development policy.'
- 'The important role played by industry for European growth, competitiveness, exports and job creation and as a driver for productivity and innovation.'

The research, development and innovation support from the Commission will reflect the new approach. Key instruments will be the Horizon 2020 programme together with the Connecting Europe Facility (CEF) [5].

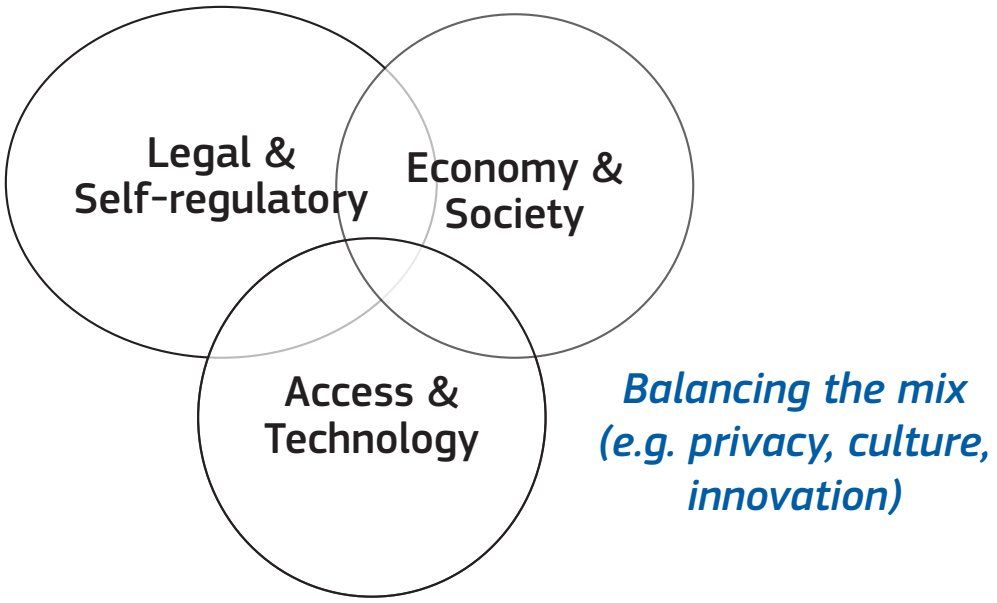
Horizon 2020 is the financial instrument implementing the Innovation Union [6], a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness. Running from 2014 to 2020 with a proposed EUR 80 billion budget, the EU's new programme for research and innovation is part of the drive to create new growth and jobs in Europe.

Horizon 2020 provides major simplification through a single set of rules. It will combine all research and innovation funding currently provided through the Framework Programmes for Research and Technical Development, the innovation-related activities of the Competitiveness and Innovation Framework Programme (CIP) and the European Institute of Innovation and Technology (EIT).

The proposed support for research and innovation under Horizon 2020 will, according to the Commission's proposal [7]:

- strengthen the EU's position in science with a dedicated budget of EUR 24 598 million: this will provide a boost to top-level research in Europe, including an increase in funding of 77 % for the very successful European Research Council (ERC);
- strengthen industrial leadership in innovation with a budget of EUR 17 938 million: this includes major investment in key technologies, greater access to capital and support for SMEs;
- provide EUR 31 748 million to help address major concerns shared by all Europeans such as climate change, developing sustainable transport and mobility, making renewable energy more affordable, ensuring food safety and security, or coping with the challenge of an ageing population.

Figure 3: Balanced mix of privacy, culture and innovation



In the approach the European Commission is taking, the integration of economical, technological, societal and legal aspects are integrated to achieve full impact (Figure 3). Hence, the glue between the various aspects of the tool sets described above to foster innovation is currently thoroughly elaborated, in order to provide a flying start to the new framework, Horizon 2020, in the year 2014.

### *Changed innovation process*

It is important when planning for new innovation support activities to see the new innovation paradigms shifting from linear innovation models to strongly parallel ones. Successful innovation combines several disciplines, all stakeholders and societal and technological drivers.

The linear innovation model may still be valid for some industries, for example related to drug research, but the more we shift to knowledge society-related innovation, the stronger we see the parallelism of the different innovation elements. They both increase the speed of innovation as well as the success rate of the deployment.

Referring to the bridge analogy (Figure 4), we actually should speak about a set of bridges, each having their specific role in the process leading to strong cross-fertilisation of ideas, technologies and the societal drivers. All the stakeholders (industry, research, public sector and the user community) need to be involved.

The wisdom of crowds (crowdsourcing, crowdfunding, etc.) is a strong element in modern innovation processes but, so far, we do not have much evidence of successful large-scale crowdsourcing activities, except, perhaps, the best known example: the Linux operating system. However, it is evident that crowd resourcing is growing due to the easier connectivity of actors sharing common values and objectives. Hence, in modern innovation systems, we need to pay attention to the processes supporting better use of the power of the crowds.

This user-centric, sharing-based innovation ecosystem approach is very much open: it also demands new types of IPR which foster sharing and value creation based on creative commons.

Figure 4: The bridge analogy

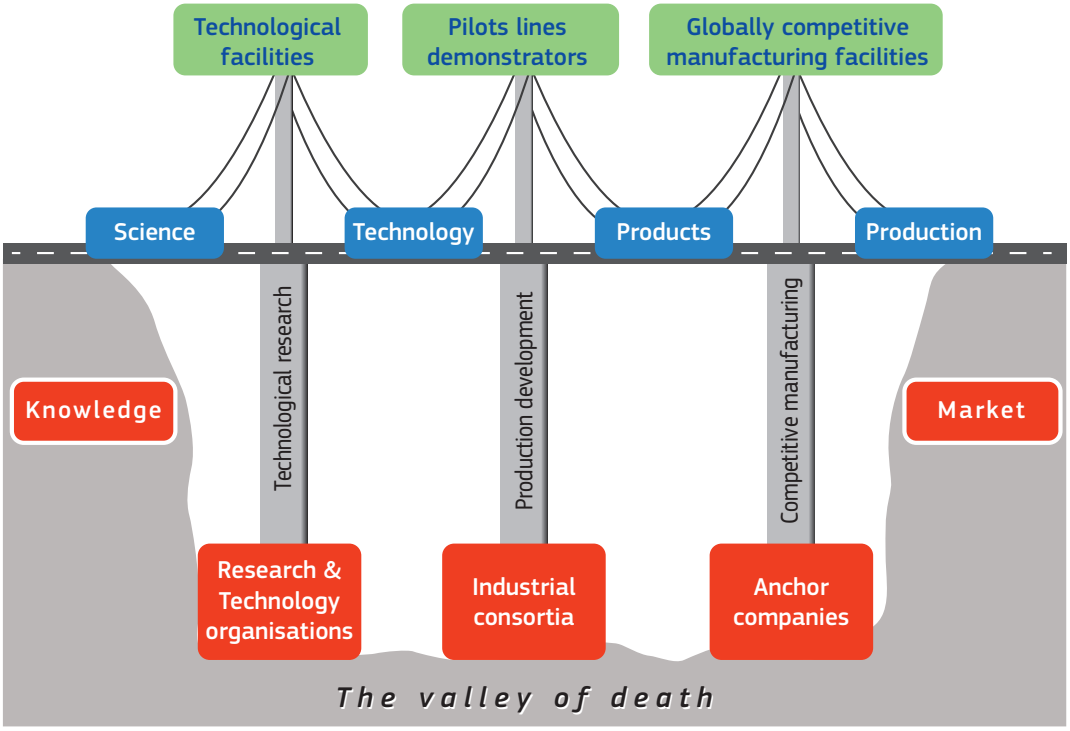
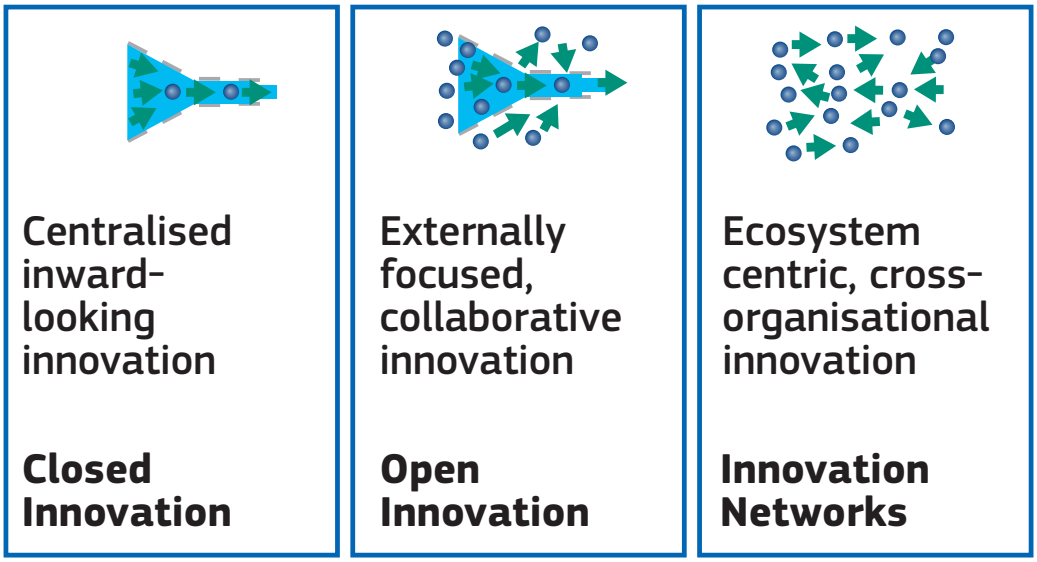


Figure 5: The bridges

The approach we can observe, for example, in the Living Labs, encourages open interaction between users and suppliers throughout the innovation and development process. This leads to real-life prototypes and experiments and to scalable and multipliable solutions which shape the markets. Rapid prototyping means also faster innovation processes, and faster feedback on the successful solutions. However, on the other hand, it also means failing fast, and not wasting time, energy and money on solutions which have no market potential: continuous user involvement is thus essential.

Figure 6: The evolution of innovation



Innovation dynamics have increased, also leading to new requirements for successful and sustainable innovation ecosystems (Figure 6). Experimenting and prototyping better enable trials of entirely new and risky solutions and also call for a new type of daring leadership.

Thus, the characteristics of sustainable innovation are the following.

- It is full of disruptions!
- It is about (value) choices!
- It is beyond (political) buzzwords!
- It is holistic!

All this means increased risk-taking (in a managed way) but, at the same time, greater gains for successful and, often daring, new solutions. Does the approach in Horizon 2020 allow modern innovation? My answer is definitely 'Yes', but it requires courage to take the new approach in practice.

### *New instruments*

As I write this article, new instruments which support faster innovation cycles, with higher return rates, are being developed at the Directorate-General for Communications Networks, Content and Technology.

The new approach to support innovation in a more holistic manner can, for example, be seen in the tools developed for the new Horizon 2020 framework.

Firstly, as mentioned earlier, the whole Horizon 2020 programme structure supports demand-orientation that links interdisciplinary thinking to problem-solving. The science-driven innovation part of the programme supports the growth of new science and technology-based results to be harvested in the other parts of the programme.

The new tools currently in discussion are, for example, the extension of the piloting approach currently in the seventh framework programme. The pilots were used, for example, in the IST PSP programme to verify, in large-scale pilots, the platform thinking in cross-border applications. These pilots were driven by public sector organisations. Examples of these can be found in eHealth, eGovernment and eProcurement.

In the new approach, piloting is extended beyond the downstreaming, to prototyping, testing and demonstrations in real-world settings. This, as discussed earlier, enables faster identification of the potentially successful approaches but, likewise, helps to fail fast, avoiding costly failures at a too late stage. The pilot/experimentation approach enables seamless integration of demand-side innovation with a technology-enabled approach. Users will be also in important role in this approach — ideally, involved in all stages of the projects.

Pre-commercial procurement and public procurement of innovation will be reshaped and extended to, ideally, provide the necessary bridge from prototypes and experiments to scale-up. Public sector procurers have tremendous purchasing power, meaning that their impact on take-up of modern solutions can be of crucial importance.

Importantly, inducement prizes will also be proposed. They drive real solutions which are often application-oriented. Prizes attract new constituencies who are not usually involved in EU projects. Prizes also publicly highlight well the issues to be solved. Current thinking is based on three categories of prizes, namely: grand prizes (up to EUR 10 million); major prizes (up to EUR 6 million); and sectorial prizes (up to EUR 1 million). Prizes ideally bridge research results to commercialisation without predetermining the structure or technology of the solution.

From the open innovation perspective, perhaps (besides prizes) the most interesting scheme is the non-descriptive, open, light and fast scheme which supports disruptive innovation. This approach does not predetermine the topic area, but proposes a cross-sectorial approach and leads to high rewards and high impacts. The risk level of this initiative is rather high, but by dividing the process into phases, the risk is managed. At the same time, it maintains the openness and incentive in the scheme.

One of the targets of this scheme is to create new markets through the disruptive approach, which very often also involves the strong presence of the problem owner (clientele, citizens) in the project execution. At its best, it enables co-creativity in innovative solutions.

The scheme is divided into three phases: the first is a feasibility study and demonstration, funded up to some EUR 50 000. After this period, the most promising 20 % can continue for 6–9 months to the next phase, which consists of validation and trialling the solution in real-world settings. Funding for this experimentation phase would be up to some EUR 2 million for a maximum of 18 months. At the end of the second phase, prizes could also be granted for the most successful based on the impact and scalability of the solution.

SME funding has been discussed thoroughly. One of the issues is to see clearly that one size does not fit all: the focus needs to be on growth-hungry and even on atypical SMEs and entrepreneurs. SME-enablers are critical also from the perspective that SMEs are often very dynamic and knowledgeable players in business ecosystems and bring agility and focused solutions to specific problems. It is important to realise that the (ICT-oriented) SMEs do not have 'children's' tickets as they are immediately exposed to global competition. This is especially true for the new generation of web entrepreneurs.

It is very important that a European dimension is maintained in the SME actions in Horizon 2020. One possible approach could be to adapt the US-based SBIR (Small Business Innovation Research) approach to the European context. Further details of the SME instrument are still open when writing this text, but I am sure that the new approaches will be welcomed among the most dynamic innovation actors.

## *Organisational changes to fit the challenge*

Reflecting this new approach of the European Commission's Directorate-General for Communications Networks, Content and Technology, the organisation is also well tuned with its Net Innovation Unit focusing on Internet entrepreneurship — the Innovation Unit is focusing on modern innovation methods and their implementation in the new Horizon 2020 programme. Likewise, the new Stakeholders Unit has a significant role: to discuss with our constituency the strategy and operations to foster innovation in a more holistic manner. It is also important that, in this context, there is a widened stakeholder debate, more than that seen in the more focused programming approach.

All these activities aim at more fluid innovation interaction ranging from ideation to experimentation and execution. Hence, it is also important to see how, at the actors' level, all these instruments are used to create a meaningful integrated approach: one could say innovation ecosystem and action within. The isolated non-interacting projects based on sequential innovation models are likely not to be mainstream.

## *Innovation ecosystem thinking — for full impact*

Successful innovation ecosystems seem to have the following drivers already in the design phase, based on the observations of the expert group advising the Directorate-General for Communications Networks, Content and Technology on innovation [8]:

- success rate and speed are the keys;
- freedom is prerequisite for creativity;
- courage leads to strong commitment and further engagement;
- wealth/well-being creation is the value driver instead of cost minimising;
- openness of the ecosystem attracts inwards investment (intellectual, capital).

Services and concepts require a good knowledge of the local market; hence, the ecosystems need to have a strong local presence in real-world settings. The local setting means, in turn, that the role of the individual, the citizen, becomes increasingly important.

When the dynamics of market creation is achieved, the local ecosystems become a source for highly reliable market evaluations for companies, and are thus tempting to both intellectual and capital investment locally. In turn, the involvement of users leads to a significant reduction in societal, technological and business risks.

For SMEs and start-ups, the greatest benefit is that they will be able to assess the market attitude to their ideas, concepts, products or services at a very early stage. For large companies, the experimentation on new business models and, thus, business model innovation is both faster and easier.

## *Conclusions*

The design of new innovation ecosystems, such as further development of the Living Labs, requires a strong vision as to how to get all the stakeholders more actively involved. User-centricity is not enough, as we need to have user-driven innovation more firmly in place. The users turn from objects to active subjects, where they are involved in all stages, including very early ideation and prototyping.

This approach, together with open platforms, open data and open processes, makes it possible to bring technology closer to people and organisational needs and, at the same time, to shape future market development.

In these 'next-generation' Living Labs, open platforms also enable new types of entrepreneurship, such as micro-multinationals, and even social enterprises beyond the traditional business models.

Challenges for these open innovation ecosystems are leadership and the common desire to be attractive to all kinds of players from large to small, in strong and trusted interrelationships. They need to provide high connectivity across the ecosystem (including society) and to openly foster interaction

and joint growth in an organic, non-predetermined way. This opportunistic approach can be called an 'organicsational approach', combining the organisational and organic aspects.

Can these ecosystems be created by a control approach? Or, do we need to have a more catalytic, encouraging approach? The latter is what you will see in the European Commission's Horizon 2020 activity. You are welcome to join in!

## *References*

[1] European Commission (2010), Communication from the Commission, *EUROPE 2020 — A strategy for smart, sustainable and inclusive growth*, COM(2010) 2020 final, Brussels (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF).

[2] European Commission (2010), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *A Digital Agenda for Europe*, COM(2010) 245 final/2, Brussels (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0245:FIN:EN:PDF).

[3] European Commission (2012), *Digital Agenda for Europe: Scoreboard 2012*, Brussels (http://ec.europa.eu/digital-agenda/en/scoreboard).

[4] European Council (2012), *The conclusions of the European Council*, 1 and 2 March 2012, Brussels (http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/128520.pdf).

[5] European Commission, press release (2011), *Connecting Europe Facility: Commission adopts plan for €50 billion boost to European networks*, Brussels (http://europa.eu/rapid/press-release_IP-11-1200_en.htm).

[6] European Commission (2011), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *Horizon 2020 — The Framework Programme for Research and Innovation*, Brussels (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0808:FIN:en:PDF).

[7] European Commission, Research and Innovation (2012), *The EU Framework Programme for Research and Innovation*, Brussels (http://ec.europa.eu/research/horizon2020/index_en.cfm?pg=h2020).

[8] Open Innovation Strategy and Policy Group (2012) (http://www.openinnovation-platform.eu/).

## *Contact*

**Bror Salmelin**
Advisor, Innovation Systems
European Commission, Directorate-General for Communications Networks, Content and Technology
bror.salmelin@ec.europa.eu

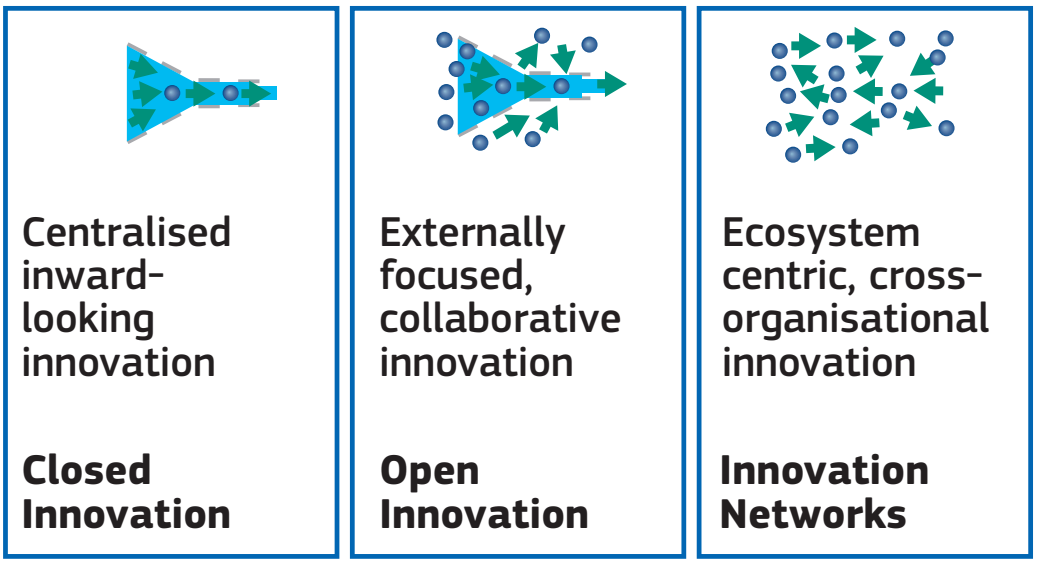
## 1.2. Innovation ecosystems: a conceptual framework

### *Introduction*

Why is an innovation successful in one organisation and met with resistance in another? How is it that certain innovations diffuse easily through an environment while others just spin their wheels? What are the implications of new paradigms such as *open innovation* for our very understanding of the term? These are some of the questions that increasingly exercise the minds of managers, entrepreneurs, policymakers and academics as they grapple with the perennially important topic of innovation. After almost half a century of intense research and theorising, the academic contribution to answering these questions is less than convincing. For example, in a review of the prolific growth in innovation publications, Wolfe [1] concluded that it had made little contribution to the understanding of innovative behaviour in organisations. The results presented were largely 'inconclusive, inconsistent and characterised by low levels of explanation' (p. 405). More recently, Fagerberg [2] states that our understanding of how innovation operates is still fragmentary and 'that further conceptual and applied research is needed' (p. 20). Whilst Teece [3] says 'no study of innovation can ever claim to have the last word on the subject'. The phenomenon is too complex, dynamic and adaptive to fit into a single conception for any extended period of time. Such characteristics prompt the examination of whether it is appropriate to look at new theories. Figure 1 outlines the progression of innovation from a closed innovation paradigm, to an open innovation paradigm, to the recent formulation in terms of innovation networks.

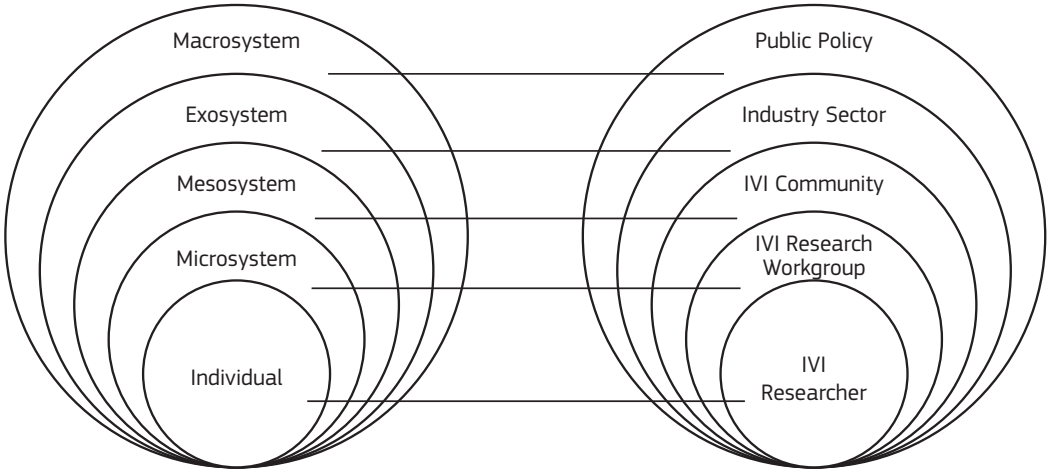
The evolution of innovation toward an ecosystem centric, cross-organisational configuration creates a compelling logic and case for exploring an ecological theory perspective [4]. Such an analysis prompts this research objective: to develop a theoretical framework that can position the person as the cornerstone of the innovation phenomenon and incorporate the broad spectrum of teams, organisations, inter-organisational networks and public policy, while treating these interconnections as dynamic interactions subject to the contingencies of time and history. The framework that we build on is that of ecological systems theory (EST), which provided a new perspective for research in human development when it was introduced by Urie Bronfenbrenner [4]. The benefits of the framework include: providing a fresh perspective for researchers to investigate the phenomenon; integrating the complexities and deficiencies identified in the literature; and presenting innovation as a dynamic interactive process resulting from the encounter between people and

Figure 1: Evolution of innovation (Source: Salmelin (http://www.slideshare.net/globalforum11/2-bror-salmelin) after Chesbrough, Forrester and Von Hippel)



their environment with its technological capability. Some commentators use the metaphor of a biological ecosystem to describe the nature of a business ecosystem. A key characteristic of an ecosystem is that it is evolving with organic, diverse and symbiotic attributes. The principle of synergy is central — the idea that through collaboration, entities can deliver something which is unattainable on one's own. Ecosystems are also complex adaptive systems. Once the raw materials are put in place and the initial relationships and couplings established, they are often self-organising and self-regulating according to Darwinian principles. In *Knowledge Driven Entrepreneurship* (Springer publications), Andersson, Curley and Formica define a business ecosystem as 'a network, or coalition, of resources, competencies, potential, energy, commitments, and promises to realise a shared profitable future'. Geographical or virtual ecosystems can span or traverse a number of business ecosystems. Figure 2 shows the mapping of the Innovation Value Institute as an innovation ecosystem which will be described in more detail later.

Figure 2: Innovation Value Institute as an innovation ecosystem




## Background

The seminal Minnesota Innovation Research Program (MIRP) concludes that further theoretical development is required to incorporate local and global phenomena 'at different levels of analysis, such as how individuals *relate* to project teams, teams to organisations, organisations to a larger industry community' [5] (p. 641). Storey [6], in his review of key articles from over 30 years of research, emphasises the growing prevalence of alliances and inter-organisational networks with their increasing importance for innovation. A prominent theme emerging from studies in the area is the subject of social relationships that includes factors such as 'persuasion, influence, politics and power' [6] (p. xxvii). The growing significance of the *open innovation* paradigm has prompted West, Vanhaverbeke and Chesbrough [7] to propose a research framework with the following classifications: individual, organisational, value network, industry/sector and national institution [7] (p. 288). In related work, Vanhaverbeke and Cloodt [8] suggest that emerging forms of value networks must be examined at the level of different nested layers. These diverse layers span the spectrum from the individual; to firms/organisations; through Dyads; and on to inter-organisational networks, ultimately reaching national/regional innovation systems. Fonseca [9] — building on the work of Stacey [10] — argues that innovation needs to be viewed in a much more human-centred way, conceptualised as a complex responsive process of relating between people. Lester and Piore [11] propose that the great project of developing a creative economy rests on the uniquely human capacities of rational analysis and creativity. They define these two fundamental processes as *analysis* and *interpretation* and express their concern at the increasing neglect of the latter in management strategies.

### Analysis of prior theory and research

Many scholars trace the introduction of innovation into the realm of economic and social change to Joseph Schumpeter's seminal work [12], *Theorie der Wirtschaftlichen Entwicklung* (Theory of Economic Development). Schumpeter's writing spanned

a period of 40 years from his undergraduate days at the University of Vienna to his term as Professor of Economics at Harvard [13]. According to Marz [14], he is one of the few social scientists who bequeathed an 'intellectual legacy that continues to attract new generations of students teachers, scholars and politicians' [14] (p. xv). Innovation, and bank credit, according to Schumpeter, are the economic mechanisms 'that define a large part of the history of mankind' [13]. In his *Theory of Economic Development*, he classified innovation into five categories: new products (or goods); new methods of production (or processes); new sources of supply (or half-manufactured goods); the exploitation of new markets; and new ways to organise business. In Schumpeter's original schema, innovation is accomplished by 'entrepreneurs' who developed new combinations of existing resources [15]. However, in his later works, he came to regard the large corporation as the innovative engine driving the development of leading economies [16]. His emphasis on the *entrepreneur* being a single individual changed to viewing the concept as capable of being embodied by a collaborating team of people. In the 1940s, he published his classic *Capitalism, Socialism and Democracy* which, in a salient point for contemporary economics, predicted the demise of capitalism becoming a victim of its own success [17]. McCraw [18] concludes that the history of information technology confirms Schumpeter's thinking. On the significance of the pioneer and innovator (i.e. the entrepreneur), he has this observation to make.

*The pleasure derived from being creative and from pushing through sporadic innovations is the prime factor from which the acquisition of economic power is derived.*

Later in his career, Schumpeter paid increasing attention to history 'as key to understanding not only capitalism but economic life in general' (McCraw [18], p. 248).

Fagerberg [2] makes the fundamental distinction between invention and innovation: the former is regarded as the 'first occurrence', while the latter is the 'first attempt to carry it out into practice'. This is in line with Van de Ven's [19] assertion that 'an invention or creative idea does not become an innovation until it is implemented or institutionalised'. Storey [6] concludes that the very meaning of the term 'innovation' has been both controversial and problematical. One of the main challenges of a review of innovation is the range of definitions from a wide body of literature. In their analysis of the terms *innovation* and *innovativeness* from 21 empirical studies in the new product development (NPD) literature, Garcia et al. [20] discovered that 'no less than 15 constructs and at least 51 distinct scale items' were used leading to a great deal of ambiguity (p. 110). The Minnesota Innovation Research Program (MIRP) resulted in important pioneering work on innovation and its publications are generally known as the Minnesota studies [5]. The MIRP was carried out by approximately 40 researchers who conducted longitudinal studies of 14 innovation cases during the 1980s. Four basic factors are implicit in their work: new ideas, people, transactions and institutional context. The increasingly important role of academia in supporting innovation in knowledge-based societies has led to the development of a number of models from national systems of innovation (NIS) [21] to the more recent triple helix model of university–industry–government relations [22]. The fragmentation of organisational-driven innovation by the diffusion of ICT has resulted in the move towards open and user-led innovation. Furthermore, the development of social networking and networks of practice is currently the subject of growing academic interest.

Table 1 summarises some important theoretical contributions to innovation studies described in this introductory section. However, this sample is by no means exhaustive given the voluminous and eclectic nature of innovation studies.

**Table 1:** Some historically important contributions to innovation studies

| Date | Source | Contribution |
|---|---|---|
| 1930s | Schumpeter | Introduced the concept to social studies |
| 1960s | Wilson | The innovation dilemma |
| 1970s | Zaltman et al. | Contingency theory |
| 1980s | Walton | Interaction of individual, org. and environment |
| 1980s | Pettigrew | Context, content and process |
| 1980s | Van de Ven et al. | Minnesota studies |
| 1990s | Slappendel | Innovation perspectives |
| 2000s | Christensen | Disruptive innovation |
| 2000s | Henderson and Clark | Innovation types |
| 2000s | Fagerberg | Oxford handbook of innovation |

In the course of his work, McInerney [23] assembled over 30 author-centric definitions of innovation from publications since 1960. These were built, like Russian dolls, from antecedent work by Rahmanseresht [24] and that of Zain [25]. A list of these innovation definitions are presented in Appendix 1. A content analysis of the innovation definitions was carried out by converting the author-centric definitions in the literature into a concept-centric format, and then published [26]. This was in order to identify the most common concepts and also ones that may require further attention [27].

To summarise, prior research does not adequately encompass the innovation spectrum which can be broadly described as follows: the person as the protagonist of the innovation phenomenon, operating in an ecological milieu spanning from immediate collaborators and organisations to national systems embedded in a cultural context. Furthermore, existing theories do not sufficiently account for the dynamic relationship between person and environment that is contingent on the flow of time and history.

## *Theoretical development*

Elsewhere, we have proposed the ecological systems theory (EST) as a meta-theoretical framework for the study of innovation and information systems [28]. We have also used the EST to examine a particular ecosystem — the Innovation Value Institute [29]. In this paper, we will argue that the EST can illuminate an historical analysis of innovation definitions in order to develop a conceptual framework to assist further work in the general innovation area. With this aim, we will now introduce the ecological systems theory and suggest that it provides a suitable framework for researchers to approach the topic of innovation ecosystems.

### Ecological theories: an overview

This section provides an overview of prominent ecological theories and provides a background to our argument that the framework of Urie Bronfenbrenner is most suitable to meet the present theoretical deficiencies in information systems (IS) innovation research.

Firstly, we will define the term 'ecology' for the purpose of this paper. The ecological approach is normally taken as the interaction between an organism and its environment [30]. However, a recent explanation of the term in the Oxford Dictionary of English (2005) defines ecology as 'a branch of biology that deals with the relations of organisms *to one another* and their physical surroundings'. Therefore, we would like to build on this concept of the primacy of the relationship to others by offering the following definition: *an ecological approach is the study of the relationships between a person and their environment and to other collaborators within the environment*.

Kurt Lewin is regarded as both the father of social psychology and of action research, and is famous for his assertion that there is nothing as practical as a good theory. He believed that a fundamental goal of researchers is to put their theories into action in order to make the world a better place in which to live. Lewin trained in Europe during the early years of the 20th century and his academic training was greatly influenced by the Gestalt movement. Gestalt psychology proposes that an organised whole is perceived as more than the sum of its parts [31]. Borrowing an analogy from physics, he developed his psychological *field theory* which evolved into his conception of *ecological psychology* and this was further refined in the 1950s by his students Roger Barker and Herbert Wright [32]. Lewin argued that scientific research requires a transition from the static classifications of what he termed an *Aristotelian* paradigm to a dynamic *Galilean* paradigm. The latter examines the underlying theoretical processes which bring about the observed phenomenon [33].

J. J. Gibson was another influential theorist who introduced an ecological approach to the study of perception psychology. This arose from his work on pilot selection and the spatial challenges resulting from flying aircraft [30]. Gibson [34] proposed that the contemporary account of natural vision as a sequence of snapshots, *aperture vision*, be replaced by a dynamic perspective that took into account *ambient vision* and *ambulatory vision*. He developed his theory by considering an animal or person and their environment as an inseparable and mutual pair. Furthermore, the environment ranging from atoms to galaxies consists of structural units organised in such a way that smaller units are embedded in larger units in what he termed *nesting*. From the point of view of perception, the most important levels are the ecological levels of the habitat which can be perceived by the sense organs such as things we can 'look at and feel, or smell and taste, and events we can listen to' [34] (p. 9).

*Organisational ecology* is a prominent body of theory in sociological research that examines the interactions within and between populations of organisations. Its chief apologist, Michael Hannan, introduced the idea in the 1970s building on evolutionary perspectives such as adaption and selection. Hannan developed his early work by engaging in the debates initiated by the influential Amos Hawley whose structural theory had launched a branch of research in the

field of sociology [35]. Hawley's emphasis on the critical role of technology — in what he termed *human ecology* — is of particular interest to this study. However, after 30 years of mainly empirical work in *organisational ecology* there is a major concern with the fragmentation of research in the area. Hannan and his collaborators have recently sought to address this issue by undertaking a project of theoretical integration and unification that investigates the relationships between the distinct fragments [36]. Previous studies in organisational ecology had utilised theories involving such concepts as 'legitimation, age dependency, competition and inertia' [36] (p. 290). Their current proposal offers deeper conceptualisations through adopting an approach based on a *non-monotonic logic*, together with *fuzzy-set theory*, which, they argue, changes the fundamental theoretical core of the discipline.

**Bronfenbrenner's ecological systems theory**

Urie Bronfenbrenner spent most of his professional career as Professor of Human Development, Family Studies and Psychology at Cornell University. His development of the ecological systems theory [4] is regarded as having revolutionised studies in these areas by shattering barriers and building bridges among the social science disciplines. Previous to Bronfenbrenner's work, the study of human development was compartmentalised among psychology, sociology, anthropology, economics and political science. However, through the concept of the ecology of human development, these disparate environments were integrated into a holistic conceptual framework of interdependent nested systems where human development was viewed as a continuum [37]. Bronfenbrenner viewed a 'child's development within the context of the system of relationships that form his or her environment' with each complex 'layer' influencing the development [38]. His own conception of the theory was as 'a set of nested structures, each inside the next, like a set of Russian dolls' [4]. He acknowledges the debt he owes to the theories of Kurt Lewin who expressed behaviour as a function 'of the interplay between person and environment' in the form of a classic equation shown below. Furthermore, Bronfenbrenner affirms that his theoretical framework originated from Lewin's antecedent work that places behaviour in context: 'situational, interpersonal, sociological, cultural, historical and above all theoretical' [3] (p. 43).

$$B = f(PE)$$

Lewin's well-known formula expresses *behaviour* (B) as a combined *function* ($f$) of forces from within a *person* ($P$) and from the external *environment* ($E$) [32].

Bronfenbrenner argued that Lewin's formulation did not include a time dimension and proposed his own version of the equation for the area of human development. Here, development is regarded as a function of the person interacting with the environment. This includes the effects of both constancy and change (the time dimension) on personal characteristics throughout the life span which is captured in the following equation.

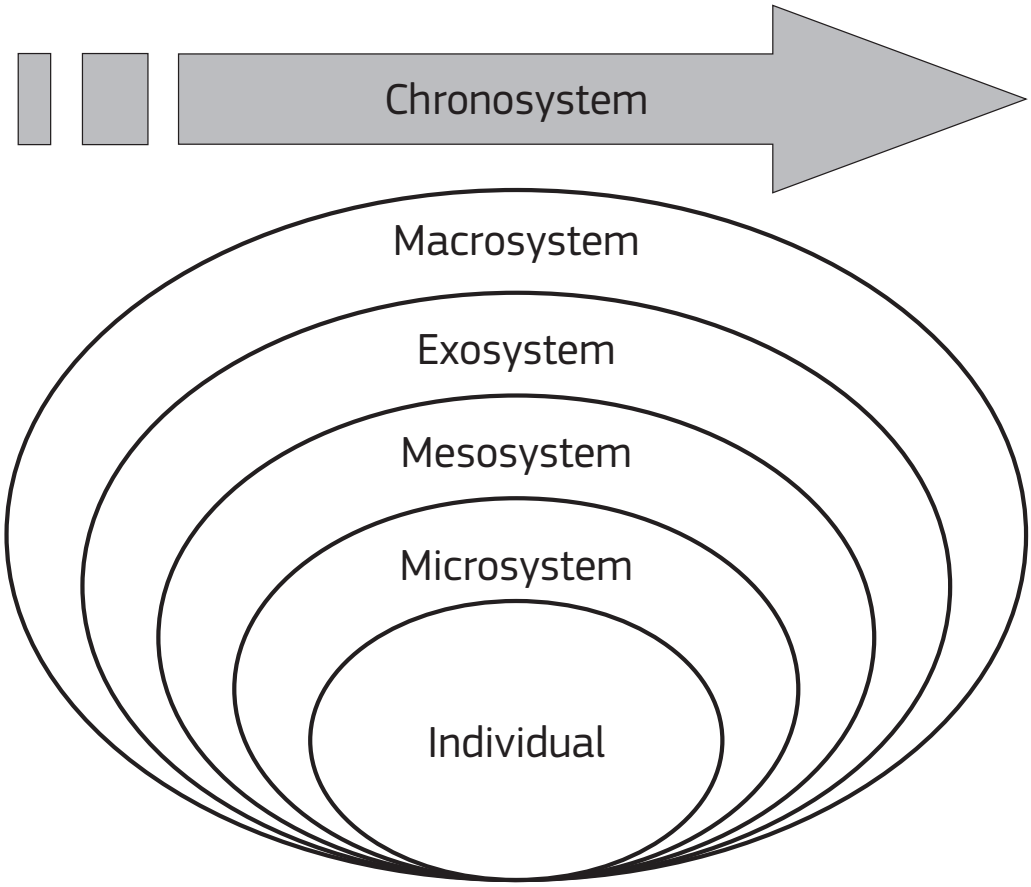
$$D = f(PE)$$

Bronfenbrenner affirmed that a major motivation for his work was to provide both psychological and sociological depth to Lewin's theories. From an information systems viewpoint, it is significant that he claimed his theory differed from antecedent research models in that he analysed the environment in *systems* terms. His theory is shown diagrammatically in Figure 3.

We will now, firstly, describe each nested layer of the modified Bronfenbrenner model where the 'patterned behaviour' is determined by the following.

1. Individual level: intrapersonal factors — characteristics such as knowledge, attitudes, behaviour, self-concept, skills, etc., including the developmental history of the person.
2. Microsystem: interpersonal processes and primary groups — formal and informal social network and social support systems, including the family, work group and friendship networks.
3. Mesosystem: institutional factors — social institutions with organisational characteristics, with formal (and informal) rules and regulations for operation.
4. Exosystem: community factors — relationships among organisations, institutions, and informal networks within defined boundaries.
5. Macrosystem: public policy — local, state and national laws and policies.
6. Chronosystem: this was a later addition by Bronfenbrenner [5]. The concept 'encompasses change or consistency over time not only in the characteristics of the person but also of the environment in which that person lives' [39].
7. We have presented our argument that Bronfenbrenner's theory best matches the criteria developed earlier due to its comprehensive topology, its focus on relational interactions, and its synthesis of the concepts of ecology and systems. We will now present our adaptation of the model to address two main issues: incorporation of technology and emphasising the importance of collaboration in the IS innovation process.

Figure 3: Ecological systems framework [28]




**Elements of an ecological systems theory for IS innovation**

Based on the foregoing analysis, we will now present our framework to analyse innovation based on Bronfenbrenner's theory. The structure is based on the implicit assumption that innovation originates from the human person but is significantly influenced by interaction and interconnection with the five other layers. We conceptualise our argument by modifying both Lewin and Bronfenbrenner's equations in a format that explicitly included the time dimension:

$I_{(t)} = f\,(P_{(t)}\, E_{(t)})$ (equation 1)

The next step is to propose a formula to capture the theoretical concept of an EST for IS innovation which builds on both Lewin and Bronfenbrenner but specifically includes two extra dimensions: technology as an integral component of information systems and the interpersonal interconnections that are essential to the innovation process. The subject of technology is not specifically addressed in Bronfenbrenner's final work. However, it is alluded to via a quotation from the work of Lev Vygotsky who was influential on the development of ecological systems theory. As pointed out earlier, theorists such as Hawley have stressed the importance of technology when seeking to understand human ecology. The relational aspect is captured in Bronfenbrenner's description of the ecological *microsystem*. However, we propose that the concept is explicitly included in our formulation given its importance for the innovation process which, in both the initiation and implementation stages, cannot be carried out in total isolation.

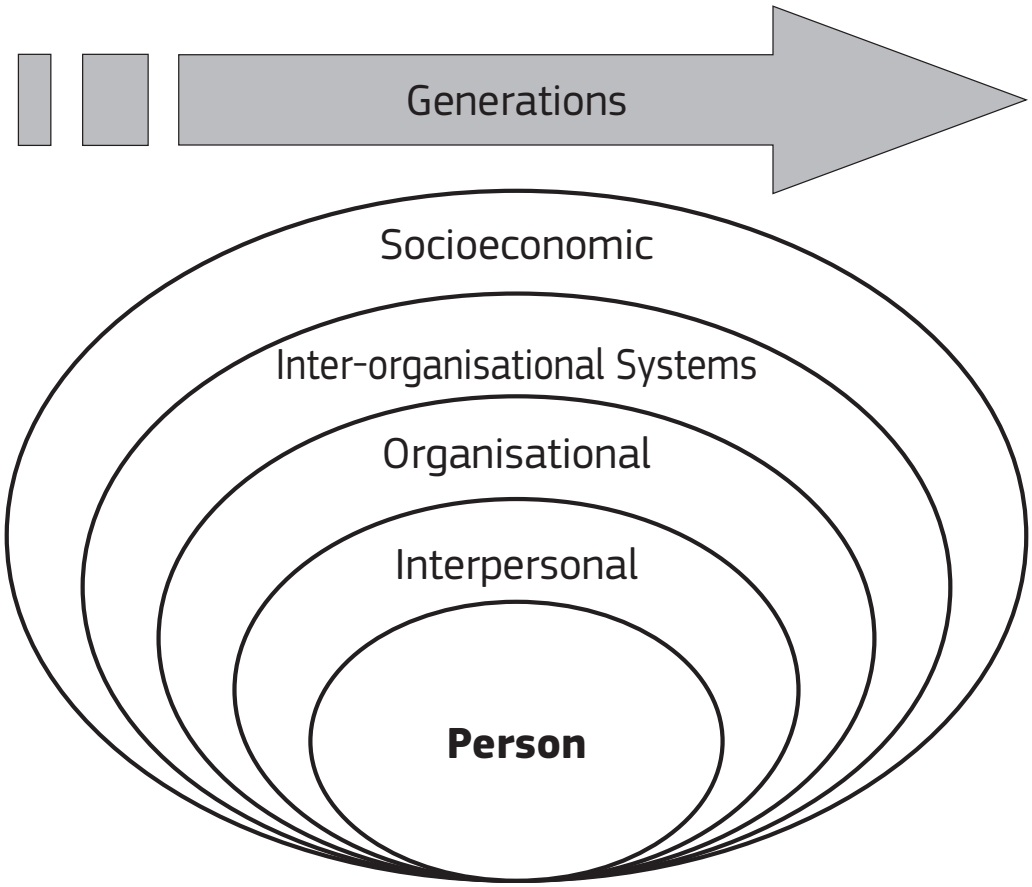
ISI(t) = f (P (t) R (t) E (t) T (t)) (equation 2)

Where:

ISI = information systems innovation
P = person
R = relational connections to collaborators within the innovation context
E = environment
T = technological capability

The adapted framework for IS innovation is illustrated in Figure 4.

Figure 4: An ecological systems framework for innovation [29]




The revised innovation framework is now described and a small number of references are included as examples.

1. Personal dimension: this layer includes the intrapersonal characteristics that assist or inhibit innovativeness. Development of knowledge, skills and competencies through education and training to support innovation both in terms of creative invention and of implementation are relevant here [40].
2. Interpersonal: formally, this dimension will include the ability to contribute to, and direct, teams or work groups. Informally, it will include social networks, communities of practice and personal contacts, both inside and outside the organisation. Interpersonal attributes such as empathy will also be deemed relevant in this layer [41].
3. Organisational: the characteristics of the organisation that the person is a member of will be significant for this layer. Culture, climate, and the management of innovation and change will influence the person's tendency to innovate [42].
4. Inter-organisational systems: this layer will include relationship of the organisation with peer organisations, academic institutions, and state-sponsored support bodies [22]. The layer will also encompass formal and informal networks, clusters that support innovation, and the general area of inter-organisational systems (IOS) which has an increasing influence on business-to-business (B2B) and business-to-government relationships.
5. Socioeconomic: this dimension will include innovation policy at local, regional, state and supranational (e.g. the European Union) levels, National Systems of Innovation (NSI) [21], indicators of innovation [43] and important economic theories of innovation [12].
6. Chronological generations: analogous to human development, 'generations' can encompass a number of concepts. At a macro level, it will take cognisance of the time dimension of the innovation environment which has been, for example, outlined in Rothwell's taxonomy of innovation processes [44]. At the organisational level, this would involve assessing the

innovation maturity level such as the 'archetypes' of innovation proposed by Tidd et al. [45]. In the realm of information systems, Ward et al. [46] developed a three-era model of IS to illustrate this concept.

### *Implication of the theory*

Building on this antecedent body of literature, we will now summarise our argument for the adoption of ecological systems theory to examine innovation ecosystems. This approach, we argue, meets the ecological criteria outlined earlier as it:

- addresses gaps in literature that identify the need for an ecological conceptualisation of innovation;
- provides an impetus to an important area that has stagnated due to a dearth of theory;
- adapts a theory that is highly regarded in the wider academic community: good theories are generally applicable [4] [47];
- provides a framework that responds to the call for a more interdisciplinary and cross-functional approach to this research area;
- firmly places the human acting person as the fundamental wellspring of the innovation process [48];
- focuses on the human aspect which can provide an impetus for the philosophical debates in reference [49] and invites further reflection on Lee's rejection of the 'objectivist ontology' that knowledge can exist independently of knowing subjects;
- provides guidance for practitioners, for example strategic managers, portfolio managers, and R & D managers, by providing a framework to deal with the emerging Innovation Landscape;
- introduces a novel methodological approach that opens up research possibilities: the ecological experiment;
- encompasses the dimension of time which has not been significantly explored in the innovation discourse.

Now, we will suggest how the ecological systems theory addresses the gaps in the innovation literature outlined at the beginning of this paper [50]. The first is the *lack of clarity* as there are numerous different definitions of innovation and theoretical frameworks as outlined in Appendix 1. The second is the *lack of theoretical glue* which should be present to bind all the factors together by means of a strong underlying logic and rationale. Innovation studies are multidimensional and complex and have not been extensively classified in the literature. The third is the *lack of cumulative tradition* as a good concept or theory should build on existing research. The fourth is a *lack of parsimony* as there is much redundancy and duplication in the definitions of innovation. Finally, there is *limited applicability* as existing theories and definitions are restricted to narrow scope conditions. We argue that the ecological systems theory expands and interlinks the landscape innovation.

## Discussion: a practical application of the theory

Now, we will outline a practical application of the theory specifically in the area of information systems illustrated by using a case study of the Innovation Value Institute (http://www.ivi.ie). The discipline of information systems (IS) has been considered to have certain failings in its effort to impact on practice [51]. Additionally, Sambamurthy and Zmud [52] noted that there is a growing gap between scholarly research and the needs of practitioners. There have been numerous research studies identifying failures in IS in its attempts to achieve the desired outcomes, and disappointments in assessments of return on investment [53] [54]. The analyses in these studies often yield recommendations that operate at a high level of abstraction and lack the detail and specificity to lead to action-oriented solutions. Such findings, while offered in a constructive spirit of helpfulness and concern for continuous improvement, do little to advance either (i) the capability of practitioners to achieve their goals or (ii) the theoretical knowledge underpinning IS academic research. One of the requirements for a more helpful methodology is a more systematic approach with greater sensitivity to the contextual complexity of the organisational problem-solving environment where IS practitioners work.

The development of the IT-CMF (The Information Technology Capability Maturity Framework) [55] [56] is a response to the need for a more systematic, comprehensive approach to managing IT in a manner that meets the requirements of practising IT professionals. This research is being undertaken by the Innovation Value Institute. Applying the principles of Design Science Research (DSR) [57], IT management is being investigated using a design process with defined review stages and development activities based on the DSR guidelines advocated by Hevner et al. During the design process, researchers participate together with practitioners and subject matter experts within research teams to capture the working knowledge, practices and views of key domain experts.

Developing innovative artefacts is a central activity in DSR [58]. Such artefacts can be in the form of constructs, models, methods or instantiations. For

the construction of such artefacts, two basic activities can be differentiated: build and evaluate, where building 'is the process of constructing an artefact for a specific purpose' and evaluation 'is the process of determining how well the artefact performs' [58] (p. 254). The construction of an artefact is a heuristic search process. Within this process, an extensive use of theoretical contributions and research methodologies stored in the knowledge base should be made. On the one hand, theoretical contributions can come from governance, value-based management, risk management, compliance management, etc., to build an artefact (i.e. the situational method). The IT-CMF uses the following DSR patterns proposed in Vaishnavi and Kuechler [59].

- *Different perspectives*: the research problem is examined from different perspectives, for example conceptual, strategic, organisational, technical and cultural.
- *Interdisciplinary solution extrapolation*: a solution or solution approach (i.e. methods, instructions, guidelines, etc.) to a problem in one discipline can be applied in or adapted to the integrated IT-CMF.
- *Building blocks*: the complex research problem of IT management is broken into 33 critical competencies that are examined in turn.
- *Combining partial solutions*: the partial solutions from the building blocks are integrated into the overall IT-CMF and the interdependencies between the building blocks are identified and highlighted. In order to rigorously demonstrate the utility of the developed artefact, different evaluation methods can be used: amongst others, the 'informed argument' is suggested as an appropriate evaluation method.

## Conclusions

The importance, nature and philosophical underpinning of theory continue to be the subject of lively debate in the literature [49] [60] [61]. This paper addresses the need for a theoretical framework to stimulate research in the area of innovation ecosystems by building on historical analyses of innovation definitions. The work is a response to the assessment by scholars that there are significant research questions to be addressed in this important topic. The approach involved a review of antecedent models from the innovation literature. Arising from the analysis, we proposed a new theoretical lens to stimulate research in the innovation ecosystems. The result is an adaptation of Urie Bronfenbrenner's ecological systems theory (EST) that incorporates a technological component. The EST for innovation is an important theoretical contribution because it provides a fresh perspective for academic researchers to investigate the phenomenon, and it offers an accessible conceptual structure to navigate the increasingly complex innovation ecosystem. Future work includes developing a research agenda outlining directions and themes that we hope will be profitable for researchers interested in pursuing this perennially important subject. We will conclude by quoting Schumpeter's apologia for history towards the end of his life. For 'economic phenomena', read 'innovation phenomena'.

*Nobody can understand economic phenomena without an adequate command of historical facts, an adequate amount of historical sense encapsulated in historical experience.*

## References

[1] Wolfe, R. A. (1994), 'Organizational innovation: Review, critique and suggested research directions', *Journal of Management Studies*, 31(3), pp. 405–431.

[2] Fagerberg, J. (2005), 'Innovation: A Guide to the Literature', Fagerberg, J., Mowery, D., Nelson, R. R. (eds), *The Oxford Handbook of Innovation*, Oxford University Press, Oxford. pp. 1–26.

[3] Teece, D. (2006), *Foreword*, Chesbrough, H., Vanhaverbeke, W., West, J. (eds), *Open Innovation: Researching a New Paradigm*, Oxford University Press.

[4] Bronfenbrenner, U. (1979), *The Ecology of Human Development: Experiments by Nature and Design*, Harvard University Press, Cambridge, MA.

[5] Van de Ven, A. H., Angle, H. L., Poole, M. S. (eds) (2000), *Research on the Management of Innovation: the Minnesota Studies.*, Vol. 32, Oxford University Press, Oxford, New York, pp. 590–607.

[6] Storey, J. (2004), *The Management of Innovation — Volume I*, Northampton Edward Elgar, Cheltenham, United Kingdom.

[7] West, J., Vanhaverbeke, W., Chesbrough, H. (2006), 'Open Innovation: A Research Agenda', Chesbrough, H., Vanhaverbeke, W., West, J. (eds), *Open Innovation — Researching a New Paradigm*, Oxford University Press, pp. 258–284.

[8] Vanhaverbeke, W., Cloodt, M. (2006), 'Open Innovation in Value Networks', Chesbrough, H., Vanhaverbeke, W., West, J. (eds), *Open Innovation — Researching a New Paradigm*, Oxford University Press, pp. 258–284.

[9] Fonseca, J. (2002), *Complexity and Innovation in Organizations*, Routledge, Oxon.

[10] Stacey, R. D. (2001), *Complex Responsive Processes in Organizations — Learning and knowledge creation*, Routledge, London.

[11] Lester, R. K., Piore, M. J. (2004), *Innovation — The Missing Dimension*, Harvard University Press.

[12] Schumpeter, J. A. (1934), *The theory of economic development: an inquiry into profits, capital, credit, interest, and the business cycle*, Harvard University Press (1959 printing), Cambridge, Mass.

[13] Oakley, A. (1990), *Schumpeter's Theory of Capitalist Motion: A Critical Exposition and Reassessment*, E. Elgar, Aldershot, Hants, England.

[14] Marz, E. (1991), *Joseph Schumpeter — Scholar, teacher & politician*, Yale University Press, New Haven, Conn.

[15] Swedberg, R. (1991), *Joseph A. Schumpeter — His life and work*, Polity Press, Cambridge.

[16] Lazonick, W. (2005), 'The Innovative Firm', Fagerberg, J., Mowery, D., Nelson, R. R. (eds), *The Oxford Handbook of Innovation*, Oxford University Press, Oxford.

[17] Coe, R. D., Wilber, C. K. (1985), *Capitalism and democracy: Schumpeter revisited*, Notre Dame, Ind., University of Notre Dame Press.

[18] McCraw, T. K. (2007), *Prophet of innovation — Joseph Schumpeter and Creative Destruction*, Belknap Press of Harvard University Press, Cambridge, Mass.

[19] Van de Ven, A. H. (1986), 'Central problems in the management of innovation', *Management Science*, 32(2), pp. 590–607.

[20] Garcia, R., Calantone, R. (2002), 'A critical look at technological innovation typology and innovativeness terminology: a literature review', *Journal of Product Innovation Management*, 19(2), pp. 110–132.

[21] Lundvall, B.-A. (1995), *National Systems of Innovation: towards a theory of innovation and interactive learning*, Pinter, London.

[22] Etzkowitz, H., Leydesdorf, L. (2000), 'The dynamics of innovation: From National Systems and "Mode 2" to a Triple Helix of University-Industry-Government Relations', *Research Policy*, 29, pp. 109–123.

[23] McInerney, D. P. A. (2004), *Innovative regions: a comparative analysis of the innovative activities of indigenous and non-indigenous small and medium-sized enterprises* (SMEs) *in the Shannon and Dublin regions of Ireland*, PhD thesis, University of Limerick, Ireland.

[24] Rahmanseresht, H. (1988), *Towards a Revised Model of Innovation in Organisations*, PhD thesis, University of Hull.

[25] Zain, M. (1993), *A Field Study of Adoption and Implementations of Innovations by Manufacturing Firms in Malaysia*, PhD thesis, Manchester Business School.

[26] Costello, G., Donnellan, B. (2008), 'Seeking the Face of Innovation with the Ethical Compass of Emmanuel Levinas', León, G. et al. (eds), *IFIP International Federation for Information Processing*, Vol. 287; *Open IT-Based Innovation: Moving Towards Cooperative IT Transfer and Knowledge Diffusion*, Springer, Boston, pp. 97–117.

[27] Webster, J., Watson, R. T. (2002), 'Analyzing the Past to Prepare for the Future: Writing a Literature Review', *MIS Quarterly*, 26(2), pp. xiii–xxiii.

[28] Costello, G., Donnellan, B. (2012), 'Proposing a Meta-Theoretical Framework for Innovation Research', *Social Innovation for Competitiveness, Organisational Performance and Human Excellence,* European Academy of Management, EURAM 2012 conference 2012, Rotterdam, 6–8 June 2012.

[29] Curley, M., Costello, G., Donnellan, B. (2012), *A New Organisational Ecology for Open Innovation: The Innovation Value Institute*, The XXIII ISPIM Conference — Action for Innovation: Innovating from Experience, Barcelona, Spain, 17–20 June 2012.

[30] d'Ydewalle, G. (2000), 'Sensation/Perception, Information Processing, Attention', Pawlik, K., Rosenzweig, M. R. (eds), *The International Handbook of Psychology*, SAGE, London, pp. 79–99.

[31] ODE (2006) (ed.), *Oxford Dictionary of English*, Second Edition, Revised, Oxford University Press, Oxford.

[32] Jackson, J. M. (1998), *Social Psychology, Past and Present: An Integrative Orientation*, Lawrence Erlbaum Associates, Hillsdale, NJ, London.

[33] Estes, W. K. (2000), 'Basic Methods of Psychological Science', Pawlik, K., Rosenzweig, M. R. (eds), *International Handbook of Psychology*, SAGE, London, pp. 20–39.

[34] Gibson, J. J. (1986), *The Ecological Approach to Visual Perception*, Lawrence Erlbaum Associates, Hillsdale, NJ, London.

[35] Britannica (2008), 'Social structure', *Encyclopædia Britannica* (http://www.britannica.com/EBchecked/topic/551478/social-structure).

[36] Hannan, M. T., Pólos, L., Carroll, G. R. (2007), *Logics of Organization Theory: Audiences, Codes, and Ecologies*, Princeton University Press, Princeton, NJ, and Oxford.

[37] Lang, S. S. (2005), 'In Appreciation — Urie Bronfenbrenner', Association for Psychological Science, *Observer* (http://www.psychologicalscience.org/observer/).

[38] Paquette, D., Ryan, J. (2001), Bronfenbrenner's ecological systems theory.

[39] Marentette, P. (2007), *Bronfenbrenner.*

[40] Amabile, T. M., Hadley, C. N., Kramer, S. J. (2003), 'Creativity Under the Gun', *Harvard Business Review on The Innovative Enterprise*, Harvard Business School Press.

[41] Ciborra, C. (2002), *The Labyrinths of Information — Challenging the Wisdom of Systems*, Oxford University Press, Oxford.

[42] Goffin, K., Mitchell, R. (2005), *Innovation Management — Strategy and Implementation using the Pentathlon Framework*, Palgrave Macmillan, Houndmills, Basingstoke.

[43] OECD (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition*, Organisation for Economic Cooperation and Development, Directorate for Science, Technology and Industry.

[44] Rothwell, R. (1994), 'Towards the Fifth-generation Innovation Process', *International Marketing Review,* 11(1), pp. 7–31.

[45] Tidd, J., Bessant, J., Pavitt, K. (2005), *Managing innovation — Integrating technological, market and organizational change*, John Wiley & Sons, Chichester.

[46] Ward, J., Griffiths, P., Whitmore, P. (1990), *Strategic Planning for Information Systems*, John Wiley & Sons, Chichester.

[47] Bronfenbrenner, U. (ed.) (2004), *Making Human Beings Human — Bioecological Perspectives on Human Development*, Sage Publications.

[48] Leonard, D. (1998), *Wellsprings of Knowledge — Building and Sustaining the Sources of Innovation*, Harvard Business School Press.

[49] Weber, R. (2003), 'Editor's Comments: Theoretically Speaking', *MIS Quarterly*, 27(3), pp. iii–xii.

[50] Whetten, D. A. (1989), 'What Constitutes a Theoretical Contribution?', *Academy of Management Review*,14(4), pp. 490–495.

[51] Kawalek, J. P. (2008), *Rethinking Information Systems in Organizations — Integrating Organizational Problem Solving*, Routledge, New York, NY.

[52] Sambamurthy, V., Zmud, R. W. (2000), 'Research Commentary: The Organizing Logic for an Enterprise's IT activities in the Digital Era — A Prognosis of Practice and a call for Research', *Information Systems Research*, 11(2).

[53] Lam, W., Chua, A. (2005), 'Knowledge Management Project Abandonment: An Exploratory Examination of Root Causes', *Communications of the Association for Information Systems*, 16(23), pp. 723–43.

[54] Pan, G. (2005), 'Information System Project Abandonment: A Stakeholder Analysis', *International Journal of Information Management*, 25(2), pp. 173–184.

[55] Curley, M. (2004), *Managing Information Technology for Business Value*, Intel Press.

[56] Curley, M. (2007), 'Introducing an IT Capability Maturity Framework', Keynote address at the International Conference for Enterprise Information Systems, ICEIS, Madeira, Portugal, 12–14 June 2007.

[57] Hevner, A. R. et al. (2004), 'Design Science in Information Systems Research', *MIS Quarterly*, 28(1), pp. 75–105.

[58] Vaishnavi, V., Kuechler, W. (2004, 2011), *Design Science Research in Information Systems* (http://www.desrist.org/desrist).

[59] Vaishnavi, V., Kuechler, W. (2007), *Design Science Research Methods and Patterns: Innovating Information and Communication Technology*, Auerbach Publications, New York, NY.

[60] Gregor, S. (2006), 'The Nature of Theory in Information Systems', *MIS Quarterly*, 30(3), pp. 611–642.

[61] Markus, M. L., Saunders, C. (2007), 'Looking for a few good concepts ... and theories ... for the information systems field', *MIS Quarterly*, 31(1), pp. iii–vi.

## Appendix 1: Definitions of innovation developed from McInerney (2004)

| Innovation definition | Author |
|---|---|
| New products, new methods of production, new sources of supply, the exploitation of new markets and new ways to organise business. | Schumpeter (1934) |
| Generation, acceptance, and implementation of new ideas, processes, products and services. | Thompson(1965) |
| An innovation or more precisely a major innovation is a fundamental 'change in a significant' number of tasks. | Wilson (1967) |
| The first or early use of an idea by one of a set of organisations with similar goals. | Becker & Whistler (1967) |
| An innovation is the adoption of a change which is new to an organisation and to the relevant environment. | Knight (1967) |
| The implementation of new procedures or ideas whether a product of invention or discovery, will be referred to as 'innovation'. | Evan & Black (1967) |
| When an organisation learns to do something it did not do before and it proceeds to do it in a sustained way a process of innovation has occurred. | Shepard (1967) |
| The successful introduction into an applied situation of means that are new to the situation | Mohr (1969) |
| An innovation is an idea, practice, or object perceived as new by an individual. It matters little, as far as human behaviour is concerned, whether or not an idea is objectively new as measured by the lapse of time since its first uses or discovery ... if the idea seems new and different to the individual, it is innovation. | Rogers & Shoemaker (1971) |
| The successful utilisation of processes, programmes, or products which are new to an organisation and which are introduced as a result of decisions within that organisation. | Rowe & Boise (1973) |
| New idea, practice, or material artefact perceived to be new by the relevant adopting unit. | Zaltman et al. (1973) |
| Innovation is defined as the earliness or extent of use by a given organisation of a given new idea, where new means only now to the adopting agent, and not necessarily to the world in general. | Down & Mohr (1979) |
| A portmanteau to cover the wide range of variegated processes by which man's technologies evolve over time. | Nelson & Winter (1977) |
| Innovation includes any discrete idea, practice or material artefact that is introduced for the first time ... and is seemingly discontinuous with past practice, The term technological innovation moreover refers to those innovations that consist of (1) an artefact or material (2) a computer system or (3) an analytic idea or practice that lends itself to quantitative symbolisation. | Yin et al. (1977) |
| A managerial innovation is any programe product or technique which represents a significant departure from the state of the art of management at the time it first appears and which affects the nature, location, quality or quantity of information that is available in the decision-making process. | Kimberly (1981) |
| Industrial innovation includes the technical design, manufacturing, management, and commercial activities invoked in the marketing of a new (or improved) process or equipment. | Freeman (1982) |
| Commercialisation of invention. | Rickards (1985) |

| | |
|---|---|
| Innovation does not necessarily imply the commercialisation of only a major advance in the technological state of the art (radical innovation) but it includes also the utilisation of even small-scale changes in technological know-how (incremental innovation). | Rothwell and Gardiner (1985) |
| Innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or service. It is capable of being: presented as a discipline, capable of being learned, capable of being practised. | Drucker (1985) |
| The process of development and implementation of new ideas by people who over time engage in transactions with others within an institutional context. | Van de Ven (1986) |
| The process whereby an adoption unit chooses a significant alternative that is perceived as superior to and/or different from some current practice or outcome and attempts to realise it so that a deficiency in the practice or outcome can be corrected or so that either/or both can be improved. | Rahmanseresht (1988) |
| Innovation includes the opening up of markets, the conquest of new sources of supply of materials, new forms of organisation of an industry, including the creation or breaking up of monopoly positions as well as process and product innovations. | Davies (1988) |
| The generation of an idea while innovation incorporates both invention and exploitation. | Roberts (1988) |
| A purposeful, concentrated effort to develop and implement a novel idea that is of substantial technical, organisational and market uncertainty that entails a collective effort of considerable duration and that requires greater resources than are held by the people undertaking the effort. | Angle & Van de Van (1989) |
| Innovation is a product of the interaction between necessity and chance, order or disorder, continuity and discontinuity. | Nonaka (1990) |
| Any renewal designed and realised, that strengthens an organisation's competitiveness. | Vrakking (1990) |
| Companies achieve competitive advantage through acts of innovation. They approach innovation in its broadest sense, including both new technologies and new ways of doing things. | Porter (1990) |
| The creation of the future — the process of bringing new ideas (products, processes, know-how, budgeting systems, management techniques, etc.) into use. | Nystrom (1990) |
| Innovativeness is a combination of technological, enterprise and market and other environmental dimensions by which means that a small and medium-sized industrial enterprise develops and adopts new ideas, also other than technical ones, for industrial use or for markets earlier than other corresponding enterprises. | Hyvärinen (1990) |
| The combining of materials in a novel fashion to produce other things or the same things by a different method. | Elam (1992) |
| The process of matching organisational and environmental means and needs. | Zain (1993) |
| Successful exploitation of new ideas. | DTI UK (1994) |
| The combined activities leading to new marketable products and services and/or new production and delivery systems. | Burgelman et al. (1996) |
| Innovation is the creation and adoption of something new which creates value for the entity (individual, organisation, ecosystem, society) which adopts it. This definition postulates that innovation occurs at the nexus of newness, adoption and value. | Baldwin & Curley (2007) |
| An innovation is a human activity resulting in an artefact, idea, practice, organisation, learning or information system — perceived to be new by the unit of adoption — that is the cognisant of the 'Other'; the ethical issues that affect instigating, implementing and using the innovation and the associated use of resources. | Costello & Donnellan (2008) |

## *Contact*

**Professor Martin Curley**
Vice-President and Director, Intel Labs Europe, Intel Corporation
Industrial Director, Innovation Value Institute, National University of Ireland, Maynooth
Martin.G.Curley@intel.com

**Professor Brian Donnellan**
Professor of Information Systems Innovation
Logic Annex, South Campus, National University of Ireland Maynooth, Maynooth, Co. Kildare, Ireland
Academic Director, Innovation Value Institute, National University of Ireland, Maynooth
Brian.donnellan@nuim.ie

**Dr Gabriel J. Costello**
Galway-Mayo Institute of Technology, Galway, Ireland
Gabrielj.Costello@gmit.ie

## 1.3. Why is a European model for start-ups necessary?

This reflection on a model for European start-ups is the result of work I have carried out in parallel with my entrepreneurial activities. I have always analysed and admired the success of Silicon Valley, the ultimate benchmark in the field of innovation. At the same time, I have strived to develop a strong ecosystem for Paris and for Europe. Ten years' work in the corporate and non-profit sectors has taught me that Europe needs to build its own model, rather than aping Silicon Valley. Here, I aim to provide a brief summary of this vision of the European start-up scene.

The European Web start-up scene has already yielded several gems — Spotify, SoundCloud, Rovio and Dailymotion, to name but a few. The talent and ambition of European entrepreneurs are a genuine inspiration. However, the one thing that all these European start-ups have in common is not so much their European origin as their immediate similarities with Silicon Valley, or at least evidence of the influence of the Californian ideal of a young innovative company. As an inveterate entrepreneur and the instigator of alternative models such as the *La Cantine* and PARISOMA co-working spaces and the *Le Camping* incubator [1] in France, I note that despite the success of these initiatives, the model still remains Californian.

Having been nurtured at *Le Camping*, the most promising projects apply to join Silicon Valley start-up incubators, primarily Y Combinator and 500 start-ups. This is hardly surprising considering the projects they have produced: Airbnb, Reddit and Dropbox with the former, and Wildfire, 9Gag and Twilio with the latter.

The reason for this is simple — there is no European identity for start-ups, nor are there any strong links between digital entrepreneurs in Europe. We don't work together, or at least not enough. The first comment when the subject is addressed is invariably 'Which is the best European city for Web entrepreneurs?' And the response differs according to blogs and rankings: London, Berlin, Moscow, Paris, Amsterdam, Stockholm — all dynamic cities engaged in misguided one-upmanship without any real sense of healthy competition or collaboration. Basically, the concept of European ecosystems is meaningless other than in an abstract political sense.

And this is because the model still remains that of Silicon Valley and the American culture. So much so that Europeans need to go to San Francisco to meet one another!

However, the existence of a high concentration of innovative players in an area is not the sole preserve of Silicon Valley. Israel is currently the second-ranking country for NASDAQ-listed companies. And this hotbed of entrepreneurialism is a big hit with the top Californian venture capitalists, as revealed in this comment by Dror Berman, a former engineer and founder of the Innovation Endeavours investment fund, which should be a lesson to the Old Continent: 'We need to encourage Israelis to go out and acquire knowledge and build networks in other countries, and provide the incentives needed to ensure that the best entrepreneurs and investors from around the world see Israel as a key and natural partner for technological development' [2].

This offers further proof that necessity is the mother of innovation and risk-taking, since with 8 million inhabitants Israel does not have the internal market required to support its start-ups and is immediately forced to look to the international market. This prime necessity gives it an edge over Europe, and particularly France, which is historically torn between contradictory geographical projections. As Maurice Aymard argues, following in the footsteps of Fernand Braudel, France is the result of an 'original three-way division of a space contested between the Mediterranean, the Atlantic and Europe' [3].

### *How can we explain this lack of identity for European start-ups?*

**Incomparable markets**

Unlike Silicon Valley, Europe is difficult to define as a market. From the Urals to the Strait of Gibraltar, common characteristics are hard to find on a continent which has been marked significantly by its onerous industrial history. The language barrier is a real constraint. Making a website available in 23 languages (the number of official languages in the European Union) is a costly and complex task, destroying the responsiveness demonstrated by these start-ups. After this first obvious barrier, the most striking thing is the wide range of behaviour and contexts. While Finnish and Czech companies achieved 20 % of their turnover from e-commerce in 2011, this figure was just 5 % for Italian companies [4].

**The absence of a European scale**

European start-ups are identified on the scale of cities. Like the city-states of Ancient Greece, Europe does not represent a coherent melting pot for young companies. The scales which exist are the city, the country and, finally, the global market,

where Europe remains an abstraction. In its 'start-up ecosystem report', the open source community dedicated to start-up data, Start-up Genome, does not identify Europe as a single entity, but breaks it down into its major urban centres, each compared with Silicon Valley, which is used as a benchmark. For example, we learn that the average age of start-up founders in Moscow is 28, while in Paris it is 33 and in Silicon Valley it is 34 [5].

**A lack of available capital**

The American 'venture capitalism' culture is one of the pillars of Silicon Valley's success. While the practice is becoming more widespread in Europe, it is less systematic and is organised around smaller players. As a result, there is greater difficulty raising funds in the Old Continent and, therefore, greater difficulty moving up a level for our start-ups, which tend to fall behind their American counterparts. The outlook is not completely bleak, however, and although the United States still represents 70 % of funds raised globally, Europe is making considerable progress, with a 50 % growth in venture capital in 2011 (in 2012, French start-ups raised nearly EUR 542 million). The central issue remains that of time: in order to reach a situation that has taken Silicon Valley 50 years to construct, Europe needs time to build the right structures and adopt the right mindset regarding investment strategies [6].

**A lack of brand recognition**

The National Basketball Association (NBA) offers a simple analogy to illustrate the lack of identity affecting European start-ups. Young basketball players cover their bedroom walls with posters of the Lakers, the Heat or the Celtics, but rarely of Panathinaikos, Bologna or Pau Orthez. This lack of brand recognition is an urgent question for Europe if we want to encourage healthy economic competition in relation to start-ups. Basically, European companies are never 'top of mind' in their category. This reputational factor is difficult to quantify, yet plays an essential role in the assessment of ecosystems. To get an idea of the ground that Europe needs to make up in the new technologies sector, casting an eye over the 'most valuable brands' provides a wealth of information. Out of the 17 companies listed in the technologies category, only one is European: Siemens. Founded in 1847, this is hardly a paragon of the emerging company! Apple and Google meanwhile hog the top places, with China being represented in the top 40 by Baidu and Tencent [7].

**The role of large groups**

A form of industrial segregation exists in Europe, between large, long-established groups and start-ups. This invisible barrier is enormously damaging to innovation in the sense that small companies do not benefit from the same pulling power as larger ones, and these large companies cut themselves off from a real mine of innovation.

This phenomenon is especially damaging since the groups making investment mostly remain within their national borders. As an interesting counter-example, the German group Axel Springer AG could serve as a model for many European groups, due to its distinctive strategy of major investment in the digital field. Structured and international, the group's investment plan has paid off, allowing the company to successfully negotiate the digital shift, while at the same time enabling young players like aufeminin.com, seloger.com and interactive marketing companies Zanox and Digital Windows to develop and expand their markets. The digital sector now accounts for 28 % of the group's income and looks set to peak at 50 % in 6 years. This offers a lesson to many European giants which are still too reticent to take a risk in digital.

**The lack of world-class managers**

In a virtuous circle, Silicon Valley has succeeded in attracting the best managers in the digital sector. As Mark Zawacki commented on his visit to faberNovel, one of the key factors in Silicon Valley's success was 'a very high concentration of very smart people, with large networks, who had come from all over the world and were prepared to take risks'. Europe is not yet able to boast of management rock stars such as Eric Schmidt and Meg Whitman, capable of transforming promising small businesses into multinationals [8].

## *How can these challenges be addressed?*

Once this situation has been recognised, actions need to be defined to tackle it — to promote the European start-up scene rather than lamenting the fact that it does not exist.

**Self-knowledge**

This is undoubtedly the first stage in a model of European start-ups. Silicon Valley is very well documented, constantly discussed and debated, and has developed its own distribution channels through major events such as the Crunchies and the famous techblogs such as TechCrunch and ReadWrite. Mashable, a prime example of California's force of attraction, was first created in Scotland on the keyboard of Pete Cashmore before going on to become the technological leader it is today … in Silicon Valley.

This hegemony is in contrast to a European media landscape which is generally of a lower quality, more timid and, above all, less benign. This means that the world of start-ups is, by default, always

analysed from a Californian perspective, due to the lack of competition. It is therefore vital for Europe to develop genuine media outlets, capable of uniting innovation players and, above all, exerting an influence on an international level.

**Networking**

In addition to information, self-knowledge also means finding new ways of collaborating between players who are unaccustomed to meeting in Paris, Madrid or Moscow but who already work alongside one another in San Francisco. The digital revolution is in the process of establishing new industrial 'equations'. Large traditional players need to work with young innovative companies in order to create new synergies and break certain industrial stranglеholds at a time when digital is infiltrating every sector of the economy. Particularly since the European market has many advantages to promote, as emphasised by Martin Varsavsky, CEO of Fon, offering as an example the fact that European developers' salaries are 30 % lower than their counterparts' in Silicon Valley [9].

Networking must also be financial. European startups need effective 'exits' to break the 'glass ceiling' condemning them to remain small or medium-sized. Incentives need to be offered to promote the emergence of business angels, capable of reinvesting their profits in the ecosystem and encouraging investment and takeovers by large groups through multicorporate and pan-European investment funds!

**Finding a voice**

Channelling the energies that exist in Europe into a single voice may be an ambitious undertaking but, even short of that, the question of representation is essential in order to make more impression at a global level and become a credible partner for the rest of the world. To achieve this, European startups must be able to access some form of lobbying, without expecting too much from the leading players in the economy. This need for a concerted approach is not new and has always allowed the major industries to survive and prosper, at any level. As far back as the Middle Ages, guilds gave their names to the streets they occupied, witness the Rue des Orfèvres in Paris. It may be time for Europe to create names which will resonate on an international level as benchmarks in terms of innovation.

**Self-confidence and above all a belief in our young people**

We can dream of what Erasmus achieved for a generation. Languages are much less of an issue today. One of the great strengths of Silicon Valley is that a young PhD student can create an algorithm and find business angels to invest in it, before it even becomes part of a technology. And a glass-blower can team up with the founder of Twitter to create a company that is revolutionising one of the most highly regulated industries in the world and is valued at more than USD 4 billion, 2 years after its creation (Square). In Silicon Valley, there is confidence in young people to invent the future, although with plenty of support from experts. Silicon Valley is not a location, contrary to what our political friends would have us believe (inventing the 'Silicon Valley of XXX'), but a culture, a state of mind.

Creating European solidarity does not mean coming up with some sort of Heath Robinson machine or constructing a Tower of Babel with no legitimacy. It is a ground-swell which must arise out of startups' desire to exist and work in collaboration on a European scale. It means restoring confidence in the future of entrepreneurialism on the Old Continent since, as *The Economist* writes 'Parisian opinion is convinced that if Sergey Brin's father had picked France instead of America after leaving Russia, the son would have become an ivory tower computer scientist instead of co-founding Google.' Responding to structural challenges in a pragmatic way while inspiring dreams through a few figure-heads embodying a European model: that is the main challenge [10].

In other fields, Europe has already succeeded in establishing internationally recognised models. To extend the sports analogy, we could think of Formula 1 or the Champions League, competitions which started life in Europe and now export their symbols and champions worldwide. For that is the key challenge: finding symbols and promoting champions who will give structure and impetus to the whole ecosystem.

This is the only way in which we will succeed in creating the conditions for the emergence of a strong ecosystem in Europe, with its own champions and culture.

## *References*

[1] Le Camping (http://www.lecamping.org/).

[2] Rooney, B. (2012), 'Israel's Local Start-Ups See International Success', *Wall Street Journal* (http://online.wsj.com/article/SB10001424052970204712904578090762559469112.html).

[3] Aymard, M., Braudel F. (1988), 'L'identité de la France, t. I, Espace et Histoire. t. II et III, Les hommes et les choses', *Annales. Économies, Sociétés, Civilisations,* Vol. 43, No 1, pp. 111–115 (http://www.persee.fr/web/revues/home/prescript/article/ahess_0395-2649_1988_num_43_1_283477_t1_0111_0000_001?_Prescripts_Search_tabs1=standard&).

[4] Giannakouris, K., Smihily, M. (2011), 'ICT usage in enterprises 2011', *Eurostat Statistics in focus*, 65/2011 (http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-11-065/EN/KS-SF-11-065-EN.PDF).

[5] Start-up Genome, *Start-up Ecosystem Report 2012*.

[6] EVCA YearBook 2012, *Creating lasting value* (http://www.evca.eu/uploadedfiles/home/press_room/Yearbook_2012_Presentation_all.pdf).

[7] MillwardBrand (2012), *Brandz™ Top100 Most Valuable Global Brands 2012* (http://www.millwardbrown.com/brandz/2012/Documents/2012_BrandZ_Top100_Chart.pdf).

[8] 'Whitman served as president and chief executive officer of eBay from 1998 to 2008. During her ten years with the company, she oversaw expansion from 30 employees and USD 4 million in annual revenue to more than 15 000 employees and USD 8 billion in annual revenue ', Wikipedia (http://en.wikipedia.org/wiki/Meg_Whitman); 'In the eight years since Eric Schmidt got hired to run a hot private company called Google (GOOG) in 2001, the company has become one of the fastest growing and profitable companies the world has ever seen', *Business Insider* (http://articles.businessinsider.com/2009-04-08/tech/30046445_1_google-ceo-eric-schmidt-video-advertising-apps).

[9] Varsavsky, M. (2011), 'Why You Shouldn't Move your company to Silicon Valley', EUstarups.com (http://www.eu-start-ups.com/2011/05/why-you-shouldnt-move-your-company-to-silicon-valley/).

[10] European Entrepreneurs (2012), 'Les Misérables', *The Economist* (http://www.economist.com/node/21559618).

## *The author*

**Stéphane Distinguin**
Founder and CEO of faberNovel
Stephane.distinguin@fabernovel.com

## *Contact*

**Guillaume Ladvie, faberNovel**
Guillaume.ladvie@fabernovel.com

CHAPTER II

# Trends and country reports

## 2.1. Open innovation towards smarter cities

### *Introduction: smart cities as innovation-led development model*

Cities of today are confronted with immense problems in terms of economic development, inclusion, housing, transport, environment and climate, infrastructure, public security and more. The current economic crisis is making it even harder for cities and their citizens, neighbourhoods and businesses, and many European cities are in a state of decline. Cities, particularly in rural areas, face the implications of an ageing population in combination with economic downturn [1]. At the same time, the city also represents a promise: a vision of freedom, creativity, opportunity and prosperity [2]. More than half of the global population is now urban and projections estimate that this percentage will even grow towards 70 % around 2050 [3]. In this context, the concept of the 'smart city' represents technology and innovation-driven visions and solutions. The challenge is to redefine the smart city as an environment of innovation, empowerment and participation of citizens, businesses and other stakeholders in shaping their future. The challenge is on change and transformation towards a smarter city which is more participative, inclusive and empowering, instead of imagining an ideal future vision.

Many European cities are currently developing strategies towards becoming 'smarter cities' and are gaining lessons for transformation. Such strategies are based on an assessment of the future needs of cities and innovative uses of ICTs embodied in the broadband Internet and Internet-based applications now and foreseen for the future. These strategies are also based on a new understanding of innovation, grounded in the concept of open innovation ecosystems, global innovation chains, and on citizens' empowerment for shaping innovation and urban development: these strategies include the development of new types of innovation in urban areas. These new ways of innovation are characterised, firstly, by a high level of citizen involvement in co-creating services in all sectors of the economy and society through the use of the Internet and Internet-based technologies; secondly, through the emergence of new forms of collaboration among local governments, research institutes, universities, citizens and businesses (e.g. public–private–people partnerships). Such strategies and the resulting urban 'innovation ecosystems' are becoming increasingly relevant given the urgent need to tackle growing social, economic and societal issues that cities are currently facing in a context of economic woes while simultaneously many improvement opportunities are offered to cities by new technologies and approaches to innovation.

This contribution is based on outcomes of the FIRE-BALL (Future Internet Research and Experimentation By Adopting Living Labs) project, a Coordination Action within the European Commission's seventh framework programme for ICT, which ran 2010–12 [4]. The aim of this project was to bring together communities and stakeholders who are active in three areas, namely: research and experimentation on the Future Internet (FIRE); open and user-driven innovation in Living Labs; and urban development for smarter cities. The goal was to develop a common vision on how the different methodologies and concepts in these areas can be aligned for cities as playgrounds of open and user-driven innovation related to the Future Internet.

Cities and urban areas of today are complex ecosystems, where ensuring sustainable development and quality of life is an important concern. In such urban environments, people, businesses and public authorities experience specific needs and demands regarding domains such as healthcare, media, energy and the environment, safety, and public services. These domains are increasingly enabled and facilitated by Internet-based applications, content management platforms and broadband infrastructures. Therefore, cities and urban environments are facing challenges to maintain and upgrade the required infrastructures and establish efficient, effective, open and participative innovation processes to jointly create the innovative applications and services that meet the demands of their citizens. In this context, cities and urban areas represent a critical mass when it comes to shaping the demand for advanced Internet-based services and experimentation in large-scale open and user-driven innovation environments.

The term 'smart city' has attracted a lot of attention in recent years. Since the end of the 1990s, many cities have initiated smart city initiatives. In the Digital Agenda of the European Commission, cities are considered as innovation drivers in areas such as energy, environment, inclusion and business. The concept of smart cities captures different meanings, and we must look beyond a superficial use of the term for pure city marketing purposes. We aim to shed more light on this concept of smart cities, in particular focusing on the defining role of the Internet and user-driven innovation. A useful definition to start with is to call a city 'smart' when 'investment in human and social capital and traditional (transportation) and modern (ICT-based) infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory government' [5]. To this, the notion of empowerment of citizens and 'democratising innovation' should be added [6]. Other definitions have tried to identify key domains of smart cities, such as smart economy, smart mobility, smart environment, smart living, smart people, and smart governance, and have defined rankings based on measurable underlying indicators. Smart cities can be also understood as places generating a particular form of spatial intelligence and innovation, based on sensors, embedded devices, large data sets, and real-time information and response. While these definitions are relevant for benchmarking or for placing emphasis on specific development aspects, they are merely based on technology-led views. There is a need for research on effective strategies of cities to become smarter, taking into account the particular socio-economic context and urban development objectives, and on approaches mobilising the participation and intelligence of citizens, businesses and societal organisations.

In the next sections, we first describe how open innovation and crowdsourcing enable development towards smarter cities. Then, we address the emerging innovation platforms such as Living Labs, systematically pushing user-driven and open innovation in smart cities. Finally, we discuss some of the conditions to be established to stimulate the transformation towards smart cities. This also points to the changing structures and processes of innovation and urban development. Interestingly, we see a tendency towards more decentralised and bottom-up approaches to planning and innovation. Innovation ecosystems are characterised by a continuously evolving combination of top-down and bottom-up initiatives, leading to networking and collaboration among stakeholders, which eventually extend to real innovation communities. Increasingly, citizens, advanced businesses and local governments act as proactive catalysers of innovation, shaping cities as 'agents of change'.

## *Open innovation and crowdsourcing in smart cities*

The standard model of intelligent cities is based on the integration of three fundamental components, those of 'city', 'innovation' and 'digital space' [7]. These components, however, include many different layers and appear under multiple forms, which lead to multiple manifestations of the standard model (Table 1). For example, within the last 10 years, we have witnessed the rise of three successive innovation paradigms and three successive waves of Web technologies. In the field of innovation, the institutional paradigm (national and regional systems, clusters, incubators, liaison offices, technology intermediary organisation) has been followed by user-driven innovation, democratising innovation, and Living Labs and, recently, innovation through smart specialisation is gathering the interest of the European innovation community. In Web technologies, Web 1.0 technologies using representation tools and one-way communication ceded place to Web 2.0, the interactive Web, participatory content management systems, social media and crowdsourcing, and now the interest has turned to embedded smart environments, the Internet of Things, sensor networks, M2M communication, cloud computing, and the semantic Web.

Table 1: Components and layer of intelligent cities standard model

| | COMPONENTS | | |
|---|---|---|---|
| | **City** | **Innovation** | **Digital space** |
| LAYERS | Cities within the national and global space | R & D-funding-production-marketing networks | Communication: xDSL, FTTH, GSM, Wi-Fi |
| | Social space of cities: Citizens and economic activities | Innovation ecosystems, clusters and innovation poles | Embedded sensor networks, actuators |
| | Physical space: Buildings and infrastructure | Urban and regional systems of innovation | Access: PCs, smartphones, iPads, augmented reality readers |
| | Governance and city management | User-driven innovation, Living Labs, glocal innovation networks | Applications and platforms: dedicated and generic software |
| | Challenges: Conflicts and problems to resolve | Smart specialisation | Various types of e-services |

The question which immediately comes to mind is why these components make cities intelligent. If the presence of the 'city' component is somehow self-explained (we search for intelligent cities and city intelligence), we should turn to definitions and understandings of intelligence to justify the presence of the other two components of the standard model.

The paper of Legg and Hutter [8] on definitions of intelligence offers an inventory of definitions, the largest and most well-referenced collection according to the authors. They list 18 definitions of intelligence that have been proposed by groups or organisations, 35 definitions by psychologists, and 18 by researchers in artificial intelligence. Then, they scan through these definitions pulling out commonly occurring features and conclude that intelligence has three key attributes which occur simultaneously, such as the property of an individual agent to interact with its environment, the ability to succeed or profit with respect to some goal or objective, and to adapt to different objectives and environments. These attributes refer, on the one hand, to the ability to collect, process and exchange information, the ability for perceiving, storing and retrieving information, calculating, reasoning, learning, acquiring knowledge and, on the other hand, to the ability to find solutions and innovate, plan, apply knowledge to practice, solve novel problems, create products, and achieve complex goals in complex environments.

Understanding 'intelligence' with respect to the abilities of 'information processing' and 'problem-solving' justifies the presence of the 'digital' and 'innovation' components in the intelligent cities' standard model. If cities are to become intelligent, they should enable large-scale and city-wide communication and information processing (through digital interaction), and define pathways that resolve cities' problems and challenges (through innovation networks and ecosystems). The fundamental components have different roles to this end. Cities offer the human communities, skills and resources, the physical infrastructure of human action, the capacity for governance and management. But cities are also fields of conflicts, contradictions, problems to resolve, and challenges to address. Innovation and innovation ecosystems define how solutions to city challenges are produced; how citizens and organisations respond to challenges; how to create new products and services to address challenges; how to adapt to changing conditions. The Internet offers capabilities for information processing and the digital agglomeration of resources, and makes cities interactive, capable of gathering, storing, and disseminating information.

Complementarities among cities' innovation processes and digital interactions are not only related to their different roles. Innovation itself changes dramatically as it is immersed into the Internet. Somehow, innovation nodes 'explode' and multiply geometrically as large urban communities are involved and undertake innovation tasks and social media organise interactions among the members of communities.

Crowdsourcing is a good case for understanding such interactions between innovation, social media, and large communities. Crowdsourcing comes from the combination of 'crowd' and 'outsourcing' and the main idea is to assign a task to a large group of people or a community [9]. It is an extreme form of open innovation in which tasks are not assigned to selected external providers, but to the crowd. In the case of intelligent cites, crowdsourcing tasks focus on innovation, while problem-solving is expected from end-users and citizens. Crowdsourcing is also strongly related to digital interaction, online platforms and collaborative Web spaces because the participation of large communities (crowds) presupposes the use of digital media. It is an online, distributed problem-solving and production model [10]. It also characterises a major stage in the evolution of the intelligent cities' standard model during the first decade of 21st century. Two cases that illustrate the use of crowdsourcing in smart cities are 'NYC Simplicity Idea Market' and 'Improve-My-City', an application used in many cities all over the world.

**NYC Simplicity Idea Market** was launched in February 2011 by New York City and remained in operation for about a year. Employees at all levels of administration and city agencies were invited to suggest and share ideas about improvements to city government. Everyone could upload ideas, comment on the ideas proposed by others, and vote for those considered the best. Then, the most popular proposals were reviewed by experts and the best were implemented by the city [11]. The components of this experiment are quite clear: a large community in the city, estimated at 300 000 employees, was invited to elaborate on ideas about education, safety, and the maintenance of the city's infrastructure. Innovation was based on the combination of ideas generation by employees, user-driven evaluation of ideas, feasibility assessment by experts, and ideas implementation by the city. A content management system and crowdsourcing platform was used to enable employees' participation and assessment through voting. Everything revolved around crowdsourcing, involving a large community of the city, selecting ideas by preference of the same group, and enabling participation through social media.

**Improve-My-City** is an application developed under the framework of the 'People' project, a smart city project of the EU Competitiveness and Innovation Programme (CIP-ICT-PSP). Improve-My-City is an open source application and anyone can download the code from the GitHub [12] for use or improvement. Because Improve-My-City is a free application, it has already been used in many cities in Europe and America. Citizens can report local problems and suggest improvements, write comments on other posts, and vote to support suggestions and demands. Reported issues go directly to the city's government queue for resolution, and users are informed by the responsible authority about the progress of their request. Again, the main concept is about motivated crowdsourcing. The entire community of a city can be involved. Reports and suggestions are listed in 25 categories related to improvements in the environment. Innovation is based on a combination of crowdsourcing about city problems and solutions, while implementation relies on institutional action from the city hall. The digital application Improve-My-City is a Joomla 2.5.x-compatible component to report, gather, present, comment, vote, and track demands on the map. On a secondary circuit of crowdsourcing, communities of users and developers support the customisation of the application to different environments and languages.

Crowdsourcing platforms make this type of citizens' participation in problem-solving a reality. A large collection of platforms is presented on Crowdsourcing Landscape [13] which can support the entire cycle of innovation: from innovation funding (crowdfunding), to ideas generation (idea platforms, prediction markets, content markets, content rating), collaborative innovation and product development (distributed innovation, innovation prizes, cycle sharing, competition platforms) and implementation (crowdsourcing aggregators, microtasks, service marketplaces). Each platform combines an objective with a roadmap to achieve it. The crowd — a community of users — has to follow the roadmap on the platform to generate solutions, prioritise them, and aggregate skills and resources to implement.

As crowdsourcing rises in popularity and use, platforms evolve and specialise. A recent report on crowdfunding presents 41 platforms for different funding purposes and users: general crowdfunding platforms, crowdfunding for social causes, for health and medical, for small and local businesses, for science, for music, for education, for gaming and apps, crowdfunding for start-ups and companies [14]. Two types of innovation funding are supported: innovators can pledge support for an idea or project as a donation or in exchange of some kind of reward or use value; on the other hand, innovators can ask for 'crowdinvesting'. However, the latter demands the loosening of funding regulations to permit more people to invest in what they consider promising ventures and to take part in equity funding. Crowdfunding and other forms of crowdsourcing cover specific gaps in innovation: UK crowdfunding, for example, complements and covers equity gaps in innovation funding between GBP 0.5 million and GBP 2 million. For 2011 and 2012, the National Endowment for Science, Technology and the Arts (NESTA) estimates an annual rate between 50 % and 60 % on UK crowdfunding platforms [15].

A specific form of city intelligence stems from crowdsourcing, user-driven open innovation, and social media platforms. We have called it 'empowerment' or 'amplification intelligence' as it is based on people's upskilling supported by experimental facilities, open platforms and city infrastructure [16]. Collaboration among the components of the standard model of intelligent cities (city–innovation–digital space) actualises this type of intelligence. In the first step, the city — citizens and communities — define challenges to address. Any form of intelligence starts with the definition of problems to address, which also sets the metrics of success. Challenges are specific to each city, its sectors, districts, utilities, quality of life and governance. In the open innovation/crowdsourcing perspective, challenges are defined collectively by aggregation and prioritisation of citizens' views and demands. Then, a problem-solving roadmap is defined. User-driven innovation is called on to customise the building blocks of the roadmap in terms of information collection, use of proven solutions, inventing new solutions, and disseminating selected solutions. Digital media and open platforms facilitate the entire process by offering e-tools that help a large number of participants to be involved, sharing insights, combining skills and aggregating resources. The outcome is city empowerment: an increase of collective capability in defining problems and solutions, and actualising implementation mechanisms through collaboration and agglomeration of skills and resources.

### *Cities as Living Labs for open innovation*

Such technology-oriented developments with high relevance for user or community-driven and open innovation have been taken up by many cities to develop smart city visions and strategies. Within FIREBALL, we have collected a corpus of observations on current and emerging strategies and policies towards smarter cities and how these try to

benefit from the opportunities of ICT-based technologies and applications. Some of them illustrate how cities are working with experimentation infrastructures such as technology test beds and Living Labs. They provide an overview of the current situation and future planning and a roadmap towards the development of smart or intelligent urban systems. The following cases present lessons learned that are of interest for current and future stakeholders.

**Barcelona** pioneers the smart city concept with various initiatives such as the 22@Barcelona District. The Barcelona Smart City strategy aims to provide an environment for generating smart ideas in an open environment through fostering clusters and open data or developing proper Living Labs while directly involving citizens in the co-creation process of products or services. The main driver of the Barcelona Smart City is the fostering of competitiveness in the city. Other drivers are to promote innovation, create new channels of communication, facilitate access to information both locally and internationally, and improve the efficiency of public services. Barcelona's smart city knowledge economy is built on an industrial network and clusters creating a relationship space, social networks between companies, institutions and the city hall and citizens. This interaction of the citizens with this area and companies creates a knowledge society. The Barcelona Smart City concept is used as a strategic tool to encompass modern urban production factors in a common framework and foster competitiveness in the city. The main Barcelona Smart City model components are Smart Districts (22@Barcelona District), Living Labs initiatives (22@Urban Lab), infrastructure, new services for the citizens, and open data. The city has created more than 4 000 units of new housing at 25 % less rental, 55 000 jobs with over 1 500 new companies, and new institutions, mainly in information and communication technologies and media industries. It has 10 universities and 12 R & D centres.

The innovation strategy of the region of **Helsinki** shows the way forward for collaboration that will more efficiently harness the huge innovation potential of the metropolitan area. Helsinki Region forms a strong innovation-oriented cluster around mobile technology, based on favourable factor determinants such as high-quality research and education institutes, a continuous demand for change and innovative services, a highly competitive business environment and, at the same time, strong innovation-driven networks of businesses and governmental actors. The prominent role of user-driven and open innovation (Living Labs) underlines the strength of the cluster. Actively supported by local and regional government, as well as through governmental funding for research, development and innovation projects, Living Labs have been established in and around Helsinki Region (e.g. Helsinki Living Lab and Arabianranta Living Lab). Their functions are diverse, but all are basing their activities on the principles of user-driven innovation. There is a strong tradition of Living Lab research in Finland and various types of organisations — universities, city or region-owned development agencies (Forum Virium), companies and SMEs — have established Living Labs in the Helsinki Region area. The municipalities use Living Labs for economic development and societal engagement in energy issues, or service provision of healthcare for the elderly, preventive care, or urban living. Several universities of applied science conduct research in Living Labs at the edge of science and practice. Companies, such as Nokia and Philips, use Living Labs as user-centred hubs for ideation and product development and national research institutions use Living Labs as platforms for innovation. These Living Labs focus on bringing users with their knowledge, ideas, and experiences together with the developers of new services and products to increase the quality and usability of the services and products created. While the role of Living Labs is only a partial aspect of Helsinki Smart City, it has a wide influence because of its emphasis on openness, user engagement and co-creation.

The ambition of **Lisbon** as a smart city is to improve the city's liveliness and quality of life, namely through the active involvement of citizens in the city's governance model. The city strives to become a pole of creativity and innovation with a prospering atmosphere for entrepreneurs, and incubator for new ideas and business models. The strategy defined for Lisbon's Smart City is based on three pillars: building spaces (Co-Working spaces and Fab Labs), fostering entrepreneurship (launching of new business projects) and creating useful tools (citizens can co-create new, economically valid projects for the city). Nevertheless the achievements of this strategy so far have been very positive with the creation of the Lisbon Start-Up, the launch of the Fab Lab initiative and public and private Co-Working centres. At the urban management level the strong effort in the improvement of the public transport system and the collection of real-time data regarding energy use in public buildings and services allowed the optimisation of infrastructures and the definition of intervention priorities. Finally, user's involvement in the city's governance model has been successfully achieved with the Participatory Budgeting Initiative. Citizens are eager to

participate, and a proof of this is the increasing participation in the Lisbon Participatory Budgeting initiative that started in 2008 with 1 000 citizens and achieved more than 17 000 participations in 2011. Despite the positive feedbacks a strong effort has to be put into the communication strategy, enabling different actors to interact and represent their role in the society. The Living Lab methodology is already a tool, being mostly applied in energy efficiency projects dealing with consumer behaviour, with positive results and incentives to deploy new projects and address new areas. Entrepreneurial activities, taking advantage of the assets created, are flourishing, especially within the creative industry that already plays an important role in Lisbon's economy and can further be deployed in this sense.

The strategy of **Manchester** is to become a Digital City Test Bed with an open innovation Living Lab for creating Future Internet next-generation services and applications for making available more efficient public services, and to stimulate urban regeneration and entrepreneurship. The availability of Next-Generation Access (NGA) networks is key, enabling city service providers to maximise the ability for citizens to self-serve and to provide efficient access to expensive specialist resources. An example of such resources is to provide expert medical care using innovative new services such as telemedicine enabling the exchange of knowledge and expertise. Manchester is an example of how cities are ideally placed to mobilise and aggregate demand for NGA services for the Future Internet 'Smart City' and to provide the strong leadership required to make this happen. The 'Core Cities' network is currently working on an initiative to develop closer engagement between city leaders, government, communications service providers and the Internet industry as a whole. The Manchester City Region NGA initiatives are being developed in partnership by the Manchester Digital Development Agency (MDDA), which is part of Manchester City Council, and the Commission for the New Economy, working on behalf of the Association of Greater Manchester Authorities (AGMA) in the context of the City Region Pilot and the proposed 'combined authority'. Currently, linked initiatives are being developed: the Corridor 'Living Lab' NGA pilot project, aiming to connect 500 businesses and 1 000 residential users through an FTTP network, and the Manchester City Region NGA initiative (e.g. Metrolink and other transport corridors together with public service network development).

The city of **Thessaloniki** illustrates an evolutionary course from digital to intelligent and smart city. The knowledge economy of Thessaloniki is developing via two parallel processes: on the one hand, through setting up innovation clusters and technology districts, such as the Technology Park, the Technopolis ICT business park, the Thermi and i4G incubators, the Alexander Innovation Zone; and, on the other hand, through the deployment of broadband networks and Web-based services for business, government, and citizens sustaining a new economy relating to the ICT sector. A new planning effort under the label 'Intelligent Thessaloniki' is blending ICTs and innovation at the city district level with specific objectives to: (i) create smart city districts with strong local connectivity based on open broadband networks, embedded sensors, smart meters, RFID, QR codes, and actuators; (ii) develop new applications and e-services adapted to each city district that enhance its functioning, competitiveness and environmental sustainability; (iii) sustain the innovation capability of the city's economic activities through networks of collective intelligence and crowdsourcing, technology learning, innovation, digital marketing, and performance benchmarking. 'Intelligent Thessaloniki' is being implemented in stages and on a per district basis through open calls for drafting and implementing detailed plans for the port area, the central business district, the University campus, and other peri-urban technology and commercial districts.

These smart city cases (see [7] for more details) demonstrate, besides the similarities as regards their future vision, also differences in the concept of the 'smart city', the driving factors, strategies, driving factors, and challenges ahead. There are also similarities such as the formation of innovation districts, neighbourhoods and clusters as fundamental elements of the smart city strategy. This also offers the opportunity for exchanging good practices and solutions from one city to another. Overall, it seems clear that the 'smart city' is more a strategy than reality. Several cities investigated are advanced in terms of technology infrastructure. However, a smart city is more than technology and infrastructure: it is also a universe of smart applications and platforms which are empowering citizens in innovative ventures. This is why many cities have endorsed the concept of 'Living Labs', promoting a more proactive and co-creative role of users in emerging urban innovation ecosystems. Within the territorial context of cities, rural areas and regions, the main goal of Living Labs is to empower communities of users at an early stage in the innovation process. Interestingly, there is a trend towards integration and shared use of Living Labs and experimental test bed resources related to the Future Internet, such as exemplified in smart city projects such as SmartSantander, TEFIS and ELLIOT [17]. Such constellations of distributed resources may

form the backbone of future connected urban and regional innovation ecosystems.

### *Smart cities and social innovation*

It is also clear that a smart city strategy involves many actors, organisations, communities and clusters. The strategy should achieve a shared vision, flagship projects, and collaboration. For that, top-down planning and bottom-up initiatives should complement each other [18]. Urban development and planning has been dominated by top-down 'blueprint' approaches since long ago. At the same time, there have always been 'grass-roots' developments based on empowering neighbourhoods and communities of citizens. These grass-roots developments have now become considerably stronger, as they are currently supported by a wide spectrum of social media/Web 2.0 technologies. Whereas the smart city visionary approach still provides inspiration as a target scenario, there is a need to consider real and daily-life problems and issues, to foster grass-roots movements aiming to empower citizens, neighbourhoods and businesses, and to push for 'social innovation'.

Social and technical infrastructures form one of the key determinants of the future welfare of cities. A creative population, infrastructure and institutions for education and innovation, networks of collaboration between businesses and governments, the role of active and demanding citizens, businesses and authorities to push for innovation and quality of services are the other important determinants. In analogy to Michael Porter's concept of national competitive advantage, the welfare potential of cities and urban areas depends on factors such as human resources, capital, infrastructure and information, on demand conditions (the citizen), urban networks of industries and entrepreneurs, and on the role of local government. This also has implications for the smart city concept itself. The smart city is not the future urban scenario but is about how *citizens are empowered*, through the use of widespread technologies, for contributing to urban change and realising their ambitions. In this sense, the city constitutes what is called, in different terms, an 'urban laboratory', 'urban innovation ecosystem', 'Living Lab', or 'agent of change'.

In this context, the concept of Living Labs as open and user-driven innovation looks well positioned to serve as a mediating, exploratory and participative playground combining Future Internet 'push' and urban policy 'pull' in demand-driven cycles of experimentation and innovation. Living-Lab-driven innovation ecosystems may evolve to constitute the core of '4P' (public–private–people partnership) ecosystems. Hence, it would provide opportunities to citizens and businesses to co-create, explore, experiment and evaluate innovative scenarios based on technology platforms such as Future Internet experimental facilities involving SMEs and large companies as well as stakeholders from different disciplines. However, in order to fulfil their promise as a key element of urban innovation ecosystems, many Living Labs should mature and become professional in terms of their 'business model' and 'business process management' service offerings and capabilities to create networks and orchestrate collaboration among a wide diversity of actors such as SMEs, citizen user groups, larger companies, policy actors and research laboratories.

### *Open access in open innovation ecosystems*

A promising strategy to foster innovation ecosystems in urban areas is to ensure open access to innovation resources. Innovation resources include test beds, Living Lab facilities and services, access to user communities, technologies and know-how, open data and more. Such resources can be potentially shared in open innovation environments. Evidence of collaboration models for sharing innovation resources such as the use of Living Lab facilities and methods in experimenting on Future Internet technologies and the use of Living Lab methodologies for implementing innovation policies of cities is growing [17]. However, the potential types and structures of these collaboration frameworks and the concrete issues to be resolved in sharing research and innovation resources, such as governance, ownership, access, transferability and interoperability, need further examination, development and piloting in future projects.

A promising area of work in this respect is 'connected cities', addressing issues such as how different cities in a region, or in different regions, can have access to the services provided by assets or resources hosted elsewhere. And, what kind of new services can be foreseen building on this concept of common, geographically distributed assets (e.g. test bed and Living Lab services for innovators in smart cities). There already exist examples of emerging bodies integrating a technology test bed and a Living Lab, such as ImaginLab in the region of Bretagne in France, which is an open platform dedicated to experimentation, from integration and interoperability testing to usability evaluation for new products and services on fixed and mobile networks (FTTH and 4G LTE). To some extent, projects dedicated to Future Internet experimentation and dedicated to Living Labs innovation may interact with, and even integrate into, hybrid models. Such

models could dynamically evolve over time, as 'organisms' constituting the infrastructure of urban and regional innovation ecosystems. Hence, a vision for 2020 as regards smart cities and regions might be that Internet infrastructures, services and applications form the backbone of connected regional, urban and (trans)national innovation ecosystems, fostering co-creative innovation and new business creation.

## Acknowledgments

The FIREBALL project, which ran 2010–12, was funded under the FP7-ICT programme of the European Commission (Grant Agreement 257291). The authors acknowledge the European Commission for their support as well as the FIREBALL project partners for their contributions to the project and to the ideas developed in this paper.

## References

[1] Pallagst, K. et al. (eds) (2009), *The Future of Shrinking Cities: Problems, Patterns and Strategies of Urban Transformation in a Global Context*, Berkeley IURD Monograph Series.

[2] Glaeser, E. (2011), *Triumph of the City — How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier*, Penguin Press.

[3] United Nations (2008), *World Urbanization Prospects — The 2007 Revision — Highlights*, United Nations, New York.

[4] FIREBALL project website (http://www.fireball4smartcities.eu/).

[5] Caragliu, A., Del Bo, C., Nijkamp, P. (2009), *Smart cities in Europe*, Series Research Memoranda 0048, Free University Amsterdam, Faculty of Economics, Business Administration and Econometrics.

[6] von Hippel, E. (2005), *Democratizing Innovation*, The MIT Press, Cambridge, MA.

[7] Schaffers, H., Komninos, N., Pallot, M. (eds) (2012), *FIREBALL White Paper Smart Cities as Innovation Ecosystems Sustained by the Future Internet* (http://www.urenio.org/wp-content/uploads/2012/04/2012-FIREBALL-White-Paper-Final.pdf).

[8] Legg, S., Hutter, M. (2007), 'A collection of definitions of intelligence', Goertzel, B., Wang, P. (eds), *Advances in Artificial General Intelligence: Concepts, Architectures and Algorithms*, IOS Press, Amsterdam.

[9] Howe, J. (2006), 'The rise of crowdsourcing', *Wired Magazine*, No 14.6.

[10] Brabham, D. (2008), 'Crowdsourcing as a Model for Problem Solving — An Introduction and Cases', *Convergence*, Vol. 14.1, pp. 75–90.

[11] Barkat, H., Jeaggli L., Dorsaz P. (2011), *Citizen 2.0: 17 examples of social media and government innovation* (http://www.thinkinnovation.org/en/blog/2011/11/citizen-2-0-17-examples-of-social-media-and-government-innovation/).

[12] GitHub (2012), Improve-My-City (https://github.com/icos-urenio/Improve-my-city); a full description can also be found online (http://smartcityapps.urenio.org/improve-my-city_en.html).

[13] Crowdsourcing Landscape (http://crowdsourcingresults.com/images/CrowdsourcingLandscape_v1.jpg).

[14] Pierrakis, Y. (2012), 'Financing University Entrepreneurial Ventures: Evidence from the UK', Innopolis Final Conference (http://conference.knowledgecities.eu/conference-organisation/papers-presentations/).

[15] Kim, R. (2012), *A GigaOM guide to Kickstarter wannabes* (http://gigaom.com/2012/11/28/kickstarter-copycats).

[16] Komninos, N. (2011), 'Intelligent cities: Variable geometries of spatial intelligence', *Journal of Intelligent Building International*, Vol. 3.3, pp. 172–188.

[17] Schaffers, H., Sällström, A., Pallot, M., Hernandez-Munoz, J. M., Santoro, R., Trousse, B. (2011), 'Integrating Living Labs with Future Internet Experimental Platforms for Co-creating Services within Smart Cities', Proceedings of the 17th International Conference on Concurrent Enterprising (ICE), Aachen, Germany.

[18] Komninos, N., Schaffers, H., Pallot, M. (2011), 'Developing a Policy Roadmap for Smart Cities and the Future Internet', *Proceedings of the eChallenges e-2011 Conference*.

## Contact

**Nicos Komninos**
Professor, Urban and Regional Innovation Research (URENIO), Aristotle University of Thessaloniki
komninos@urenio.org

**Marc Pallot**
Senior Research Fellow, Centre for Concurrent Enterprise, Nottingham University Business School
marc.pallot@9online.fr

**Hans Schaffers**
Visiting Professor, Center for Knowledge and Innovation Research (CKIR),
Aalto University School of Business
hans.schaffers@aalto.fi

## 2.2. Collaborative innovation ecosystems for solving societal challenges

According to the Europe 2020 Innovation Union flagship initiative [1], research and innovation for entrepreneurship are the key engines for smart, sustainable and inclusive growth and job creation. The Europe 2020 Innovation Union is a bold attempt to solve the 'European innovation emergence' [2]. In terms of inputs to European R & D, the EU, on average, was lacking (2 % of GDP) in comparison to the United States (2.8 %) and Japan (3.4 %) in 2010 [3]. Even though the EU is slowly advancing towards its 3 % R & D target, there is a widening gap between the EU and its world competitors [4]; the overall picture is that Europe is falling behind the United States, Japan and China. The global R & D funding forecast 2012 [5] views that this tendency will continue even though the growth of overall global R & D spending continues, especially in China, Japan and the United States, while globalisation accelerates. Europe maintains the problem of lacking R & D in the business sector and some Member States. However, countries such as Sweden, Finland, Denmark, Austria and Germany [4] still rank high in international R & D comparisons.

Horizon 2020 [6], the new EU framework programme 2014–20, proposes a major investment of EUR 80 billion in research, innovation and entrepreneurship. Horizon 2020 aims at strengthening Europe's global competitiveness through, firstly, globally competitive science and technology excellence in Europe and, secondly, European global industrial leadership in research, development and innovation (RDI). Horizon 2020 also proposes a further third pillar (EUR 32 billion) that is a new key element to the programme: the RDI around major societal challenges of our time. These are the grand challenges shared by all Europeans, such as climate change, well-being and ageing, sustainable urban and rural development, sustainable transport and mobility, energy efficiency and making renewable energy more affordable, ensuring food safety and security, and coping with challenges of globalisation, poverty, and immigration.

Horizon 2020 reflects the understanding that Europe's current problems are outcomes of underlying structural problems and lacking economic and social dynamism. Europe needs to invest in RDI that renews and strengthens economic and social foundations. At its best, Horizon 2020 — with its emphasis on solving societal challenges — opens new avenues for transformative innovation, balanced economic and social development, and entrepreneurial activities, in the business sector and across sectors, whether private, public or civic. However, this calls for the engagement of firms, academia, public agencies and people in a strategic dialogue and collective actions that aim at making the world a better place in which to live.

Horizon 2020 and European Innovation Union mean — in terms of *how* to solve the major societal challenges — strategic partnerships of firms, academia, cities, public agencies and people in RDI. Traditionally, the innovation partnership is viewed as relevant to technology development. We argue that it is even more relevant for solving societal challenges. Public–private partnerships in RDI around solving societal challenges are crucial: they are needed in order to guarantee a wide and deep impact (i.e. all the relevant players should get involved). We even argue that the strategic collaboration in solving societal challenges brings opportunities to create new firms, joint ventures, social entrepreneurship and entrepreneurial activities — along with wider societal, institutional and structural transformation.

However, solving societal challenges brings about questions such as: who is in the position to define the societal challenge in the first place, and how? How should the consequent leadership and organisation of the joint effort to solve that challenge be viewed? Who sets, and how, the strategic goals to solve these societal challenges? How should we organise the creation of the strategic agenda and organisation for the process of collaborative RDI? Who should lead and organise the collaboration around solving the societal challenges?

However, these problems should be solved: the strategic collaboration of firms, academia and public agencies — even with people — offers a potential for shared value creation that reforms markets and industries, improves the productivity of public and private services, and tackles the grand challenges with new approaches; the societal challenges can be taken as starting points and the main focus in RDI — they should not be viewed just as side effects or impacts of techno-economic development but, rather, as main sources for new social and economic innovations. While doing so, there is an opportunity to apply a human-centric approach that values quality of life and nature.

Human-centric approaches and shared value creation may, however, challenge our understanding of the sources of productivity, efficiency and global competitiveness. We may find new dynamic socio-economic patterns of competitiveness. We may

even learn to pilot, experiment and scale up for new types of firms and economic activities, including non-profit activities and social enterprising.

Having the public engaged in solving the societal challenges offers an opportunity to strengthen participative democracy and open society development in Europe. Europe has the potential to become a people-driven dynamic open society that does not shy away from the major problems of our time but rather organises itself around them. However, this calls for strategic action: we should learn to mobilise the dialogue and resources for creative and innovative RDI in a way that respects human beings, nature and quality of life.

This is how Finland views itself as a society. Finland has created a bottom-up, dialogical, collaborative and human-centric strategy that is central to its development as a nation [7]. This fresh picture of a people-driven society is based on the idea that the society best develops based on its dynamic individuals and their networks. Finland's vision of a society is very pragmatic but value and future driven. Finland aims at being a Silicon Valley for social innovation by 2030.

This article discusses that Europe, as an Innovation Union, calls for new forms of strategic collaborative action that implies the integration of research and innovation instruments and public and private actors for collaborative RDI and entrepreneurship. We argue that this is best done in open and collaborative ecosystems for RDI: this also helps in engaging the people. We further argue that this can be done based on high levels of education of the people of Europe, increased consciousness about the problems at hand and the facilitation of ICT. People are willing to be of service and contribute: the issue is how to make this happen.

## *Collaborative innovation ecosystems challenge firms*

What about the role of firms in solving societal challenges of our time?

Porter and Kramer [8] argue that the capitalist system is under siege; in recent years business has increasingly been viewed as a major cause of social, environmental, and economic problems. Companies are widely perceived to be prospering at the expense of the broader community. They are blamed for society's failures. The legitimacy of business has fallen to levels not seen in recent history. Porter and Kramer further argue that the problem is the outdated approach of firms to value creation; it is viewed narrowly, optimising short-term financial performance in a bubble while missing the most important customer needs and ignoring the broader influences that determine longer-term success.

Scott and Davis [9] argue that, by definition, firms are the best positioned for efficient problem-solving and innovation. That is why mankind has developed this organisational 'format' in the first place: firms are supposed to have capabilities to mobilise people and other resources in efficient ways around problem-solving, innovation and effective implementation [10]. Firms operate as long-lasting missions or 'projects' deploying strategies, structures, processes and practices that are most purposeful and efficient to the task at hand. However, we may argue that, over time, there may have been too much emphasis on the internal efficiency of the firm at the expense of the 'external efficiency'; customers and society may have suffered from this 'biased' approach. Porter and Kramer [8] want to balance this tendency; firms should enter into shared value creation that involves creating economic value in a way that also creates value for society by addressing its needs and challenges. They see that, today, there is a cliff between economic and social development due to presumed trade-offs between economic efficiency and social progress.

Horizon 2020's third pillar offers a good opportunity to look at how we Europeans may balance economic and social development. We have the opportunity now to experiment with new firm–society collaboration in shared value creation when solving the major societal challenges of energy efficiency, well-being and welfare services, intelligent and integrated traffic and transportation, green, digitalised and smart cities, resource efficiency and poverty, among others. While US RDI policy has the emphasis on corporate-driven RDI, Porter and Kramer [8] propose that corporate sector should take the lead in this balancing act!

The European Innovation Union and Innovation Partnership can be seen as frameworks and transformation mechanisms for solving societal challenges toward shared value creation. That may even bring about the foundations for a European sustainable socioeconomic model [11].

We argue that firms benefit from firm–society collaboration in RDI ecosystems when rethinking their strategic positioning in terms of technologies and markets, when experimenting and piloting for new open service and technology architectures, and when reforming a business model or even the whole

industry. The RDI in collaborative ecosystems may be used when changing the centralised production and delivery patterns towards a more distributed situation, when moving towards more customer-driven structures in industry, and when moving towards more partnering, networking and collaboration-based business ecosystems.

## *Process of collaborative RDI for shared value creation*

At the beginning of the 21st century, the global company AGC Glass [12] wanted to rethink its technology base and consequent role in the global marketplace. It invited a wide and strategic group of customers, firms and experts, and its own people to rethink: what else could glass do for us besides what it already does? The process ended up changing the role, technological properties and use of glass, even to the point where it became a protective and breathing 'skin for us' in houses, cars and other applications. This process included wide idea collection and piloting and experimentation with new technologies, business models for social and economic validation, and the means of implementing a new strategy. The experimentation also involved issues such as: do we need new service logic as well as industrial logic? What are the new sources of scalability, productivity, and efficiency? How can we contribute to sustainable development?

The collaborative RDI process may have steps such as the following.

(i) *Mission, vision and strategy creation* with a wide collection of ideas about future issues and scenarios, including experimentation and piloting around a set of potential hypotheses and pre-concepts for solution.
(ii) Focused *experimentation around* selected sets of hypotheses and properties of pre-concepts as *service or business models, or specifications for architectural or ecosystem designs*. This includes economic and social validation of new concepts with firms, public agencies, and people: this is a wide, interactive dialogue with future 'markets' of emerging innovations. This broadens the understanding about the sources of the economic, social and environmental sustainability of value propositions.
(iii) Furthermore, we may commit partners, developer communities and people to the *co-creation of features of usage and sources of economic and social scalability*. This pre-market prototyping, experimentation and piloting is designed to capture the new market dynamism and customer behaviour and the personalised and generic functionalities of future usages, among other things.
(iv) We may even enter into *wide-scale experimentation and piloting that brings about understanding of how to implement new solutions*: how to produce and to deliver. All of these steps involve — in different ways and combinations — own people, customers, collaborative firms, experts and others.
(v) And, we may even *experiment with new forms of entrepreneurial activities* — and firms! We argue that there is an opportunity to create foundational elements of a new value creation 'formula' for firms — non-profit or profit based — to emerge.

Like AGC Glass, IBM, Nokia and many other corporations have used ICT, social media, social webs, crowdsourcing and other means of dialogue for identifying — even with millions of customers and experts — strategic challenges and their solutions for future development. Nokia [13] has developed a crowdsourcing-based dialogical strategy and practice for listening to consumers and developers in the RDI of mobility. IBM has come up with service offerings and concepts towards the Smart Planet and Smart City [14].

It is evident that the integration and engagement approaches have an impact on the whole process of collaborative RDI: from strategy to implementation. This is imperative while the shared inquiry aims at developing answers to complex, all-inclusive questions such as: what are the new consumption and production patterns for sustainable development? How do we design cities for green growth? How do we design welfare systems that are efficient not only as a service or production system, but also from the viewpoint of 'customers' or, rather, human beings? How do we improve traffic and transportation systems to become environmentally sustainable, intelligent and 'user-friendly'? Do we need to develop new distributed co-production systems of energy? How do we change the energy consumption behaviour of people?

However, the challenge is to integrate the bottom-up and top-down approach and means of 'control and setting free'. It is also demanding to transcend beyond one's own strategies, agendas, competences and resources. Furthermore, open ecosystems challenge the underlying principles and practices of IPR (intellectual property rights). IPR may reflect, in a righteous way, the role of partners and the process and context of the creation and usage of IPR. The Netherlands has even created instruments for citizen rewards (vouchers) in RDI!

This is what is going on in the EU-funded PPP project on the Future Internet (FI PPP). In this project,

European ICT companies are collaborating with cities and public services in order to meet people's expectations of a more transparent and efficient society with increasing digital social capital and participation. The FI PPP is tapping into this unprecedented window of opportunity for new types of openness and co-creation. By joining forces, European stakeholders can develop not only novel and innovative Future Internet-enabled services, but also innovative concepts through demand-driven innovations and collaborative innovation networks that can become a new European-led market concept in global competition.

### *Need for new funding instruments?*

Europe may need to also consider funding arrangements that integrate individual, local or regional and national efforts across borders for RDI that solve societal challenges of our time. We may even need to pilot a cross-border funding agency, a 'European innovation' or 'venture fund' that combines European interests with national, local and regional interests and provides not only RDI funding for experimentation with new innovations but also pre-market and 'early-market' 'venture' funding for validation and scalability of new service and business models towards new market and industry creation — even with global reach. Along with new funding instruments for entrepreneurship, we may also need cross-border entrepreneurship programmes and activities for bridging the 'death valley' from RDI to international market place. This may mean improving regional, national and European-wide networks, frameworks, instruments and RDI infrastructures towards European strategic RDI goals of jobs and growth for entrepreneurial activities.

This may include competitive pre-market and 'early-market' venture funding of new businesses, firms and other entrepreneurial activities. European-wide cross-border collaboration in RDI should be sustained through network efficiency that sustains and scales up new findings towards the global marketplace. This is what project-by-project-based collaboration and funding do not offer.

However, the solving of the major societal challenges of our time through collaborative RDI is a costly and resource-intensive way to conduct RDI, which means that this approach should be used with strong strategic arguments, resource commitments and long-lasting motivation.

Currently, in Finland, Tekes, the Finnish Funding Agency for Technology and Innovation, explores new roles for itself in Fuelling Finnish Innovation [15]. During the 2000s, there was a change in innovation policy towards a more demand and customer-oriented standpoint, based on networks and open innovation ecosystems that are embedded in the global economy. Policies aiming to enhance and promote innovation are no longer restricted to manufacturing and R & D-intensive technologies but have to take into account wider opportunities for innovation such as the services sector. Tekes views that, from the mid-2000s onwards, knowledge bases and policymaking have expanded towards a more general, socioeconomic context and way of thinking. The new Finnish broad-based national innovation strategy targets these challenges. This is a major shift: even in the 1990s, the Finnish innovation strategy emphasised technology-driven integration, user-orientation and societal impacts of technology related R & D. In the 1980s, there was a move from science to technology policy when promoting the techno-economic emphasis in the development of the Finnish economy.

Based on the shift in innovation policy thinking in Finland, Tekes considers new roles, among other things, concerning RDI in societal challenges. Besides funding roles, it may even facilitate the whole process of innovation. Tekes also considers what role it should take as a local, regional, national and global actor in RDI, how it should promote new RDI partnership constellations and RDI networks, and how it could facilitate mission and vision creation processes through its foresight for vision creation activities. It also considers if it should be involved in the RDI programme creation in some complex cases such as those related to societal challenges.

### *Academia needs to integrate not only research and innovation but also disciplines*

From the viewpoint of academia, Nelson, in *Scientific American* [16], discusses the challenge of solving major societal problems of our time as an issue of 'a convergence revolution and a paradigm shift which leads to rethinking of how scientific research can be conducted'.

Convergence as a research design involves merging distinct methodologies, technologies, tools, processing principles, and other elements of research designs into a unified whole. The Massachusetts Institute of Technology (MIT) views this approach to research as a blueprint for innovation. Convergence is a paradigm shift, but not just, in Thomas Kuhn's terms, within a discipline [17]. Convergence means a broad rethinking of how all scientific research can be conducted, so that we capitalise on a range of

knowledge bases — dependent on the very nature of the problem. The MIT concludes that the convergence revolution does not rest on a particular scientific advance but on a new integrated approach for achieving advances.

However, the integration of disciplines is a challenge to the historic structure of universities, which are organised into departments focusing on discrete disciplines. The convergence-style research does not fit nicely into the funding categories of research-funding agencies, and it does not align neatly with the missions of traditional research institutes either. Consequently, convergence faces a series of structural, financial, organisational and even policy challenges that must be resolved in order to allow a scale of transformation to really take place. The January 2011 forum of the American Association for the Advancement of Science (AAAS) concludes that it is imperative that we continue efforts to overcome the problem of 'stovepipes' and develop both new investment mechanisms and new models for organisational collaboration.

Solving societal challenges calls for human, social and economic sciences to take a stronger role in RDI; in EU-funded projects such as Collaboration@Rural, SAVE ENERGY, Peripheria, and Concorde (FI PPP), we have found that design principles for services, interoperability of technologies or the functionalities of service and technology platforms may be derived from R & D that recognises the patterns and variables of human, institutional, organisational and social behaviour. Human, social and economic sciences on cognition, decision-making, network efficiencies, social networking, social neurosciences, sustainability and industrial economics, provide knowledge about what the solutions could be about and according to which underlying assumptions and principles we may integrate the outcomes of other disciplines. This is the human-centric approach to integration of research and innovation for entrepreneurship.

## *'Citizen science' challenges methodologies of experimentation in real life*

The further challenge is methodological; the solving of societal problems requires experimentation and piloting 'outside controlled laboratories' in the middle of people's everyday lives and, in some cases, even at large scales. The development of ICT and social media offers revolutionary opportunities for open RDI that engages wide user panels and developer communities. One would like to see major investment in Europe, not only in technical research laboratories, but also in European-wide virtual and social RDI infrastructure and methodology development that benefits from computing capacity that can run through major data for analysis, modelling and pattern-building.

The issue is about having a sound theoretical and methodological basis for solidity, validity and reliability of the large-scale RDI designs in real life. The conditions for truth, validity and reliability claims — and even those of ethics and aesthetics — require real concern in human-centric collaborative RDI for social, societal, institutional, structural and systemic innovation.

However, this is a costly and resource-intensive way to conduct RDI, which means that this approach should be used only with strong reasoning and by sharing risks, efforts and costs.

Does it make any sense to involve people? Begley, in *Scientific American* [18], argues for 'citizen science' and the human intuitive capacity to grasp the essence of the situation, scientific method and experimentation. It is possible to 'invite' that capacity in people by providing the means to connect between abstract concepts and the real world. Norris [19] argues for 'citizen engagement' and that governments and civic societies are adapting to ICT worldwide and creating new political opportunities for active citizenship and civic engagement.

## *European networks of cities and regions: a critical mass for solving the societal problems of our time?*

Europe has innovative networks such as EuroCities, Smart Cities and Innovative Regions. From the viewpoint of solving major societal challenges, the role of cities and regions is crucial: they are the places of life where the contemporary problems can be met and solved. However, cities and regions should view themselves as places for globally competitive RDI around societal challenges with entrepreneurship strategies. They may develop new means for partnering and citizen dialogue, innovation agencies to fund efforts to solve societal problems, etc. Helsinki — the World Design Capital 2012 — participates in many European networks; it also has a bold RDI strategy, Innovation Fund and Forum Virium for partnering, wide dialogue with stakeholders and project work in opening public data, improving energy efficiency, intelligent traffic, well-being, and many other areas of policy.

Recently, European regions have organised a forum where they can discuss the issues of 'smart specialisation' [20] as a regional growth strategy. The

'smart specialisation platform' supports regions and Member States in better defining their research and innovation strategies. As there is no 'one-size-fits-all' policy solution, the new facility helps the regions to assess their specific research and innovation (R & I) strengths and weaknesses and build on their competitive advantage. This is, for the regions, another step on the path to achieving the objectives set by the Member States in the field of research and innovation as part of the Europe 2020 strategy.

### *European Network of Living Laboratories*

Since the Finnish EU Presidency in 2006 [21], the EU presidencies have promoted open, ecosystem-based human-centric RDI in real-life contexts such as living laboratories that engage people. Currently, the network has over 300 identified members as urban, regional, public service or industrial reform-driven living laboratories in Europe [22] and globally. The network started its operations by identifying competitive open RDI ecosystems for solving major societal challenges of our time such as well-being, energy efficiency, smart city development and participative media. However, the next big challenge is to develop, across borders, the network efficiency that is needed for scalability of pre-market research and innovation for entrepreneurship. This includes institutional, leadership, funding and other network-efficiency-related challenges. Furthermore, if this is done successfully, this network may fundamentally boost the internationalisation of new services, businesses, firms and industries. This also means not only solving the major societal problems in Europe but also boosting single market development.

Currently, the European Network of Living Labs (ENoLL) is experimenting in providing European network efficiency in RDI across borders for entrepreneurship. ENoLL members have already piloted with European firms, academia, cities, and citizens, the network efficiency of RDI methodology and scalability: this work is carried out through EU-funded projects such as SAVE ENERGY, Apollon and Concorde (FI PPP). Based on these experiences, the network may be capable of developing basic and applied research methodologies for experimentation and piloting at large scales in real life. The potential of European-wide RDI networks should be taken into account when developing RDI capacities for solving societal challenges. There is a need to strengthen the consequent RDI infrastructure and research and education — even in universities. Students would be a fantastic resource to 'put into action' and learn how to conduct 'hands-on' RDI with people in order to make the world a better place in which to live.

### *Distributed leadership for shared value creation*

Collaborative RDI means distributed leadership that is based on trust and shared responsibilities among people, firms and public agencies. Nonaka and Takeuchi [23] argue for prudent distributed leadership where wisdom is embedded in every individual practice and action. This means capabilities such as competence in grasping the essence of a problem and knowing how to draw general conclusions from random observations and mastering, as a craftsman, key issues of the moment and acting on them immediately. This also implies that values such as beauty, goodness and truth are applied, tested and recreated together in every action — not put on others. This inspires people to create and apply high-level values and aspirations as well as bonds that sustain collaborative action. This may contribute to what Michael Porter [8] discusses as a need for shared value creation. In collaboration, firms, academia, public agencies and people bridge economic and social cliffs that, according to Porter, exist due to the presumed trade-offs between economic efficiency and social progress. The shared value creation involves creating economic value in a way that also creates value for society by addressing its needs and challenges [8].

We believe that collaborative RDI around the major societal challenges of Europe's social and economic foundations brings about major social and economic transformative innovations with entrepreneurial spirit and activities, jobs and growth that by their very DNA deploy collaboration for shared value creation.

### *References*

[1] European Commission (2010), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *Europe 2020 Flagship Initiative — Innovation Union*, COM(2010) 546 final of 6 October 2010.

[2] Barroso, J. M (2011), *Innovation Priorities for Europe*, Presentation by the President of the European Commission to the European Council of 4 February 2011 (http://ec.europa.eu/europe2020/pdf/innovation_en.pdf).

[3] European Commission (2011), *Innovation Union Competitiveness Report* 2011, Executive Summary (http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=executive-summary&section=competitiveness-report&year=2011).

[4] European Commission, Eurostat, R & D Expenditure, Data from September 2010.

[5] R & D (2012), '2012 Global R & D Funding Forecast: R & D Spending Growth Continues While Globalization Accelerates' (http://www.rdmag.com/articles/2011/12/2012).

[6] European Commission (2011), Commission staff working paper — Executive summary of the impact assessment — Accompanying the Communication from the Commission 'Horizon 2020 — The Framework Programme for Research and Innovation', SEC(2011) 1428 final of 30 November 2011.

[7] Finland's Country Brand Strategy (2010) (http://www.tehtavasuomelle.fi).

[8] Porter, M. l. E., Kramer, M. R. (2011), 'Creating Shared Value: How to reinvent capitalism — and unleash a wave of innovation and growth, *Harvard Business Review*, January–February 2011, Reprint R1101C.

[9] Scott, W. R., Davis, G. F. (2007), *Organizations and Organizing — Rational, Natural and Open Systems Perspectives*, Prentice-Hall, Englewood Cliffs, NU.

[10] Scott, W. R. (2001), *Institutions and Organizations, Foundations of Organizational Science,* Sage Publications.

[11] Kulkki, Seija (2012), 'Towards a European Socio-economic Model: Firm-society collaboration for shared value creation', *Public Service Review: Europe*, Issue 24.

[12] Axiom Conference for Innovation Excellence in Barcelona, 26 and 27 November 2009.

[13] Vilppunen, A. (2010), 'Nokia Puts Crowdsourcing at Its Core', *Talouselämä,* 27 October 2010.

[14] IBM (2009), *Global Innovation Outlook*, 5 November 2009.

[15] Tekes (2012), 'Funder, activator, networker, investor: Exploring Roles of Tekes in Fuelling Finnish Innovation', *Tekes* (The Finnish Funding Agency for Technology and Innovation) *Review*, 289/2012.

[16] Nelson, B. (2011), 'Research: Big Buzzword on Campus: Is "convergence" a revolution in science jargon?', *Scientific American*, July 2011, p. 22.

[17] MIT Massachusetts Institute of Technology (2011), *The Third Revolution: The Convergence of Life Sciences, Physical Sciences, and Engineering*, MIT Washington Office, January 2011.

[18] Begley, S. (2011), 'More Than Child's Play: Young children think like researchers but lose the feel for scientific method as they age', *Scientific American*, October 2011, p. 16.

[19] Norris, P. (2001), *Digital Divide — Civic Engagement, Information Poverty and the Internet Worldwide*, Cambridge University Press, Cambridge UK.

[20] EUROPA Press Release, *Commission launches the 'Smart Specialisation platform' to further boost innovation in the EU regions*, 23 June 2011; European Commission (2010), Commission staff working document, 'Document accompanying the Commission communication on Regional Policy contributing to smart growth in Europe 2020, COM(2010) 533 final', SEC(2010) 1183 final of 6 October 2010; European Commission (2011), *Innovation Union Competitiveness report 2011*, Executive Summary.

[21] The Helsinki Manifesto, 26 November 2006.

[22] Google: Open Living Labs and European Network of Living Labs (ENoLL).

[23] Nonaka, I., Takeuchi, H. (2011), 'The Wise Leader: How CEO's can learn practical wisdom to help them do what's right for their companies — and society', *Harvard Business Review* (HBR), May 2011, Reprint R1105B.

## *Contact*

**Seija Kulkki**
Professor, Department of Management and International Business,
Aalto University School of Business
seija.kulkki@aalto.fi

## 2.3. Innovating with and for the public sector

Public sector innovation is increasingly recognised as an essential mechanism for maintaining the quality and scope of services whilst reducing costs. Cross-sectorial collaboration and coordination is increasingly seen as a solution to the most pressing social problems [1]. While public sector innovation holds great potential, it still has many barriers and challenges that require further research and experimentation.

This chapter provides a framework for thinking, debate and action on innovation models and practices in the public sector from both research and practical point of views. It explores the similarities and differences between much studied private sector innovations and the distinct factors in public–private innovation, and proposes a typology for better understanding differences in the innovation landscapes. Special emphasis is placed on transformative innovations with potential for broad societal and economic impact.

### *Introduction*

The share of privately operated public services and operational functions continues to increase. Consequently, the public sector needs to increasingly focus on critical interdependencies between public and private interests and inherent tensions between private rent-driven objectives and wider public or social good [2]. Thus, the much studied governance and innovation models from the private sector do not fully apply to these contexts, but a broader appreciation of underlying value rationales and broader organisational and managerial dilemmas inherent in the collaboration for both parties is needed in successful public–private collaboration and co-development initiatives.

In the corporate context, it has been proven that technical inventions per se do not provide value to the firm, unless they are complemented with organisational and institutional changes [3], and framed in the context of a business model that brings value out of them [4]. Since public sector innovations are typically systemic by nature, they disrupt existing linkages and initiate broader-scale changes. This requires more focus on related organisational forms and even policies. Furthermore, the public sector also needs to increasingly consider its value proposition and related partners, capabilities and costs (business model) for realising it. With these complexities, public sector innovation provides a highly interesting and understudied area of research.

### *Public sector innovation today*

Public sector innovation is increasingly recognised as an essential mechanism for maintaining the quality and scope of services whilst reducing costs. The public sector is faced with greater emphasis on performance and accountability, shifts in government funding, and increased competition for public resources. The public sector has good bases for innovation with the strong mandates of public organisations, and a plethora of benchmarks from innovation cases in the private sector. The incentives to innovate are further elevated since, without innovation, public service costs tend to rise faster than the rest of the economy. These pressures have prompted an increase in innovation initiatives, including new partnerships, collaborations, and international networking. Another major trend is the emerging demand for transparency, accountability and openness in the public sector. The new policies build on the idea that market creation benefits from open, ecosystem-based dynamism that brings together all the relevant players, including the final users. The new mindset on the roles and mandates of citizens and public institutions increasingly highlights broad-based dialogue and citizen engagement.

There is still an echo of a widely held assumption that the public sector is inherently less innovative than the private sector. This has been said to account for the lack of competition and incentives, a culture of risk aversion, and bureaucratic conservatism. However, there are several great reference cases of public sector innovation (e.g. knowledge inputs to the World Wide Web, Web-based tax filing). Debate is ongoing as to whether the public sector should innovate in the first place, or should it rather generate the conditions and incentives for innovation in academia, SMEs and private companies. However, recent pilots have demonstrated that the implementation of developed services and systems call for a sustainable organisational and institutional setting, which can only be realised through active public sector participation.

Innovating is a hard and risky endeavour and, in the public sector, the various mutually exclusive priorities add yet another layer of complexity. Whereas private corporations strive to create stakeholder value, public organisations' mission is to generate 'public value'. Public value is a debatable concept, which can have various meanings and interpretations. Typically, the term is understood to refer to added equity, efficiency and democracy [5]. Therefore, tangible, non-arguable

measures for the concept must be defined separately in each innovation case. In addition to efficiency enhancement, Kivleniece and Quelin [6] have listed public value objectives as addressing pending social concerns by accessing and leveraging private sector resources, managerial skills and know-how for public resource creation. In this approach, the public sector functions as a platform for private actor innovation and, thereby, increases the cost efficiency and innovativeness of services, while improving private sector competitiveness.

Viewing public sector innovation from an institutional approach can help to better appreciate how the public sector can support innovation, and act as a platform for experimentation. Historical institutionalism approaches highlight that institutions and policies are legacies inherited from the past that can only be disrupted by critical events, such as innovation. Sociological institutionalism approaches organisations through the (public) value and meaning they bring to individuals, which is also an increasingly important consideration in public service provisioning. Traditional choice institutionalism, in its turn, explains the creation of institutions as an attempt to reduce the transaction costs of collective activity which would be significantly higher without such institutions. The rational choice approach is increasingly applied to public innovation projects due to the gradual, but noticeable, shift in institutional logic in public sector service delivery. Whereas institutional logic in the public sector has traditionally been strongly reliant on position, mandate and professionalism, with service outsourcing and competitive pressures the norm, so institutional logic is, consequently, challenged.

## *Practical consequences*

If we look for analogies between factors of systemic innovation in the public sector and private sectors, similarities can be found from the attempts to build de facto standards through transformative innovations. However, we also identify numerous differences that have to be factored into the planning of the projects. In order to establish this connection, we summarise the profound differences in public and private sector innovation focusing on outputs. This categorisation and isolation of these elements of innovation projects supports the conceptualising phase of public sector initiatives, and provides a backdrop for the consequent discussion on different institutional objectives.

We argue that the studies on technical, commercial and organisational aspects of the services or service delivery system are not sufficient in the creation and renewal of public service. Besides, one has to understand the institutional dimensions of dominant institutional logics and their components, and their interaction towards the new service creation and implementation. The competing objectives must be factored in throughout the innovation life cycle — from the initial needs assessment through planning and deployment to the *ex post* impact assessment. Numerous studies have been devoted to the subject through a corporate lens, focusing on value creation and capture logics, but more research is still needed on the realisation and value of innovation from the public sector point of view.

The following case studies highlight the importance of appreciating the competing objectives and institutional logics of various parties in public sector innovation projects. The first case presents a completed service redesign from the healthcare sector, and the second, a large-scale regional transformation project in its initial phases.

Table 1: The characteristics of public and private sector innovation

| Corporate innovation | Public sector innovation |
|---|---|
| Shareholder value | Public value |
| Customer value | Social value |
| Incremental and radical innovations | Transformative innovations |
| Competitive advantage through proprietary innovations | Societal transformation through the diffusion of innovations |
| Business models | Service delivery strategy |
| Business logic | Logic based on knowledge and mandate |
| Dissemination | Diffusion |
| Exploitative | Explorative |
| Product and service tests with consumers | Service development with citizen |

### *Case study: Helsinki City Home Care*

The Helsinki City Home Care pilot focused on analysing the impacts of increased virtualisation of services in the elderly home care ecosystem in Helsinki. Helsinki City Home Care is a division under the City of Helsinki Health Services. The Home Care Services Unit (domestic services and home nursing) of the Helsinki Health Centre provides nursing, care and necessary support services to over 100 000 customers through over 2 million annual visits in order to maintain the health and functionality of the elderly, convalescents, patients suffering from chronic illnesses and disabled people over the age of 18. The objective is to secure the clients' active and safe living at home. A person is entitled to home care services and related support services if he/she needs help in daily activities, such as eating, washing, dressing, getting out of bed/chair, walking, or visits to the toilet [7]. With the ageing population, customers' needs for such services are growing exponentially. Thus, new care solutions and technologies are actively being experimented with. In this particular case, the service was enhanced by implementing a two-way video connection between the care centre and the elderly citizens' homes.

The main participants of the trial consisted of Helsinki City Home Care Division, Palmia (a private service provider), Tunstal and the customers. This was completed by an outer circle of management and support organisations, Forum Virium Helsinki and Aalto CKIR. Helsinki City Home Care division was in charge of providing home care to the clients in the trial project. The role of Palmia in the project was central as it was in charge of running the helpdesk and operating the servers and the hardware, and installing the software for the experimental trial. Palmia was also the provider of the emergency service, and envisioned provider of the virtual home care service through their virtual contact centre. Tunstal provided the hardware and software for the project.

In the pilot, the Helsinki City Home Care division selected 10 pilot users from its customer base. The selected clients were between 50 and 90 years old and all had different profiles in terms of their independency and health. In the trial, an individual set of objectives was defined for each customer. The objectives ranged from supporting a drug-free lifestyle and increased independency through social interaction, to a reduction in regular visits through reminders to take medication and meals, as well as simple care operations such as taking medicine and measuring blood pressure. In the course of the pilot, new aspects such as an improved sense of security and confidence to live independently were also detected.

The project started with an extensive analysis of the 'as is' situation in Helsinki City Home Care services. After that, the technical and organisational requirements, as well as aspects related to security and privacy, were assessed in detail. The follow-up to the experiments in the trial was carried out by investigating two questions.

1. What are the perceived and measurable impacts of the video connection to the various parties involved?
2. What are the anticipated system level changes required for the wider implementation of the service?

The impacts and benefits were mapped through structured interviews, Web-based surveys and computer logs for quantitative evidence to support the interview data. The results summarised that the technology was non-invasive, easy to use, and added to people's sense of confidence to act and live independently through an increased sense of security, connectivity and access to the aid personnel. The video enabled more frequent calls, which added to the structure and routine of their days, and provided much appreciated social interaction at the customers' convenience, while not invading their privacy or daily schedules. The call log files demonstrated a steady increase in both the number and duration of the calls. The customers also began to increasingly initiate the calls themselves, which was interpreted as their appreciation of the opportunity to contact the care personnel at their convenience. The nurses seconded the ease of use of the system, and felt the added value in terms of increased informal communications with the customers, which was considered to contribute to preventative care. Using the system, the nurses gained a better overall knowledge of the customers' status both physically and mentally, and could address issues before they escalated to such an extent that other extra or unplanned visits were needed.

The impacts to the case owner, the City of Helsinki, as the responsible healthcare provider, were manyfold and simulated a situation where the organisation of home care is reorganised. With the encouraging results in the pilot, it was decided that the pilot will be extended, and a real service creation environment will be trialled. In the operating model, the video calls are operated by Palmia Virtual Care Centre, and integrated as a part of the Home Care-provided daily care. This co-creation by the two organisations required changes and adjustments in the processes, roles and mandates of the organisations. The need for further integration of the various dimensions of the service became apparent,

since the current information systems at Home Care and the Palmia emergency services were not integrated, and the virtual care system operated in both systems' interfaces.

### *Findings*

The Helsinki City Home Care case is a representative case of a public service creation project constituting a change in the roles and actors in the service delivery network and, thus, constituting an institutional change in the ecosystem. The case presents how the introduction of virtual services as a part of assisted independent living support changed the operational and institutional logics of the participating organisations: Palmia, as a company, and Home Care as a unit in Helsinki Healthcare Services. Both organisations had strong organisational identities, stemming from their professionalism and experience in their respective roles. Since the co-creation required changes in the existing structures, the negotiation power of the organisations was tested, regardless of the customer–buyer relationship between the organisations. While the nurses built their legitimacy strongly on their professional identity as care providers, Palmia operated in a corporate manner, where all provided care was commercialised and packaged as defined services or products.

The case presented an interesting arena in which to study how the partly competing and complementing mandates, institutional logics and objectives became evident in the course of the pilot, even though the ultimate objective (to support the elderly) was the same. The service was delivered in a multi-actor network that enabled a broader customer base to be served, which was a significant change in terms of the traditional Home Care services. The co-created service was the common denominator which bound the different organisations together. In order to continue the service delivery in a sustainable and reliable manner, it became apparent that common organisational and institutional arrangements must be made. In this environment, the two competing institutional logics prevailed, and the process of negotiating and creating a higher, system-level logic was still in progress.

The existing institutional logic of Home Care, which relied on physical attendance at the customers' homes, was contrasted by a new probationary logic of action, which utilised virtual communication systems and technology. The prevailing logic was based on strong professionalism, healthcare expertise, and identity of the nurses; the new arrangement emphasised efficiency-driven logic in which the various motivations, cultures and identities of the participating actors were embedded. These aspects construct a noteworthy dimension of service development for service innovation. The case further validated the proposition that institutional pressures, which stem from outside of the organisational setting, might affect remarkably the innovation implementation.

### *Case 2: EUE*

Energising Urban Ecosystems (EUE) is a research programme funded by the Finnish National Technology Development Agency, Tekes, and public sector actors, such as cities and universities, and private sector actors, namely construction companies, information technology companies and utility companies. The funding instrument, Strategic Centres of Excellence, is a private company especially created to link national explorative innovation policies and exploitative company innovation programmes. The EUE programme aims to produce world-class research and, specifically, to create a new Nordic School of Urban Design for a sustainable tomorrow where the future urban ecosystems are further seen as core platforms for mutually complementing innovation activities and processes, developing regional competitiveness, and pioneering competencies for complementary product and solution development for the global markets. The research programme operates in a spirit of open innovation, formalised via a consortium agreement, and supports co-creation and co-learning in Living Lab settings where the outcomes create value for the public sector as well as for private companies.

The programme is a living example of the probationary new logic presented earlier. As a case example, a private software-development company, Adminotech Ltd, has created a networked living online environment where users can move around a 3D model of the existing environment in cities. In the research programme, the Modelling Department at Aalto University measured the existing environment for this virtual environment and created related scientific breakthroughs. Consequently, the city of Espoo will be able to demonstrate its urban planning projects, creating efficiency for the department of urban planning and inclusion for its citizens. During the research programme, Adminotech received design demands for its technology system both from the public as well as other private sector actors such as construction companies willing to demonstrate their urban design projects in its 3D virtual world. As an outcome, Adminotech was recently able to release a new service product with a novel business model for global markets while continuing to develop applications for the EUE research environment.

Thus, the city has acted as a co-creation partner and provided an environment for experimentation and collaboration while it has also increased its own efficiency and enhanced its culture for innovativeness. In the same process, researchers at Aalto University have produced articles for world-class publications in accordance with the objectives of the university. Thus, in this case, the value is a multifaceted construction created in co-creation processes guided and supported by innovation policy instruments. Such an open innovation programme, however, requires a culture and mandate for innovation as well as ownership for the transformation process in the organisations of the public sector. The experiments may require a protected niche for transition experiments to reveal the transformations needed for, for example, the legislative framework; as the example in case, the virtual world environment may enable inclusive participation and changes in the urban planning process that call for changes in the related legislation for urban planning in the cities. In a similar manner, such modelling and communication technologies may change power structures inside public actors as the design and decision alternatives become more understandable and actionable for the parties involved in the decision-making process.

## Conclusions and recommendations

The cases presented demonstrate how the various orientations and objectives of public and private entities must be carefully considered in co-creation cases and, in optimal cases, new system-level processes and roles would need to be created. Only then can the organisational and institutional sustainability required for effective service delivery be ensured. As such, the cases build on the notion that quantitative macro-level analysis alone cannot explain the success or failure of the systems, but instead, qualitative micro-level analysis is required for the analysis of the system determinants. With such analysis, the innovation projects can focus on the root case issues and factors underlying the success or failure of the initiatives.

With this, we derive a more generic conclusion that public–private collaboration cases benefit from awareness and appreciation of the various competing objectives, mandates and limitations. Experience of these intangibles requires longitudinal large-scale experimentation in real-life environments. Only with accumulated knowledge in local ecosystems can services be developed to meet the specific needs in a sustainable and cost-effective manner.

## References

[1] Bryson, J. M., Crosby, B. C., Stone, M. M. (2006), 'The Design and Implementation of Cross-Sector Collaborations: Propositions from the Literature', *Public Administration Review*, 2006:66 (Supplement 1), pp. 44–55.

[2] Margolis, J. D., Walsh, J. (2003), 'Misery Loves Companies: Rethinking Social Initiatives by Business', *Administrative Science Quarterly*, 48(2003), pp. 268–305.

[3] Chandler, A. D. Jr. (2005), *Inventing the Electronic Century*, Harvard University Press.

[4] Almirall, E. (2008), 'The IT role in innovation', *UPGRADE: The European Journal for the Informatics Professional*, IX(5), pp. 10–16.

[5] Denhardt, J., Campbell, K. (2006), 'The Role of Democratic Values in Transformational Leadership', *Administration & Society*, 38(5), pp. 556–572.

[6] Kivleniece, I., Quelin, B. (2012), 'Creating and Capturing Value in Public-Private Ties: A Private Actor's Perspective', *Academy of Management Review*, 2012, Vol. 37, No 2, pp. 272–299.

[7] City of Helsinki (2012), Helsinki Home Care Services — Help at home (http://www.hel.fi/hki/terke/en/Services/Home+Care).

## Contact

**Dr Petra Turkama**
Director, Center for Knowledge and Innovation Research (CKIR),
Aalto University School of Business
petra.turkama@aalto.fi

**Pentti Launonen**
Project Manager, Center for Knowledge and Innovation Research (CKIR),
Aalto University School of Business
pentti.launonen@aalto.fi

CHAPTER III

# Interesting cases and examples

## 3.1. Open innovation in smart cities: the rise of digital entrepreneurs

*Abstract*

This article is about open innovation in smart cities and about citizens', albeit different, roles. Open service innovation is about engaging users as co-creators of the new services and eventual beneficiaries in terms of share-of-profit, users, IPR (intellectual property rights), shared ownership, etc. The digital future of Europe is highly dependent on the digital single market and citizens' participation in city, regional and country governance. Open innovation in smart cities is essential to Europe's economic growth and job creation. The digital entrepreneurs arising out of these individuals have essential roles to play to boost the EU economy. The ICT infrastructures, by themselves, are not enough to build a smart economy and a digital single market. In order to achieve a smart economy in Europe, it is necessary to exploit the societal and intellectual capital of the people in support of ICT-based knowledge-intense services and services in general. If society manages well in the current economic turmoil, it will be possible to exploit the creative and digital entrepreneurial mindset and turn into wealth for society, the market and well-being.

### *Introduction: state-of-the-art open innovation in Europe and stakeholders involved*

In western and newly developed countries, the service industries' contribution to GDP amounts to approximately 70 % [1]. Services represent 60–70 % of the GDP in the EU Member States [2]. The Member States' economies are therefore highly dependent on service innovation for their growth and employment. Technological developments in information and communication technology act as drivers and enablers of many service innovations [3]. Knowledge-intense services are a strong base for economic growth and for the well-being of all citizens in society.

Open innovation, as introduced by Chesbrough (2003) [4], but in existence even a century ago under different terms (i.e. participative co-creative workshops in 1919–33 in Bauhaus in Berlin [5]), is an innovation practice that strives to make innovation quicker, easier and more effective by the exchange of ideas fostered by collaborative environments. Chesbrough essentially sees this as a tool to improve the marketing of ideas, to the benefit of the companies involved. The basic idea revolves around purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. ICT and Internet technologies support the flow of knowledge in a connected world.

The definition of open innovation is undergoing a revision. In 2008, the Open Innovation Strategy and Policy Group (OISPG) was established to support the strategy and policy development for 'user-centric open innovation for services' [6]. The group elaborates the definition of open innovation proposed by Chesbrough revolving around the following fundamental elements: extensive networking between all involved stakeholders (research organisations, businesses, public entities, user and user communities, that is the quadruple helix); innovation as a co-creative and user-centric collaborative procedure; and the availability of, and access to, open functional platforms for interaction between users and service providers. Open innovation is about public–private–people partnerships (PPPP).

The Digital Agenda for Europe [7] states that better use of information and communication technologies will help to speed up economic recovery and lay the foundations of a sustainable digital future.

Open platforms, processes and communities leading to experimentation, application research methodology and rapid prototyping are starting points for the take-up of ICT-based innovations in Europe. Unfortunately, Europe is slow in the uptake of these ICT-based innovations. While social changes are major drivers of innovation, in the EU, we could make better use of it when building 'smart citizens' and a 'smart economy'.

Neelie Kroes, Vice-President of the European Commission responsible for the Digital Agenda, argues that unlocking the digital future can be achieved through open innovation and that openness is central to success in this digital revolution and that we should create maximum room for user-driven innovation [8].

In Horizon 2020 [9], there will be a new, more integrated approach to innovation, which is reflected in the new tools and research methods, as well as the new approach more strongly integrating research, development and innovation. Open innovation could be one of the new approaches interlinking the various elements.

On the technological side, the combination of mobile Internet, cloud computing, ICT services and growing sensor networks support the needs of the 'smart economy'. How to achieve a 'smart economy'? Should we create more regulations and policies? In order to build a 'smart economy', creating more regulations is not the answer: creating the digital single market is.

### *Individuals', albeit different, roles (users, citizens, etc.) and wealth generation*

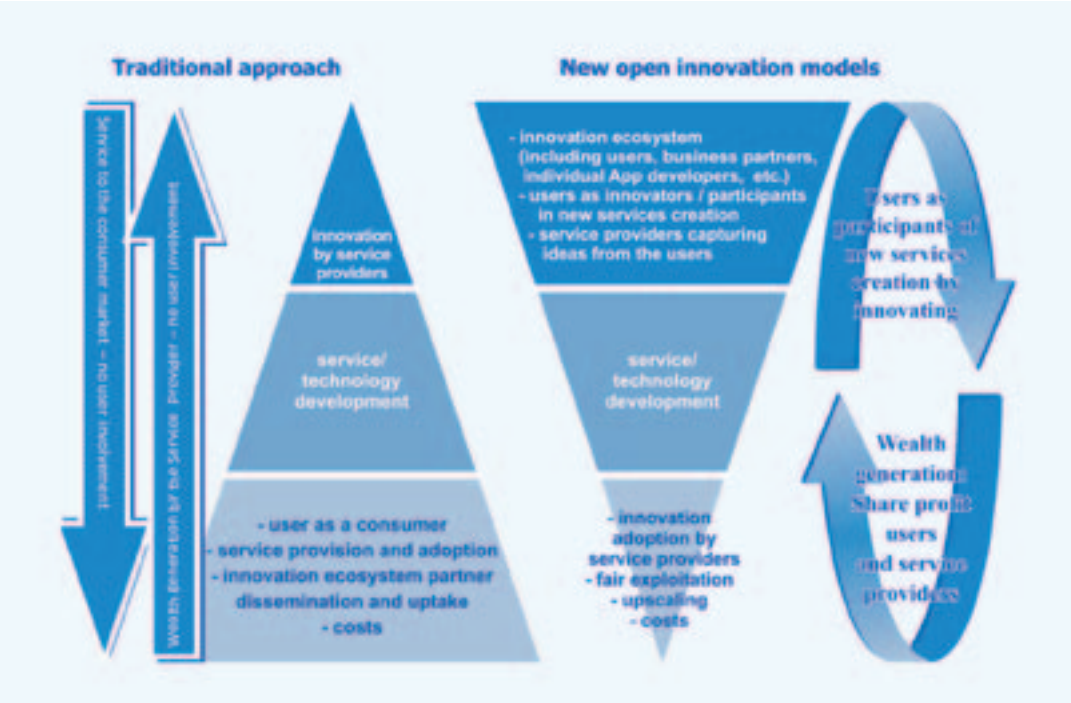
In July 2011, the final report of the industry-led study OSI, Socio-economic impact of Open Service Innovation, supported by the European Commission's former Directorate-General for the Information Society and Media, was released [10]. The study assesses the economic and societal potential and impact of an open service innovation approach in Europe. The OSI study was coordinated and led by Logica Business Consulting's Dr Gohar Sargsyan (now part of CGI). The consortium consisted of IBM, Nokia, Intel, Novay and the Innovation Value Institute. The OSI study considers the role of users and citizens in open, user-driven service innovation, as part of the industrial ecosystem, in the context of societal and ICT developments.

The OSI report offers modern models, methods and approaches to open innovation, as well as analyses of the challenges of economic values, wealth generation in socioeconomic terms and creation of common values. It also suggests successful business.

According to the study findings, wealth generation relates to client, employee and shareholder satisfaction in equal terms. In fact, this means a further increase in the role of the individual, user and citizen because, in the end, client, employee and shareholder all refer to the same individual, albeit in different roles. Our society is becoming aware of the role the individual is playing in the well-being of everything around us. The consequence of this trend is that we also have to reverse thinking about the innovation cycle. We have to start at the individual and focus on what is adding the most value to that individual.

This thinking is described as reversing the innovation pyramid (Figure 1).

Figure 1: Reverse innovation pyramid: wealth generation and share of profit [10]



Innovation (in product, service or delivery) must raise and create value for the market, while simultaneously reducing or eliminating features or services that are less valued by the current or future market, thus fostering wealth generation for the market.

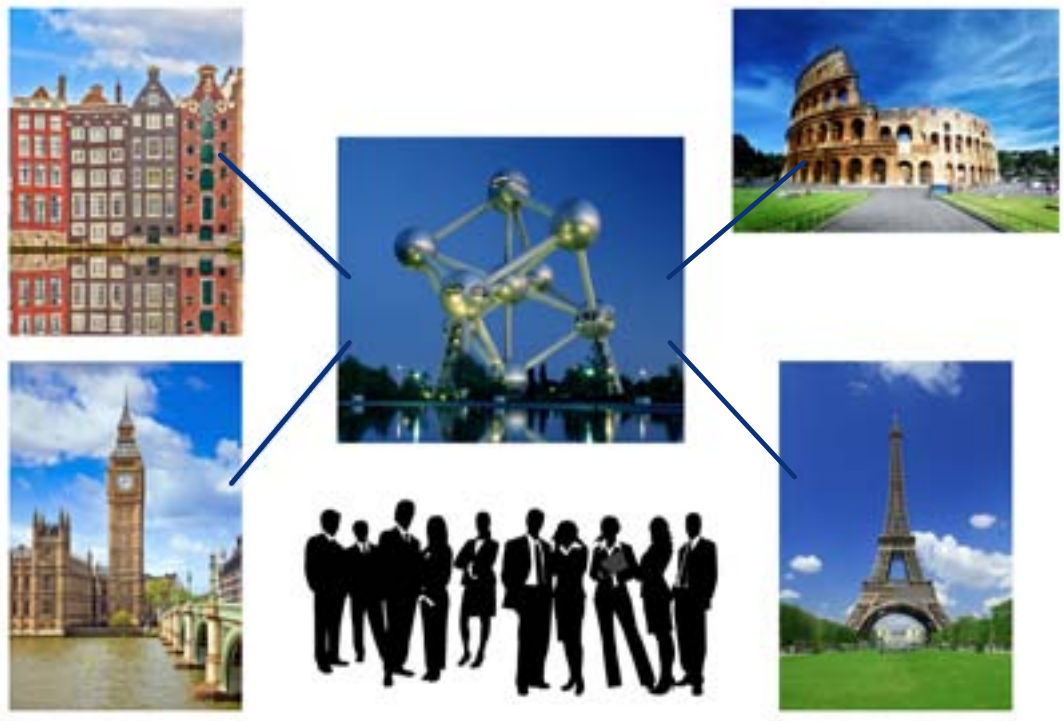
Wealth generation in an inclusive society can be understood as the right combination of creativity, content and technology that will generate services that close the digital divide. Closing the digital divide pays off in social values. Social coherence needs specific attention in response to the fragmentation of society by television and passive Internet use.

As for wealth generation for well-being, this can be explained by the following: there are many opportunities once the worlds of information, monitoring and communication have been brought together. Sharing content and creativity through the Internet will create new, and good, work/life balances: wherever and whenever. Wearable technology supported by Internet coaching will create well-being lifestyles for young people and the elderly; hence, healthcare costs will be controlled through communication as needed. Sustainable energy, sustainable water and sustainable material use will require a complete turnaround in our daily practices: for companies, for individuals, for the government.

### *Smart cities*

Another emerging term is the 'smart city' (Figure 2), which is explained as follows: urban performance currently depends not only on the city's endowment of hard infrastructure or in other words 'physical capital', but also on the availability and quality of knowledge communication and social infrastructure or, in other words, 'intellectual and social capital'. Smart cities can be identified and ranked along the following six main dimensions: a smart economy; smart mobility; a smart environment; smart people/citizens; smart living; and, finally, smart governance. These six dimensions connect with traditional regional and neoclassical theories of urban growth and development. In particular, the dimensions are based — respectively — on theories of regional competitiveness, transport and ICT economics, natural resources, human and social capital, well-being, and participation of citizens in the governance of cities.

Figure 2: Smart cities



There are many European initiatives launched under 'smart cities'. For example, the EuroCity network, which unites the local governments of more than 140 large cities in over 30 European countries [11]; the European Network of Living Labs facilitating users' involvement in the innovation process [12]; and the Smart cities initiatives funded by the European Commission [13] [14].

Active participation of citizens and all stakeholders is important in generating wealth for individuals, society, market, and well-being and job creation.

### *The future ICT for smart cities*

European cities have an essential role in the European economy. Efficient networks of European 'smart cities' are important in European sustainable economic development. The use of open source and open access solutions, developments in and contributions to open standards, open regulatory frameworks, sharing knowledge among EU cities, open creation, co-creation and collaboration processes and co-production at European level by fostering digital entrepreneurship, raising creativity and innovation are the bases to achieve a smart economy in Europe.

There are various ongoing initiatives to reach this; many governments and cities are encouraging residents' participation in governance by making public data available. One of the representative European initiatives is CitySDK which is supported and co-funded by the European Commission, Directorate-General for Communications Networks, Content and Technology's ICT CIP PSP programme [15].

The CitySDK project is developing large-scale pan-European smart city service pilots covering eight cities (Amsterdam, Barcelona, Helsinki, Istanbul, Lamia, Lisbon, Manchester and Rome) in the domains of smart mobility, smart participation and smart tourism. CitySDK is creating a toolkit for the development of digital services within cities. The toolkit comprises open and interoperable digital service interfaces as well as processes, guidelines and usability standards. CitySDK enables a more efficient use of the expertise and know-how of developer communities to be applied to city service development. This will enhance the development and innovation capability and between-city transfer possibilities of European smart city applications. CitySDK plans to engage a vast number of citizens and developers to further exploit the CitySDK reaching a total coverage of 31 million people, with up to half a million active real people-users, engage up to 1 000 new developer SMEs in eight countries, and build a self-sustaining, thriving smart city application ecosystem that lasts well beyond the project lifetime.

These kinds of initiatives are fundamentally important for a single market for European smart city applications and users' engagement.

### *Rise of digital entrepreneurs*

The further rise of individuals results in the creation of a new class of 'digital entrepreneurs' (Figure 3). In the current economic crisis in the EU, a high percentage of graduates of higher education start their own enterprise. Their ambition, at the start at least, is not to enter a big corporate, but to exploit their own intellectual capital at the innovation stage. These digital entrepreneurs are the brave entrepreneurs, visionaries. They explore the unknown, discover a new world of innovative solutions to problems, take high risks and they are, in fact, the founders of the next-generation jobs. As part of an ecosystem, all stakeholders involved (governments, policymakers, smart cities, corporates, educational institutes and society in general) have a role to play in helping these digital entrepreneurs to grow and, thus, create European wealth. If we manage well as a society, we can exploit a vast resource of creative and entrepreneurial minds.

Figure 3: Digital entrepreneurship

## Conclusions

Open innovation is about extensive networking between all involved stakeholders (research organisations, businesses, public entities, user and user communities), innovation as a co-creative and user-driven collaborative procedure, and availability of, and access to, open functional platforms for interaction between users and service providers. The role of individuals in the innovation and co-creation process is increased as they take on different roles (employee, shareholder, user, citizen, student, professor, etc.). Citizens' and residents' participation in the governance of the city is the inexpensive and necessary bottom-up governance which fosters wealth generation in well-being, in an inclusive society, in the market, and in the share of profits. Smart cities are the backbone of Europe's economy and have an important role to play in building a smart economy and digital single market together with smart people. The further rise of such individuals results in the creation of a new class: digital entrepreneurs, who are essential in the current European economic situation and for job creation.

The European political, cultural and economic model is based on diversity, subsidiarity, collaboration, and pervasive creativity across all of society. All the key assets needed already exist to create a European open innovation ecosystem and for it to become a source of profitable and fast business growth.

Finally, I would like to strongly encourage all the stakeholders involved in the innovation ecosystem to be brave and see the current crisis and economic difficulties as an opportunity to grow, to change and to build a better economy, and to act promptly towards the solutions, thus creating wealth for Europe. To end this paper, I want to invoke an entrepreneurial spirit within every individual with the following slogan: **Think big, start small, accelerate fast.**

## References

[1] OECD (2005), Open Innovation Global Networks (http://www.oecd.org/).

[2] European Commission (2010a), Communication from the Commission, *EUROPE 2020 — A strategy for smart, sustainable and inclusive growth*, COM(2010) 2020 final (http://ec.europa.eu/europe2020/index_en.htm).

[3] Chesbrough, H., Spohrer, J. (2006), 'A research manifesto for services science', *Communications of the ACM*, Vol. 49, Issue 7, pp. 35–40.

[4] Chesbrough, H. (2003), *Open Innovation: the New Imperative for Creating and Profiting from Technology*, Harvard Business Press, Boston.

[5] The Bauhaus Archive/Museum of Design in Berlin (1919–33) (http://www.bauhaus.de/).

[6] OISPG (2009), Open Innovation Strategy and Policy Group, European Commission, former Directorate-General for the Information Society and Media, *Putting the fine point on open innovation: a common definition* (http://www.openinnovation.eu/).

[7] European Commission (2010), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *A Digital Agenda for Europe*, COM(2010) 245 final of 19 May 2010 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0245:FIN:EN:PDF).

[8] Kroes, N., Vice-President of the European Commission responsible for the Digital Agenda: speech: 'Unlocking the digital future though Open Innovation', during the fourth pan-European Intellectual Property Summit.

[9] European Commission, Horizon 2020 (http://ec.europa.eu/research/horizon2020/).

[10] OSI consortium, coordinator G. Sargsyan, Logica (now part of CGI Group Inc.), 'Socio-economic impact of open service innovation — SMART 2009/0077, July 2011 (http://ec.europa.eu/information_society/newsroom/cf/itemdetail.cfm?item_id=7195).

[11] http://www.eurocities.eu/

[12] http://www.openlivinglabs.eu/

[13] http://ec.europa.eu/information_society/activities/livinglabs/index_en.htm

[14] http://ec.europa.eu/energy/technology/initiatives/

[15] CitySDK — City Service Development Toolkit (http://www.citysdk.eu/).

## Contact

**Dr Gohar Sargsyan MBA**
Senior Business Consultant/Member,
CGI Group Inc., Future IT &
Adviser at Amsterdam University
of Applied Sciences
gohar.sargsyan@cgi.com
g.sargsyan@gmail.com

## 3.2. Participative innovation in smart urban lighting

### *Introduction*

The world is rapidly transforming [1]. Economic, ecological and technological developments transcend existing boundaries and challenge the way we innovate [2]. The challenge we face is to reinvent innovation as well, changing the way organisations and industries innovate and cooperate. Only with a new approach we can design a better future: an approach where stakeholders from government, organisations, companies and users participate in new ways of collaboration [3]; an approach where solutions are realised that makes our society future-proof. Participatory innovation means that the innovation team changes: expanding beyond the boundaries of the own organisation. For organisations and companies, this is a huge step. Every partner must be willing to think and act beyond their own borders and participate in a joint effort. Participative innovation is a new way of working, where new challenges are encountered. In the field of urban lighting, this transformation is strongly felt. This paper will further explore the challenge and describe a rich case study where participative innovation is used to rethink, redesign and realise the solutions to transform urban lighting from functional lighting to improving social quality.

New lighting technologies are creating a revolution in the lighting industry. The lighting industry will go through an evolution similar to the development in computing since the invention of the first transistor. In the next 12 years, 80 billion light bulbs will be replaced by LEDs. LED technology offers many advantages, such as chromaticity control, better light quality, and higher efficiency [4].

One of the application areas for new lighting solutions is urban lighting. Cities see great opportunities in the newest lighting technologies and want to embark on the transition towards energy savings and cost reduction and, at the same time, contribute to other values such as city marketing or economic development by enabling the 24/7 economy. Visionary cities also see opportunities to become a creative hotspot where societal challenges drive new lighting innovations.

However, making the right decision is not an easy task keeping in mind costs, sustainability and societal impact in the short and longer term. With the extended possibilities that LEDs offer and integration in smart sensor networks, new opportunities arise to further reduce energy use and light pollution, and increase people's sense of perceived personal safety and comfort at the same time. However, there is still a lack of experience and knowledge on the impact of smart urban lighting solutions [5]. Companies are not able to test these solutions in the field without collaboration with municipalities and, on the other hand, municipalities hesitate to invest in solutions that are 'not ready'.

The challenge is to formulate a vision that extends beyond the economic value of urban lighting alone, and to create a roadmap to support short-term investment decisions that will enable further developments in the future. This requires a participative approach in which businesses, governmental organisations and knowledge institutes collaborate to achieve a high quality of life with smart urban lighting. The participative approach takes place on two levels:

- the creation of a vision and roadmap for a liveable city to identify the underlying principles for a municipality to guide further innovation towards improving the quality of life in the city;
- experimenting with intelligent lighting solutions in real-life settings to explore and learn how smart lighting solutions can contribute to the well-being of the citizens in the city.

The city of Eindhoven aspires to be a front runner in innovative, intelligent lighting solutions that contribute to a high quality of life in the city. The city already has a long-standing tradition of working in a triple helix structure in the Brainport Region. Building on this tradition, LightHouse, the solution partner of the Intelligent Lighting Institute (ILI) at the Eindhoven University of Technology, developed a participative approach to create a vision and roadmap. The approach will be described here using the case of urban lighting for the city of Eindhoven.

### *Approach*

The City of Eindhoven is currently faced simultaneously with a number of interrelated issues about public lighting, which can be formulated as follows.

- Firstly, there is a concrete question about the replacement of 21 000 street lights in the city: is it best to replace these all at once with LED lamps? If this investment were to be made now, the replacement budget would no longer be sufficient for further renewals.
- The City of Eindhoven is working together with 10 other European cities in a European INTERREG IVC PLUS project to define public lighting strategies for sustainable cities. The city needs to put forward a strategy and action plan as

part of this project, and wants to submit a well-founded strategy with a scope that extends further than simply short-term energy savings.
- Projects are also currently running in other public domains as well as public lighting, for example e-care, e-learning and e-traffic. These are investigating whether a city-wide infrastructure is necessary, and what would then be viable business models to recover the associated investment. Up to now, no simple and convincing financial answer has been found within the sphere of the current operations.
- The city aims to take the role of 'lead user', through which the city is made available for innovations developed by others (such as commercial parties or creative businesses). And, there is a wish to engage with citizens in different ways, surpassing the standard idea of 'citizen involvement'.

The conclusion that the city draws from the developments outlined above is that more detailed consideration is needed on the question of LED lighting than has been the case up to now. Broad acceptance — also among the citizens of Eindhoven — demands a clear proposition on the basis of which well-founded decisions can be taken.

The request from the City of Eindhoven's public lighting department to LightHouse was to formulate a vision extending beyond public lighting alone, together with a roadmap to allow decisions to be taken for short-term measures that will not prove to be barriers to longer-term developments. In the project, a participative innovation approach was applied involving the triple helix in every step.

To formulate a vision and roadmap for urban lighting in Eindhoven, extending to 2030, the project was divided into a number of phases. First of all, the current situation and ambition level of the municipality were analysed. Then, with the help of the future telling research method, the most important drivers for change for a future city with a high quality of life were identified and used to create a desired scenario for Eindhoven in 2030. To realise this scenario, a roadmap was made plotting the possible technological developments and required organisational changes together with the corresponding timeline. The insights gained into developments in societal, technological and organisational aspects have led to an innovation plan describing the concrete steps that can be taken in public–private collaboration to achieve the desired future of Eindhoven in 2030 (Figure 1).

Figure 1: The approach to a vision and roadmap for the City of Eindhoven in 2030

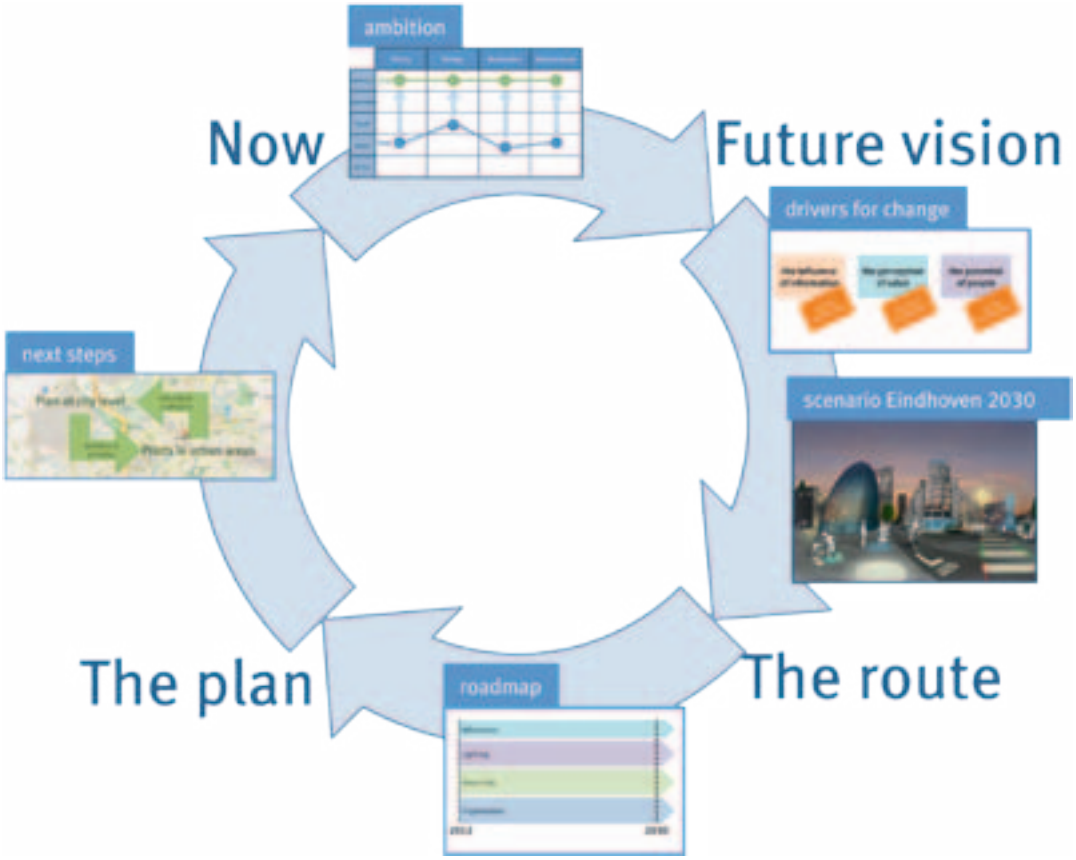
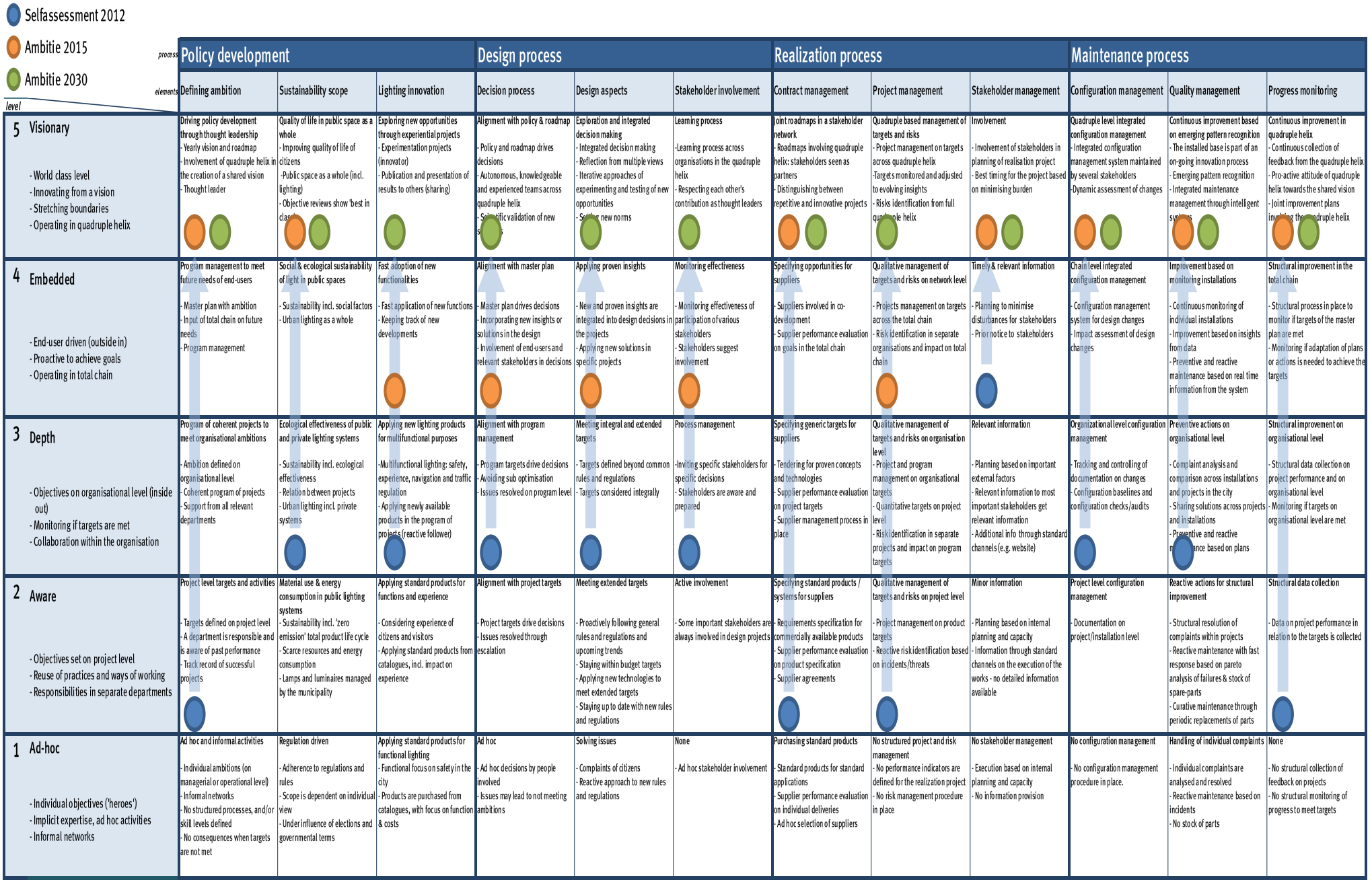


Figure 2: The reference model for sustainable urban lighting



### *Now: defining the ambition*

Using the ILI Reference Model for Sustainable Urban Lighting [6], a self-assessment was performed to find out where Eindhoven stands in terms of the processes relating to policy development, the design and realisation of lighting projects in the city, and the maintenance and monitoring of whether the ambitions expressed in the policy are achieved. Based on a process of self-reflection with municipal staff members, the city's present position on the reference model was identified: the blue scores in Figure 2. The self-assessment revealed that the city has most of its processes well organised. Eindhoven is leading in stakeholder involvement but the municipal staff members are not making their views felt to a sufficient extent in the discussions. That means the city runs the risk that the interests of citizens do not carry sufficient weight in innovative projects. To reach a higher score, the city needs to profile itself not as a 'lead user' but as a fully involved partner in the triple helix.

The results of the self-assessment were discussed in a workshop where the ambition level was also defined. This revealed that the ambition of the city is at visionary level: see the green scores in Figure 2. Eindhoven wants to apply innovative technologies to address socially relevant issues in partnership with the triple helix and with clear citizen involvement (quadruple helix). The city recognises the importance of innovation for the economic development of the region, is prepared to accept risks that are inherent in innovation, and regards its own primary task as safeguarding its citizens' interests.

This ambition requires collaboration in a quadruple helix structure (with the municipality, business parties, research institutes and citizens as equal partners). The city council has to develop from being a lead user, putting the city forward as a test bed for suppliers, towards a full partner, safeguarding public interests through collaboration in the quadruple helix structure.

### *Future vision: Scenario Eindhoven 2030*

With the help of the future telling Research method, a vision was created [7]. The method uses a set of cards with 64 future trends (Figure 3). Relevant trends with a high impact on a liveable city in 2030 are identified in interviews with thought leaders from industry, knowledge institutes and governments. These trends are then further illustrated with rich stories about possible futures, supported by examples.

An analysis of these rich stories reveals three drives for change.

The first driver is the growing influence of information (left column in Figure 4). Our behaviour will be driven by ubiquitous information (automatically gathered by sensors or added by users through social media). This will allow systems to take over complex tasks, especially when biological and sociological factors are included in the process of digitisation. This will further empower people through good technology applications. This driver triggers a number of questions: is it enough, and is it fair, for the city just to retain the task of social safety, when efforts are being made all around us to create an open grid? Who will decide

Figure 3: The future telling card set

who's allowed to do what? Who is the owner of a network and information (and are they trustworthy)? Technology becomes a social design process; this is an ethical design issue, in which a code of conduct also needs to be designed by involving all stakeholders. To allow this driver to develop in the direction of a positive society, an ethical recalibration is a prerequisite.

The second driver is the perception of value (middle column in Figure 4). The Netherlands has an excellent 'liveable environment', we have nothing to complain about, but the awareness of scarcity is beginning to take hold. There needs to be some kind of stimulus to make alternatives more attractive. People will start to use information to deliver on their individual needs and use self-management and take responsibility for their own situation in all kinds of areas: care, social safety, energy. There will be an increasing awareness that we all have duties and responsibilities, and innovation will increasingly start from a social perspective. The awareness will grow that scarcity isn't just a question of money (it also means attention, love). In this context, is it enough for the city to just put itself forward as a Living Lab, without having its own point of view about how to deal with innovation and change? Who is in control? Which prerequisites will have to be facilitated? What is the new economic system? There will be a revaluation of value: new value models (not just business expressed in euros) that strive for reciprocity, for forms of value beyond money. This second driver, the perception of value, requires an economic recalibration, in which new forms of value beyond money are included.

The third driver is the potential of people (right column in Figure 4). There is increasing independence: in work (partly as the result of circumstances, partly through choice) and in education (where financing of talents is expected to take place, instead of institutions). New networks are being formed based on individuals' own, deliberate choices, where people decide for themselves with whom they want to do things. New (ad hoc) networks arise across boundaries. Cities (regions) have an important role in bringing creative and ambitious people together, working on development, based on a vision, towards a higher goal. New developments and innovations start in attractive cities. Is it then enough, and is it fair, to use a smart grid to provide openness but without defining the framework? What role does the city take in relation to creating a framework, legislation, opportunities, and in developing a vision and making choices? Bringing parties together works for people who can express themselves, but how can you safeguard the interests of the weaker members of society in the quadruple helix? This driver, the potential of people, asks for a social recalibration.

With the drivers for change, a discussion was started on their impact on Eindhoven in 2030. This resulted in a scenario for the future vision for Eindhoven specifically. A multipurpose, smart lighting grid will

Figure 4: Three drivers for change

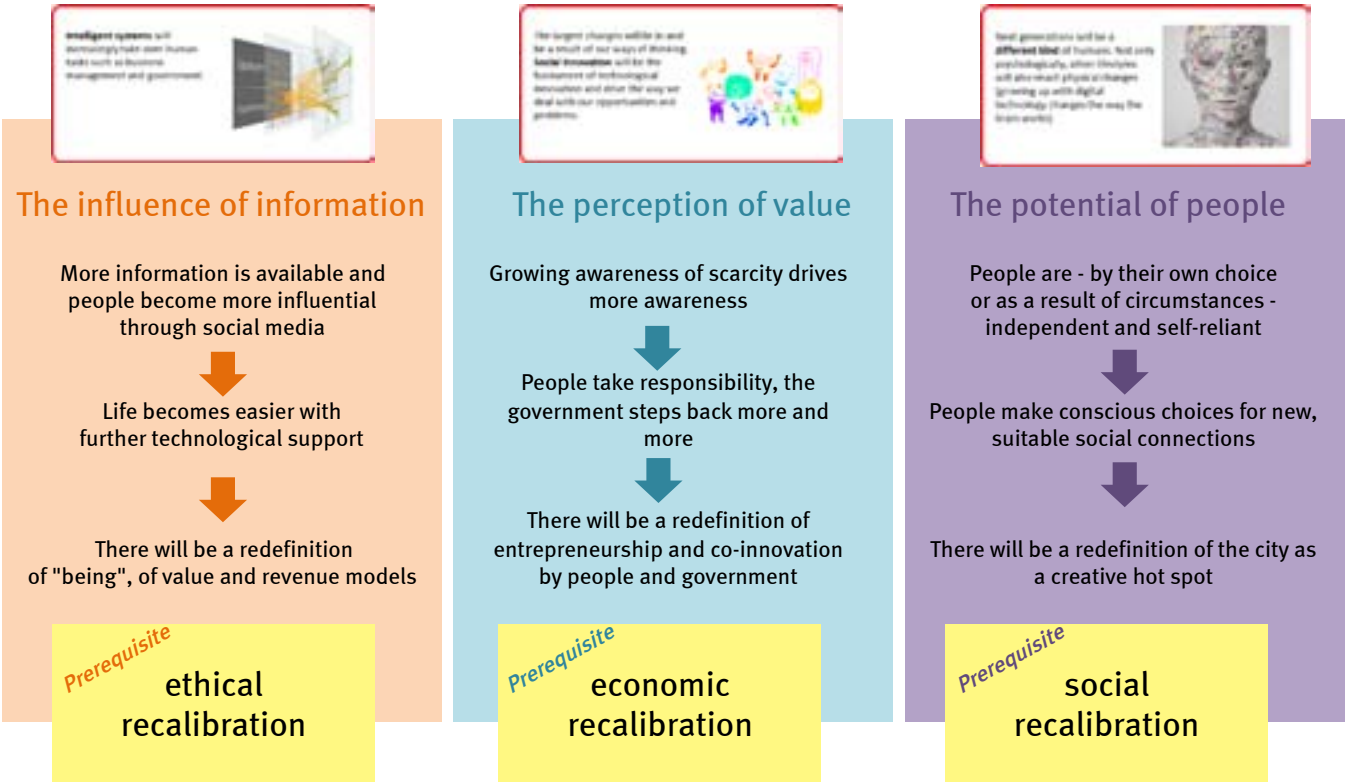
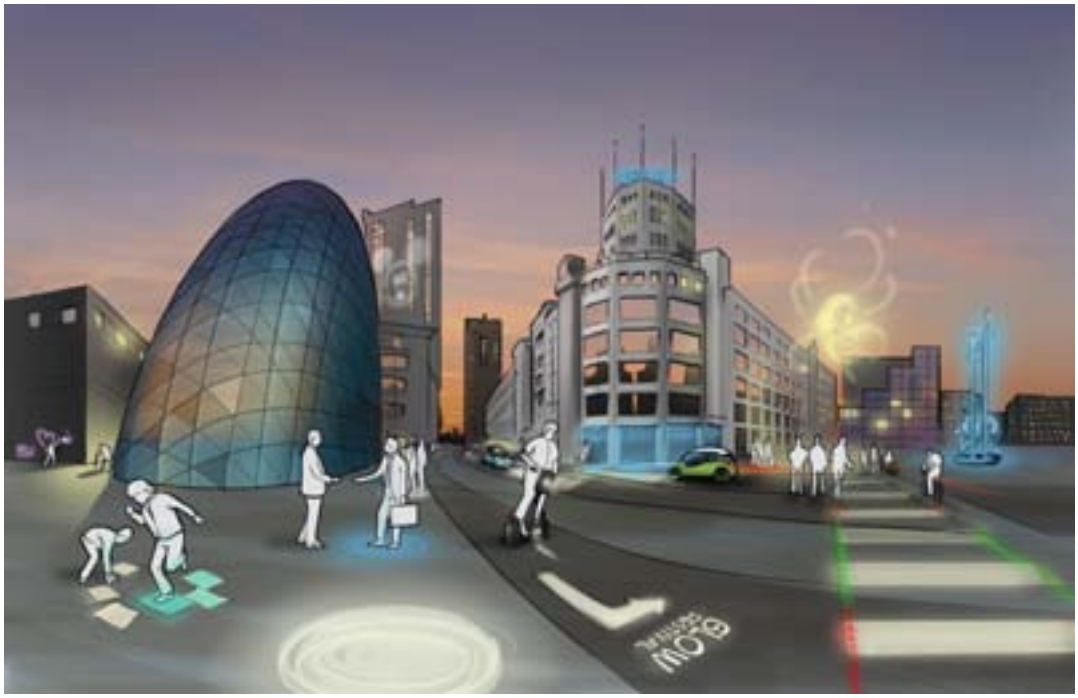


Figure 5: Eindhoven in 2030



be introduced, combing ICT (IP), energy and lighting functions. This will create new possibilities (and with them new design opportunities) in the ways the social and urban space can be used. The municipality will have an important role in providing the smart lighting grid as a public utility, including lighting in its broadest sense (from functional lighting to multimedia art projections), and safety in its broadest sense, including social safety, traffic systems and air quality. In 2030, the public space will no longer be just a 'transit' space, but an extension of living space. The municipality will be responsible as the provider and will ensure the smart lighting grid serves society's needs. Processes will have to be set up to safeguard the public interest and to make the grid accessible for all kinds of initiatives (citizens, commercial) to ensure continuous development in and through the quadruple helix. This also means creating space for experiments by providing (temporary) Living Labs to co-create and test together with partners.

Figure 5 shows a visualisation of the scenario with a number of examples to provide inspiration for the roadmap sessions reviewing the technological opportunities to realise the scenario 2030.

### *The route: Roadmap Eindhoven 2030*

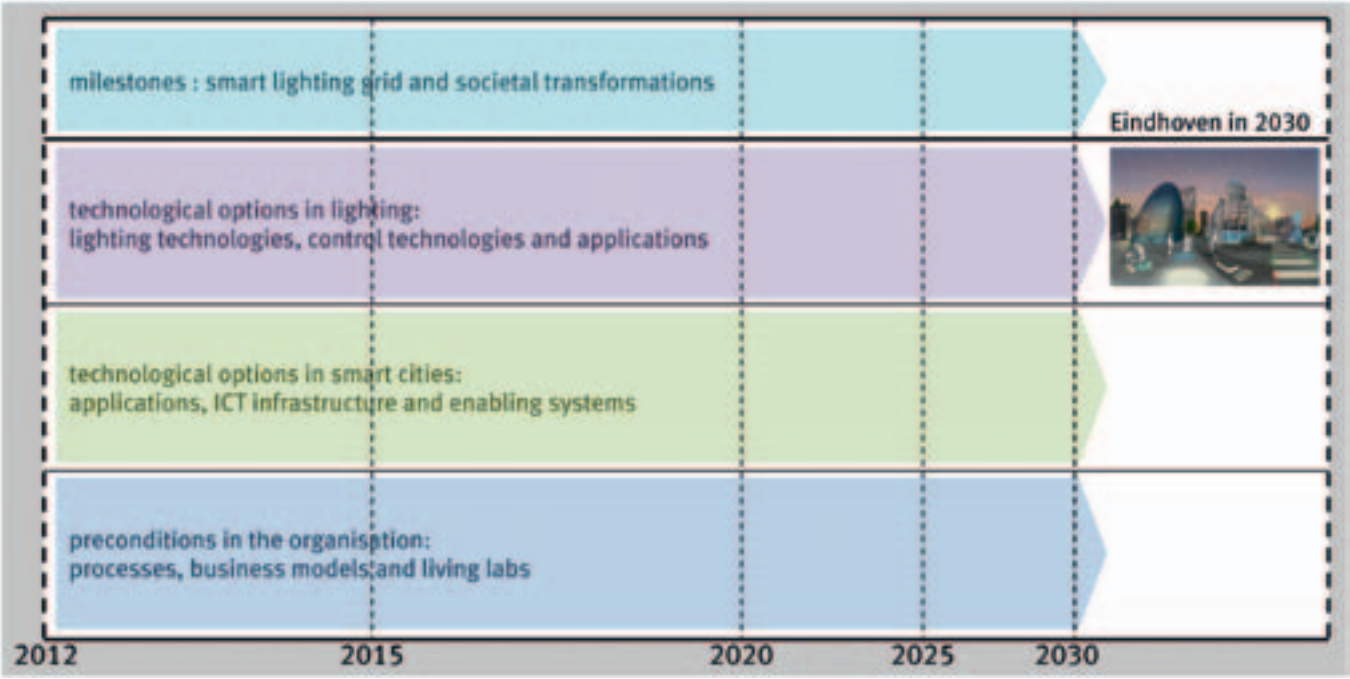
The Eindhoven 2030 scenario served as an inspiration to explore the technological opportunities and to actually put them into practice. The roadmap methodology [8] was used in workshops with representatives of the triple helix. Experts from industry including Philips, Schreder, Cisco and Cofely and knowledge institutes including TNO and TU/e have indicated the possibilities they see in the areas of lighting and smart technology and placed them on a timeline. They have also highlighted the preconditions for the organisation. This topic was also discussed in a session with personnel from the municipality.

Figure 6 shows the elements of the roadmap. The raw data from the roadmap workshops have been clustered on a number of important elements placed on a timeline. This provides insight in the steps for the development of a smart lighting grid.

Lighting technologies will first be improved on energy performance. In the near future, the focus will shift towards more dynamic and interactive systems that allow 'light-on-demand' in interactive lighting scenarios. Interaction with real-time information makes social systems possible that are more responsive to the needs of citizens. In the longer term, the lower energy requirements of the light sources and controls will make small, self-sufficient lighting systems achievable that disappear in the context of their environments. In 2030, the system will be invisibly integrated in the area and will interact through intuitive controls.

Developments in technologies for smart cities are currently focusing on realising a broadband infrastructure with many access points. In the near

Figure 6: Elements of the roadmap



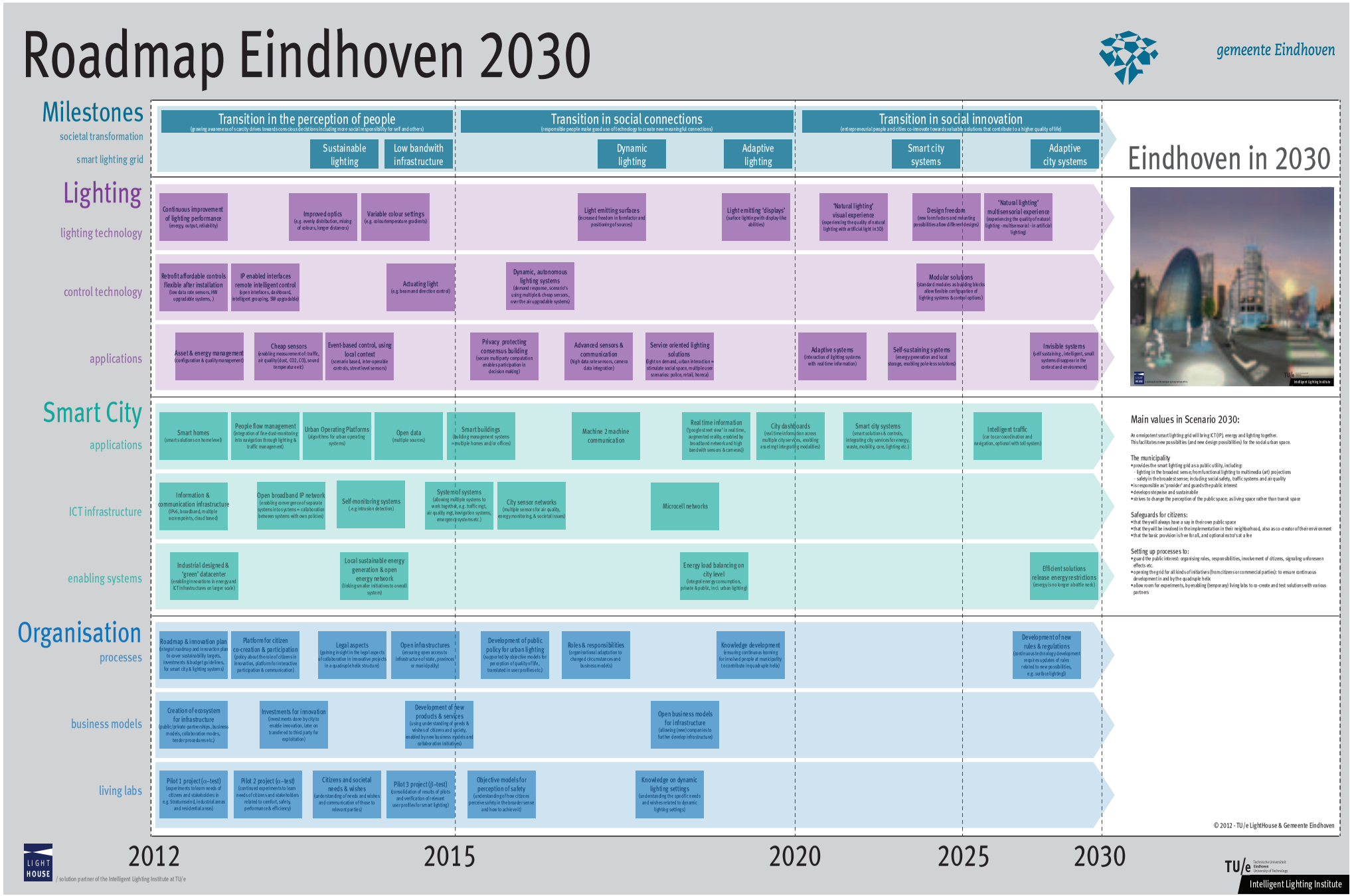

future, the availability of open data from different sources will drive new systems development: firstly, as separate systems (e.g. traffic management, air quality systems, navigation systems, emergency systems) but later merging into a 'system of systems'. This will allow further optimisation of the use of energy across different services. Restrictions in energy consumption are expected to disappear in the longer term. This is, on the one hand, because systems are becoming increasingly efficient resulting in a decrease in consumption and, on the other hand, because of constant improvements in the generation of sustainable energy, which means more sustainable energy becomes available. By 2030, smart cities will be within reach through the integration of solutions for various urban services (energy, waste, mobility, care, lighting, etc.), communicating and coordinating their behaviour jointly.

The roadmap discussions also reveal required organisational changes. First of all, plans will need to be developed for the various areas in the city, with priority for socially important themes. Innovative tendering process are needed that enable new business models in public–private partnerships. In fact, new ecosystems need to be created, in which innovation also plays a role in the longer term. In parallel, Living Labs will need to be set up to start co-creation in the quadruple helix on societal issues. A deeper understanding about the needs of the citizens will give rise to new products and services. The municipality will need to play an active role in defining new laws and regulations to facilitate these innovations and also to ensure that the public interest is safeguarded.

Last but not least, the roadmap connects the technological options to the milestones in societal transformation to achieve the aspired vision. Firstly, a transition in the perception of people will take place as the awareness of scarcity drives better-considered choices. There is a shift to more social responsibility for themselves, others and the environment (not just 'me' but more 'we'). This results in a broader support for sustainability, with citizens who also expect the government to make better-considered, more responsible choices. Then, a transition in social connection takes place, where responsible people make good use of technology to create new and significant links with other people with comparable ambitions. If the government is withdrawing, self-management becomes increasingly important. The new social networks can also play a role in the Living Labs, with input on the desired activities, system behaviour and dynamic lighting scenarios. The next transition is in social innovation: enterprising people and cities will co-innovate on valuable solutions that contribute to higher ambitions. A smart city can only function if all parties in the quadruple helix act in a way that is carefully considered and contributes to a better quality of life in the city.

The complete roadmap is shown in Figure 7. A poster size version is available online (http://www.ili-lighthouse.nl/DownloadroadmapEN.html).

Figure 7: The complete roadmap



The roadmap shows that much is already possible in terms of technology. However, finding a payback model for the investment in public–private partnerships is much more of an issue. Different areas in the city demand different infrastructures and have different possibilities in terms of the payback model. Where, for example, the city centre requires high data rates to integrate video signals, lower data rates may be sufficient to control the lighting systems in some of the residential areas. It is also clear that some 'customers' for high bandwidth can be found in the city centre, thereby enabling other payback models. It, therefore, appears logical to differentiate the plans for the respective areas, while also taking into account the payback model and the stakeholder needs in each area.

The roadmap defines the societal drivers that determine the quality of life, but still little is known about the citizens' perception of social cohesion or safety through new lighting solutions. With the roadmap, cities can take three concrete steps in the short term for specification and implementation.

To translate societal drivers into daily practice, citizens have to be involved and any consequences of lighting solutions on their perception have to be defined as leading questions for innovation. At the same time, short-term investment decisions should focus on flexible infrastructures that enable experimentation involving partners from the quadruple helix to find answers to these questions, starting participative innovation, exploring openness in the system architecture on all levels and creating viable business models. In this way, Living Labs are created; new products and solutions are co-designed and tested with the involvement of citizens. Thus, society learns and innovates together and becomes a creative hotspot where societal challenges drive new lighting innovations.

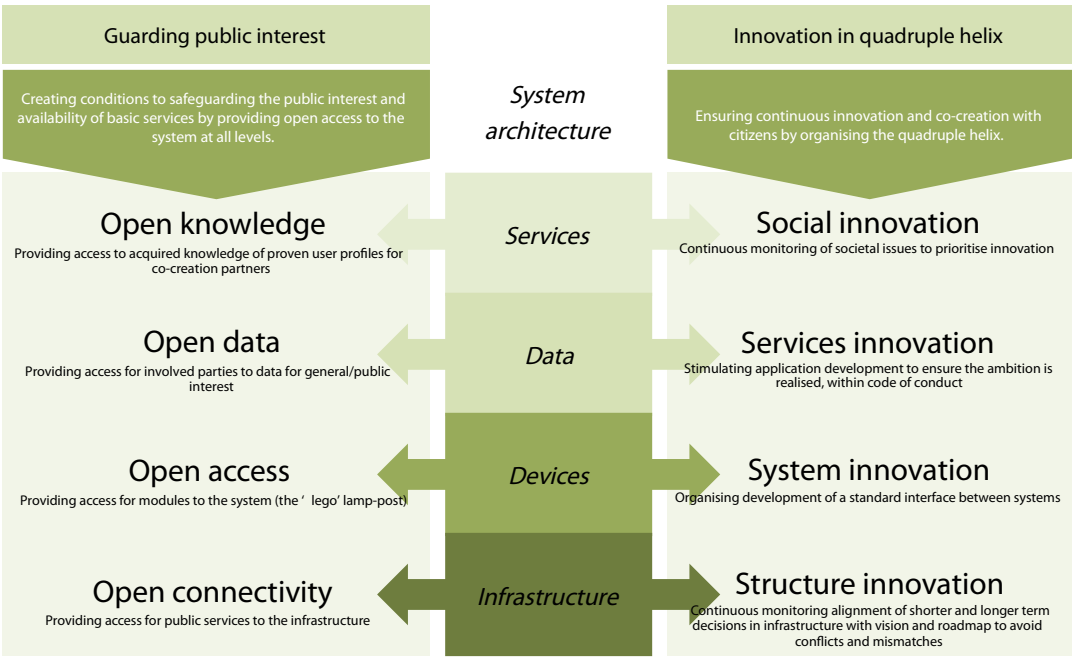
### *The plan: next steps*

Based on the vision and roadmap, future-proof follow-up steps can now be defined. Because the city's ambition is to stay ahead in technology and innovation, it is important for the innovation process to be defined and anchored to allow continuous experimentation and development with new products and services. Although most parties (companies, knowledge institutes and the municipality itself) are aware that innovations relating to the smart lighting grid have to be handled in a different way to the standard tendering processes, it is not yet clear how the innovation process should actually be handled. Partnerships between public and private parties will change, and will focus mainly on knowledge integration to reach a total system concept and on generating new payback models. The municipality will have to safeguard public interests in these partnerships, which means it will have to take its full responsibility in the triple helix, while, at the same time, extending this into a quadruple helix by actively involving citizens.

To ensure innovation through the entire system, it is necessary to understand the system architecture. In Figure 8, four levels are distinguished in the architecture (centre column, from bottom to top): infrastructure, devices, data and services. Each of these levels is an enabler for the level above it, and innovation can take place at each level. To ensure innovation through the entire system, two aspects will need to be arranged:

- the openness of the system (left column in Figure 8): the municipality will have to ensure transparency at all levels of the system; for most commercial parties, this will conflict with their present business models, which, in many cases, are based on ownership of (parts of) the system;
- the organisation of innovation (right column): the municipality will have to take a controlling role in organising the partnerships in the quadruple helix.

Figure 8: Prerequisites for innovation




The municipality will have an important role to establish the preconditions for innovation. This includes the safeguarding of public interest and availability of the basic services by providing open access to the system at all levels: connectivity to the infrastructure for public services, access to the devices, access to data for public interest and access to acquired knowledge. It also includes ensuring continuous innovation and co-creation with citizens by organising the quadruple helix to innovate at all levels of the system: innovations in the infrastructure, innovations in the system of devices and developing a standard interface, innovation in services to drive development of new applications, and social innovation to prioritise societal challenges and issues that are deemed important by the citizens.

The concrete steps to be taken in the short term involve the creation of a plan at city level that indicates ambitions and priorities. In parallel, pilots can be carried out in specific urban areas that provide a learning platform and scalability (Figure 9). There are big differences in the desired functionalities and dynamics: for example residential areas, shopping centres, industrial areas, ring roads, nightlife areas or parks. In each area, experiments can be performed in a 'small' ecosystem to find viable payback models for the investment and new business models for new products and services. Participatory innovation can be anchored in the area by engaging the directly involved parties and citizens in the quadruple helix structure. The municipality can take the initiative in its role as a fully fledged partner. The small-scale pilots can be scaled-up once enough practical experience and confidence have been built through use.

Figure 9: Next steps

Concrete actions for the short term can be formulated as follows.

- Eindhoven as a Living Lab: setting up Living Labs and organising learning cycles, experimenting with innovative lighting solutions and learning to work in new collaboration structures; the quadruple helix.
- The municipality as an innovative organisation: anticipating the changing role of the municipality by setting up new processes by defining new roles and responsibilities to safeguard the public interests in innovation, from citizen involvement to co-innovation with citizens and organising the ethical debate.
- Towards Europe: the municipality can ensure continuous innovation by the way the project description is formulated, instead of simply specifying the delivery of a system or provision of a service. In case existing contracts and regulations cause limitations in the ability to do this, the municipality will have to take the lead in discussions with European authorities about necessary changes (e.g. in relation to the 'digital agenda') to enable innovative procurement and facilitating adaptations in standards and regulations for innovative lighting solutions.

In the coming years, innovation in public lighting systems will evolve from purchasing products and services developed by companies to participatory innovation in a quadruple helix structure. This also means that all partners will have to embrace mutual dependency in participative innovation and learning by doing.

## Conclusion

The challenge we faced was to formulate a vision that extends beyond the economic value of urban lighting alone, and to create a roadmap to support short-term investment decisions that will enable further developments in the future. We took a participative approach to innovation, in which businesses, governmental organisations and knowledge institutes were invited to collaborate to achieve a high quality of life with smart urban lighting.

In the creation of the future vision and technical roadmap for a liveable city, we invited many partners to think with us and share their ideas, experiences and visions. The result is not only an inspiring vision with a broad view, challenging the quality of life in cities in 2030. A collateral value is the adoption of the vision and roadmap by all participants: because they recognise their contribution to the story, they are willing to adopt the integrated story. The shared result is owned by all and this has an impact on the acceptance of the roadmap in the municipality as well as in the cooperating parties and society.

However, a vision is one thing. The next step is implementation. The step towards implementation proves to be tough. Every partner must be willing to think and act beyond their own borders and direct short-term repayment. Every partner must be able to define their role in the innovation towards a better quality of life. This does not happen overnight, nor by itself. The challenge we face now also has to be shared by the participants, together with a willingness to adopt an experimental approach. This links closely to the transition our society is currently going through: with a growing influence of information and people, a changing perception of value and a social-driven approach.

This requires a new approach to innovation, where stakeholders from government, organisations, companies, and users participate in new ways of collaboration. An approach where solutions are realised that make our society future-proof; an approach where we participate in a redesign of the world while it keeps spinning.

## References

[1] Reflection Group on the Future of the EU 2030, *Project Europe 2030 — Challenges and Opportunities — A report to the European Council by the Reflection Group on the future of the EU 2030*, May 2010 (http://www.consilium.europa.eu/uedocs/cms_data/librairie/PDF/QC3210249ENC.pdf).

[2] Den Ouden, E. (2012), *Innovation Design: Creating Value for People, Organizations and Society*, Springer Science and Business Media, London.

[3] Valkenburg R., Sluijs, J., in co-creation with Kleinsmann, M., Den Ouden, E., Rietjens, J. J., Huskens, C., Lazarova, K., Stoimenova N. (2012), *The world of the open innovator*, The Hague University of Applied Sciences.

[4] Shur, M. S., Zukauskas, A. (2005), 'Solid-State Lighting: Toward Superior Illumination', *Proceedings of the IEEE*, Vol. 93, No 10, October 2005.

[5] European Commission (2011), Green Paper *Lighting the future — Accelerating the deployment of innovative lighting technologies*, COM(2011) 889 final of 15 December 2011.

[6] Den Ouden, E., Alblas, A. (2012), 'Towards Triple Helix Co-Design for Innovations — The Case of Sustainable Urban Lighting', Working paper.

[7] De Bruin, H., Snoek, J., Valkenburg R. (2012), 'Grafimedia sector trembles: can future telling help?', NordDesign, 22–24 August 2012, Aalborg, Denmark.

[8] Phaal, R., Simonse, L., Den Ouden, E. (2008), 'Next generation roadmapping for innovation planning', *International Journal of Technology Intelligence and Planning*, Vol. 4, No 2, 2008.

## *Contact*

The Vision and roadmap urban lighting is produced by LightHouse for, and in partnership with, the city of Eindhoven as part of the INTERREG IVC PLUS project. If you are interested, contact us (http://www.ili-lighthouse.nl or http://www.tue.nl/ili).

**Prof. Dr ir. Elke den Ouden**
Strategic Director, LightHouse
Intelligent Lighting Institute of the
Eindhoven University of Technology
e.d.ouden@tue.nl

**Dr ir. Rianne Valkenburg**
Value Producer, LightHouse Intelligent Lighting
Institute of the Eindhoven University of Technology
and Professor of Knowledge transfer
in product innovation, The Hague
University of Applied Sciences
a.c.valkenburg@tue.nl

**Prof. Dr Emile Aarts**
Scientific Director, Intelligent Lighting Institute
of the Eindhoven University of Technology
e.h.l.aarts@tue.nl

## 3.3. Smarter water: why open innovation is essential for managing the world's most essential resource

### *Introduction*

Water is one of our most essential resources. Yet many of us may not fully realise how important water actually is and the extent of the interconnections between water and a host of other areas. We cannot survive without water — aside from the water we directly consume, it is also a key input for producing the food needed for our survival. As the world's population increases from 7 billion now to an estimated 8 billion in 2025 [1], the demand for water will rise to satisfy increased demand for food, particularly as meat consumption in global diets increases [2]. Every time you consume a kilo of beef you may not realise that it takes 15 500 litres to produce it compared to 1 300 litres for a kilo of wheat [3].

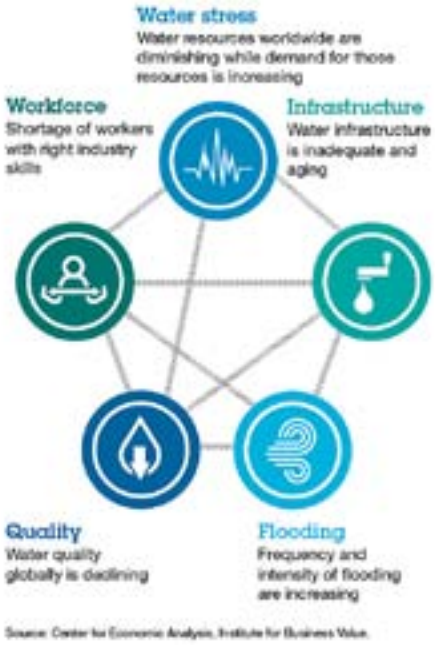
Water is also critically important for health and this link is significant — over 50 % of the world's hospital beds are occupied by people suffering from water-related diseases [4]. Water is also essential for producing a host of goods and services right across the economy. Each of us, on average, consumes about 3 800 litres a day embodied in the goods and services we produce as well as the water we directly consume [5]. As the world's population and their incomes grow, so too will demand for the water to produce the goods and services needed to satisfy consumption. Energy, in particular, is heavily reliant on water — it accounts for almost half of the total water used in the United States [6] and 44 % in the European Union [7]. As our energy needs grow, so too will our need for water and issues with water availability are already restricting energy production in various ways [8].

A less obvious, but still important, link is to our transport networks — road and rail networks are becoming more vulnerable to flooding from storm surges, rainstorms and rising water tables [9], transport infrastructure along coastal regions is at increasing risk from sea level rises [10], while at the other end of the spectrum, drought is pushing roads to their design limits and causing cracking [11], as well as restricting navigation channels [12].

### *The world's water system is facing several significant challenges*

It is important for us to realise the full extent of how important water is because the world's water system is experiencing several significant issues that are creating critical vulnerabilities. The impact of these problems could potentially be widespread given the nature and extent of the interlinkage between water and other systems that we have just described. And, while each of these issues on their own is significant, they are also interrelated, so challenges in one area can worsen and exacerbate the problems we are facing in other areas of our water system (Figure 1).

Figure 1: Interrelated challenges in the world's water system




Population growth and urbanisation are driving a significant increase in water usage and this is creating a problem with water stress — where demand exceeds water available [13]. The intensity of our water use is also rising — water use increased at twice the rate of population growth between 1900 and 1995 [14]. At the same time, water availability is decreasing and this is worsened by declining water quality in many parts of the world which effectively reduces the supply of water available [15]. As a result, we are facing growing problems with water stress and this is affecting all regions globally [16].

We are also facing almost universal issues with the infrastructure underpinning our water system. Many systems have problems with water that is 'unaccounted for' or lost through leakages

or theft. In the United Kingdom, 3.4 billion litres of water are lost daily through leakage [17]. In Mumbai, India, 700 million litres of water are lost daily through leakages and illegal connections [18]. The average leakage rate in Latin American cities is 35 % [19]. But there are also issues with existing infrastructure simply being inadequate to meet growing needs. In Brazil, inadequate water and sewage treatment facilities mean that more than half of all cities are at risk of water shortages by 2015 [20]. For cities, governments and utilities, enhancing and expanding infrastructure is costly. In the United States alone, USD 1 trillion is required by 2025 to fix ageing water infrastructure problems [21]. Of course, financial constraints for many cities and regions mean investment on the massive scale required is not a viable option, so new ways of managing our infrastructure need to be found. Infrastructure issues impact other water issues — ageing water or sewer pipes are more prone to failures that can contaminate water, and also contribute to water stress through the inability to balance supply and demand, as well as worsening the impact of flooding.

Changes in the hydrological cycle are creating more frequent and intense episodes of flooding that result in significant human and financial costs. Globally, between 1980 and mid-2012, more than 4 000 flood disasters affected 3.5 billion people, killed 6.9 million and caused USD 559 billion of damage [22]. Unfortunately, these problems are set to worsen and we expect that by 2050, the global population at risk from flooding will grow 33 %, from 1.2 billion to 1.6 billion [23]. Flooding adversely impacts water quality as surface contaminants enter water supplies, so if we are not adequately addressing this problem, our existing issues with water quality will also worsen. Over 2 million tonnes of sewage and industrial and agricultural waste are already being discharged into the world's waters every day [24]. In the United States alone, sewer overflows discharge up to 850 billion gallons of wastewater annually [25]. On a global scale, despite access to clean water being enshrined in the UN Declaration of Human Rights, we still have a situation whereby over 780 million people worldwide do not have access to safe water [26]. Our water quality problems are also worsening as the number of people without access to safe water is expected to rise to 2 billion by 2025 [27].

Against the backdrop of these challenges is the critical role the water industry needs to play in helping to effectively address these problems. The problem is that the industry itself is experiencing problems in the form of a looming skills crisis as large numbers of older workers retire, and the industry is struggling to attract and retain younger workers. In the United States, for example, between 30 % and 50 % of the workforce is expected to retire by 2020 [28]. Similar challenges exist in Australia, where a Water Industry Skills Taskforce was founded in 2008 to address the water sector skills shortage as 40 000 additional workers need to be recruited by 2019, half of the existing workforce [29]. The challenge here for the industry is to try and improve the ability to attract younger — and increasingly tech-savvy — workers into the industry so they can play their part in helping to solve these challenges.

### *Open innovation focused on existing available solutions can help to more effectively address these challenges*

Amid all these challenges is some good news. We already have the means at our disposal to more effectively address these challenges and so open innovation can be a core enabler in helping us to more effectively solve these problems.

Solutions already exist that can help us build a 'smarter' more intelligent water management system where information and analytics are used to deliver improved outcomes right across the water management life cycle. We can leverage existing solutions and capabilities for fast, automated collation of information from varied sources to increase situational awareness and to merge structured and unstructured data from multiple sources to create a holistic view of water systems at multiple scales. Solutions already exist that can build a more interconnected system where there is efficient information-sharing to deliver a real-time common operating picture and drive more effective decision-making and effective collaboration across services, agencies, suppliers and user communities. Predictive analytics and information mining solutions can be used to identify trends and hotspots, and specify preventative action based on more comprehensive, timely information to improve planning, scheduling and tactical decision-making. Indeed, many forward-looking utilities and businesses are already using these tools and solutions to address the issues we have just outlined — from Dubuque, Iowa, to Sonoma in the United States, to Galway Bay in Ireland and many other areas around the world.

For example, smarter water management enables users to more effectively manage demand and helps utilities better manage supplies by collecting data on water demand and supply from sensors and smart meter systems across utilities or

industrial users' infrastructure and networks. This data can be analysed and visualised in real-time to generate insight on water consumption behaviour and supply conditions. Users can then use this insight to more effectively manage their demand while utilities can more effectively control supply through better decisions about what, when and how much water to store, treat and distribute.

Existing smarter water management solutions such as sensors, devices and analytics can also help utilities and businesses address issues with leakages and ageing infrastructure by generating alerts of actual or potential losses from leaks and ageing equipment across the network. Reducing leakage levels helps reduce operating costs, such as for the energy used to pump, treat and pressurise water systems, and chemical treatment costs, and also reduces the need for costly construction projects.

Smarter water management can help to improve preparedness and response to flooding. Data can be collected in real-time from river systems, levees, sensors and weather systems, combined with historical data and aggregated to monitor and predict water flows and floods, monitor emerging threats from flooding and pinpoint with greater accuracy potential areas at risk to help provide early warnings and enable a more targeted focus for emergency or disaster response.

An open approach that leverages existing solutions can enhance the ability of utilities and industrial users to monitor and control water quality as vast volumes of data on the status of water quality can be gathered across industrial or utilities' networks and detect and pinpoint issues for more effective and rapid responses to quality problems by helping to prevent water contamination while also providing insights for long-term planning.

Smarter water management can help address the impending skills crisis by improving organisational memory and attracting younger workers. It can do this by using a smarter approach to data management, by helping to construct and preserve organisational knowledge on processes and procedures, and by using analytics to support decision-making in a consistent way. The more intensive use of technology in these ways and the greater collaboration it supports can together help to alter the perception of the industry as 'old-fashioned'. This can, in turn, help make it easier to attract young tech-savvy workers into the industry so as to maintain the critical mass of workers necessary to keep water systems functioning effectively.

## *The need for action*

There is danger in thinking that because we already have the solutions available the benefits from those solutions will somehow naturally flow. Looking externally to utilise the tools already available to more effectively address the existing problems is necessary, but it is not sufficient. Effective open innovation also requires that key stakeholders across the water system take action.

There are a number of core areas where the action can be focused. For example, governments need to develop a strategy for smarter water and help develop industry standards for interoperability of devices. This can help to accelerate the deployment of existing solutions by utilities, enterprises and the water industry thus fostering more rapid 'outside-in' innovation. Cities can also help by acting as the 'hub' for fostering openness and transparency in data sharing and for bringing key stakeholders together. Given that open innovation involves inter-organisational relationships as well as internal and external knowledge management processes, this can help in developing a better understanding of open innovation processes to realise the benefits from open innovation. Utilities themselves can focus on open innovation processes by utilising existing solutions to help them make better use of the data they already have, as well as by collaborating to develop the industry strategic architecture. Businesses can take action by assessing water use, developing a plan to improve efficiency and calculating the full cost of water.

Action by all four key stakeholder groups is necessary for us to put open innovation at the core of our approach to solving the world's water problems and to manage water on a scale that is appropriate for the resource. The time to act is now.

## *References*

[1] United Nations, *World Population Prospects, the 2010 Revision*, UN Department of Economic and Social Affairs (UN DESA), Population Division, Population Estimates and Projections Section (http://esa.un.org/unpd/wpp/unpp/panel_population.htm).

[2] United Nations Water, *World Water Day*, United Nations Water (http://www.unwater.org/worldwaterday/faqs.html).

[3] Water Footprint Network, *Product Gallery*, Water Footprint Network (http://www.waterfootprint.org/?page=files/productgallery).

[4] Corcoran, E., Nellemann, C., Baker, E., Bos, R., Osborn, D., Savelli, H. (2010), *Sick Water? The central role of wastewater management in sustainable development — A Rapid Response Assessment*, United Nations

Environment Programme, UN-HABITAT, GRID-Arendal (http://www.unep.org/pdf/SickWater_screen.pdf).

[5] Based on IBV calculations from data in Hoekstra, A. Y., Mekonnen, M. M. (2012), 'The water footprint of humanity', *Proceedings of the National Academy of Sciences*, Vol. 109, No 9, pp. 3232–3237 (http://www.pnas.org/content/early/2012/02/06/1109936109.full.pdf?with-ds=yes).

[6] USGS, *Thermoelectric Power Water Use*, United States Geological Survey (USGS) (http://ga.water.usgs.gov/edu/wupt.html).

[7] European Environment Agency (2009), *Water resources across Europe — confronting water scarcity and drought*, European Environment Agency, Report No 2/2009 (http://www.eea.europa.eu/publications/water-resources-across-europe/view).

[8] WEF (2009), 'World Economic Forum Water Initiative — Managing Our Future Water Needs for Agriculture, Industry, Human Health and the Environment', World Economic Forum (WEF) (http://www.scribd.com/doc/22593374/World-Economic-Forum-Water-Initiative-Managing-Our-Future-Water-Needs-for-Agriculture-Industry-Human-Health-and-the-Environment); see also, for example, Zongyang, T., Yue, Z. (2011), 'Hydropower running out of steam due to drought', *China Daily* (http://europe.chinadaily.com.cn/china/2011-05/25/content_12575531.htm); Webber, M. E. (2012), 'Will Drought Cause the Next Blackout?', *The New York Times* (http://www.nytimes.com/2012/07/24/opinion/will-drought-cause-the-next-blackout.html?_r=0); Kemp, J. (2012), France-Presse, A. (2012), 'U.S. proposes more fracking disclosure', Mother Nature Network (http://www.mnn.com/earth-matters/wilderness-resources/stories/us-proposes-more-fracking-disclosure).

[9] Transportation Research Board (2008), *Potential Impacts of Climate Change on U.S. Transportation*, National Research Council, Transportation Research Board Special Report 290, Transportation Research Board, Washington, DC (http://onlinepubs.trb.org/onlinepubs/sr/sr290.pdf).

[10] Titus, J. G. (1993), 'Regional effects of sea level rise', Warrick, R. A. et al., *Climate and Sea Level Change: Observations, Projections and Implications*, Cambridge University Press, pp. 395–400; Titus, J. (2002), *Does Sea Level Rise Matter to Transportation Along the Atlantic Coast?*, presented at 'The Potential Impacts of Climate Change on Transportation' workshop (http://climate.dot.gov/documents/workshop1002/titus.pdf).

[11] Wald, M. L., Schwartz, J. (2012), 'Weather Extremes Leave Parts of U.S. Grid Buckling', *The New York Times* (http://www.nytimes.com/2012/07/26/us/rise-in-weather-extremes-threatens-infrastructure.html?ref=earth).

[12] University of Missouri-St. Louis (2012), 'Water transportation economist discusses drought's impact on river shipping', *UMSL Daily* (http://blogs.umsl.edu/news/2012/08/05/river-shipping/).

[13] United Nations (2006), *Water — a shared responsibility*, The United Nations World Development Report 2 (http://unesdoc.unesco.org/images/0014/001454/145405E.pdf).

[14] United Nations (1999), 'The State of the Environment — Freshwater', GEO-2000*: Global Environment Outlook*, United Nations Environment Programme.

[15] 'Water stress causes deterioration of fresh water resources both in terms of quantity due, for example, to aquifer over-exploitation, dry rivers, etc., as well as in terms of quality due, for example, to eutrophication, organic matter pollution and saline intrusion', European Environment Agency (http://www.eea.europa.eu/themes/water/wise-help-centre/glossary-definitions/water-stress).

[16] OECD (2008), *OECD Environmental Outlook to 2030*, Organisation for Economic Co-operation and Development (OECD).

[17] Hennessy, M. (2012), 'Fears UK hosepipe ban to be extended', *Irish Times* (http://www.irishtimes.com/newspaper/world/2012/0406/1224314435450.html).

[18] Shukla, S. (2011), 'BMC plans to outsource pipe leak detection', *Indian Express* (http://www.indianexpress.com/news/bmc-plans-to-outsource-pipe-leak-detection/857557/).

[19] Siemens (2010), *Latin American Green City Index — Assessing the environmental performance of Latin America's major cities*, Siemens (http://www.siemens.com/entry/cc/features/greencityindex_international/all/en/pdf/report_latam_en.pdf).

[20] Hornby, C. (2011), 'Brazil needs $42 billion of water and waste investment by 2015', *The Sign Post* (http://blogs.terrapinn.com/total-asset/2011/03/23/brazil-42-billion-water-waste-investment-2015/).

[21] American Water Works Association (2012), *Buried No Longer — Confronting America's Water infrastructure Challenge*, American Water Works Association (http://www.awwa.org/files/GovtPublicAffairs/GADocuments/BuriedNoLongerCompleteFinal.pdf).

[22] IBM Institute for Business Value calculations based on data in EM-DAT: The International Disaster Database, Université catholique de Louvain, Brussels, Belgium (http://www.em-dat.net/).

[23] Global Water Forum (2012), *Water Outlook to 2050: The OECD calls for early and strategic action*, Global Water Forum (http://www.globalwaterforum.org/2012/05/21/water-outlook-to-2050-the-oecd-calls-for-early-and-strategic-action/).

[24] United Nations (2003), *Water for People — Water for Life*, The United Nations World Water Development Report (http://unesdoc.unesco.org/images/0012/001297/129726e.pdf).

[25] Environmental Protection Agency (2004), *Report to Congress: Impacts and Control of CSOs and SSOs*, Environmental Protection Agency (EPA) (http://cfpub.epa.gov/npdes/cso/cpolicy_report2004.cfm); while environmental protection policy aimed at reducing these overflows has been in place since 1994, virtually all combined sewer systems continue to overflow when it rains heavily: see National Resources Development Council (2012), *Testing the waters*, 22nd Edition, National Resources Development Council (http://www.nrdc.org/water/oceans/ttw/ttw2012-Sources.pdf).

[26] Unicef and the World Health Organisation (2012), *Progress on Drinking Water and Sanitation* — 2012 *Update*, Unicef and World Health Organisation (WHO) (http://www.unicef.org/media/files/JMPreport2012.pdf).

[27] UN Office for the Coordination of Humanitarian Affairs (2010), *Water Scarcity and Humanitarian Action: Key Emerging Trends and Challenges*, OCHA Occasional Policy Briefing Series, No 4.

[28] Olstein, M., Marden, D. L., Voeller, J. G., Jennings, J. D. (2005), *Succession Planning for a Vital Workforce in the Information Age*, American Water Works Association.

[29] IBV calculations based on data from Working in Australia (2009), *Severe skills shortage in the water industry* (http://www.workingin-australia.com/news/31175/severe-skills-shortage-in-the-water-industry).

## *Contact*

**Dr Mary Keeling**
Manager, Economic Analysis, Smarter Cities, IBM
mary.keeling@ie.ibm.com

## 3.4. Open data — the new oil for smarter EU cities

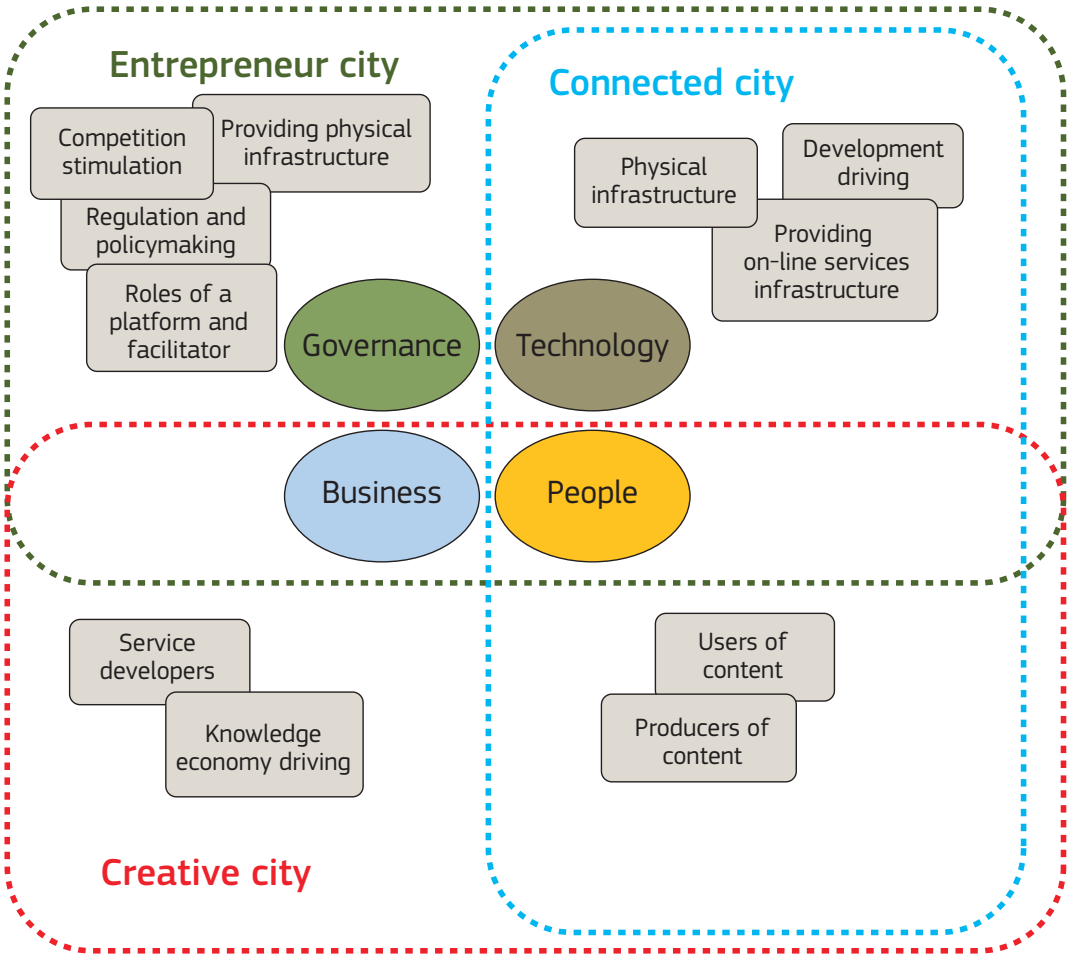
According to the last report of the United Nations Population Fund, around 7 billion people inhabit the Earth and about one in two of these people lives in a city [1]. In about 35 years, the population of cities will be much increased and two out of three people will be living in urban areas. With the fast growth of the urban population, cities face a variety of problems from ecological and transport issues to unemployment and rising crime rates. Thus, it's not surprising that local authorities try to find optimal solutions on how to make the life of city inhabitants more comfortable and safe and, at the same time, to gain benefit out of this growing urban tendency. Basically, there are two possible ways: to make a city bigger, giving citizens a chance to find their place in urban reality, or to make a city smarter, adapting urban reality to citizen's demands.

To remain competitive in an ever more challenging global economy, it is critical not only for commercial business but also governments to seek the benefits of new technologies and work towards the development of new services for consumers and citizens alike. The idea that European cities should become 'smarter' or 'more intelligent' is one of the core inspirations of the European Digital Agenda 'which seeks to recognise the power of urban planning and the role of ICTs in managing infrastructures' [2].

### *What is a 'smart city'?*

There are many different ways to describe a smart city: one could define it as a 'technologically progressive city', a 'knowledge economy and entrepreneurial city' or even a 'creative city' [3] [4] [5].

Figure 1: Smart cities classification



There is, however, a general agreement on the fact that ICTs are the core of a modern city which aims to be called 'intelligent' or 'smart'. The human component, reflected in the activity and creativity of citizens and policy, as well as the entrepreneurship component are important additional factors in defining a smart city. The triangle of 'technology–people–government' is becoming a strong basis for a modern intelligent city.

With the help of technology, the everyday life of ordinary citizens can be significantly improved through the provision of new services. In return, citizens can input to the process with creative contributions. Looking at the city as at a 'system of systems' allows for a new perspective distinguishing two parallel essential layers of modern urban mobility: a *physical/infrastructural* layer — with roads, transport and parking facilities — and a *virtual* layer, based on ICT and data development.

Knowledge-based businesses can benefit from this smart environment by finding inspiration in an intelligent ecosystem, providing smart solutions to inhabitants and, hence, driving growth. A smart government, which supports innovative businesses by creating proper policymaking solutions while facilitating its relations with and among businesses and inhabitants, will go a long way.

## *Role and importance of data for a smart city*

According to IBM, the digital universe will grow to 8 zettabytes by 2015: data is the next big thing, the 'new oil'. However, like crude, it needs to be refined to be used in a meaningful way to provide for value creation.

This also applies to the ways (smart) cities are handling 'their' data resources.

Every day, a modern city generates and collects a lot of data. All this data can become a prominent driving force in increasing urban sustainability through ICT technologies. Providing relevant updated information can actively assist people in changing and rationalising their daily behaviour and, especially, so-called *open data* can bring social and economic added value if linked and combined with other public data resources such as crowdsourcing platforms and social networks.

The number of countries around the globe that are including the 'open data' concept in their political and administrative agenda is increasing dramatically. Most of the time, authorities implement open data strategies to increase transparency, citizen participation and government performance efficiency [6]. But, most importantly, the use of open data brings economic benefit and business growth as new, high-value services can be built on top of it. This is particularly important at a time of economic crisis because open data provides a major new asset at no significant cost.

International organisations such as the Organisation for Economic Cooperation and Development (OECD) [7], and Unesco [8] also have started to promote open access to information and knowledge. Even though, in the case of Unesco, it is mostly about the right of access to scientific information, the main idea of 'open access [being] about Freedom, Flexibility and Fairness' [8] can apply to all the open data types.

Open data arrived on the EU agenda in 2003 with the release of a pan-European directive on public sector information reuse or — shortly — the public sector information (PSI) directive [9]. The document promotes the idea of reusing and sharing data free of charge or, at least, not exceeding the marginal costs.

As a matter of fact, the EU institutions strongly support the view that public sector information — including geographical and public transport data — should be open and available across borders.

The Commissioner responsible for the European Digital Agenda implementation, Neelie Kroes, accentuated the idea that data is a kind of new fuel for society nowadays: 'Data is new oil for a digital era' [10]. A number of free and paid services and applications can be built on the top of public sector information. By opening up governmental data, it is possible to provide stakeholders with an amount of new economic, political and social values, desperately needed for modernising societies in the EU. We will look at the real-life European case further.

Nevertheless, different authorities in different countries have their particular views, motivations and official positions on whether they make their PSI available or not. Even if some data are available, it's up to the national authorities as to which terms and conditions are imposed on the information to be reused, from completely open access to limited or charged access [11].

Many cities now have started to provide data on official transport websites. Very often, citizens can also find interactive maps and journey planners on these websites, which help to calculate the travel time and cost per city trip. Updates on planned

roadworks or spontaneous events such as public transport strikes can also be available online [12]. Geolocation data are especially important when they create an added social and economic value in combination with any other public sector information. In some cases, these data are available only for non-commercial or personal use; in other cases, there are fully open and interoperable data, which can be reused by Web developers to create new types of desktop and mobile applications for city mobility.

In order to follow the trends, regulate cities' mobility, evaluate the ICT impact on mobility issues and promote the best practices across the Member States, the EU institutions are setting up legal and conceptual initiatives containing some general rules.

The aforementioned PSI directive of 2003 is one of the most tangible results of such commitment to support PSI openness and availability ([1]).

### *Open data EU case: London urban mobility*

Currently, the United Kingdom is probably THE European country where open data are getting the most attention from central and local governments and where the PSI directive was rigorously implemented and a truly open data strategy is enforced.

As an international business, financial and cultural centre, the City of London is forced to optimise the public transport system. Most of the decisions concerning public transport system development in London are technical or urban by nature, but recent ICT technologies are also being used to help a modern megalopolis become more mobile and comfortable for citizens and visitors alike.

In 2008, the UK Government launched a special plan, the pan-government initiative 'UK Location Programme'; its main aim is to implement the EU INSPIRE directive [13] in a proper way, by improving the sharing and reuse of public sector location information.

The main idea is to open PSI data sets as much as possible, and encourage entrepreneurs to reuse this open data information. The government decided that the process of sharing PSI data across the country was so ineffective that people and official bodies were simply wasting time and money trying to get the information. The proposal was to improve the sharing opportunities through common interoperability standards and common Web infrastructures (websites in these terms). Moreover, according to this initiative, all the data should be updated regularly.

Citizens and communities in general are encouraged to create and develop new PC and mobile applications or to improve already existing government services [14]. In parallel, government departments are encouraged to open their PSI. A guide is provided on how to publish data easily, and a website forum offers additional assistance [15]. The authorities also give some suggestions for potential apps based on all this PSI: traffic management, location-based services, and social-economic services are all mentioned as possible apps solutions.

In June 2012, the UK Government published a new document, *Open Data White Paper — Unleashing the Potential* [16], emphasising the idea that 'transparency is at the heart of the agenda for government'. The underlying principle of the UK Government is that 'data that can be published should be published'; this distinguishes the United Kingdom and the 'London case' in particular. For this reason, each UK government department (from Environment, Food and Rural Affairs to Culture Media and Sport — a total of 14 departments) took the principle as a primary rule, and published its first ever open data strategies plans to open and publish new data sets with a 2 year perspective. Departments also stated how they are going to motivate a market and developers for the newly available open data.

Access to the data is given with an Open Government Licence for PSI, which means that citizens, non-commercial, and even commercial, organisations can copy, publish, distribute, transmit and adapt presented data sets, as well as utilise the information commercially, including the possibility of combining it with other data sets and using it in their own products and services. The main conditions are attribution to the source of the information and a link to the Open Government Licence for PSI itself must be included. The licence does not cover any personal data or any information under the intellectual property rights law.

It also provides for privacy and data security safeguards, stressing that personal data is anonymised and anonymous data sets are not altered. Finally, the authors of the White Paper proclaim that a shift

([1]) In this context, it is important to keep in mind that the meaning of 'Public Sector Information' (PSI) should not be confused with the meaning of 'open data'. They are not necessarily synonyms especially when PSI is stored by governmental services and not open to other stakeholders such as citizens, commercial and non-commercial organisations. However, often PSI and open data definitions can overlap, and even be identical, in situations where public sector information is open access.

to more personalisation on data-sharing issues in public services domains is needed.

### *PSI at work: applications for urban mobility in the City of London*

Open data initiatives in the United Kingdom operate at both national and city level. Public data is available, and it is easy to find all the data sets through a single online portal (http://www.data.gov.uk). Currently, there are about 9 000 available data sets, from all central government departments, and some public sector bodies and local authorities [16]. All these data are available on the official websites and are free to use. In addition to published data sets, potential users can already find applications (building on these data) by keywords, topics or tags.

Transport is one of the biggest categories listed and consists of 43 different data sets. The relative popularity of each data set can be evaluated by the number of comments and the feedback. All these data are open and free to use, albeit under special terms and conditions.

Mobile applications based on live departure boards and updated bus and tram timetables allow the tracking of bus, tram and tube journeys, and show how long it will be until a particular transport option arrives. Through the GPS navigation integrated into smart phones, it is also possible to identify the nearest bus stop. Some of these mobile apps are also equipped with a 'notification' function which means that the app can inform the user when they need to leave home in order to be on time for the bus or metro: the user just needs to save the information about their 'favourite' route in the app.

There are around 170 live traffic cameras across the City of London, showing what is happening on the capital's streets and if any traffic congestion or accidents occur. Data sets related to these cameras were released by the UK Government in January 2010 and they were used by developers to create free and paid apps on city mobility. The user can find the camera locations on the map integrated into the app: images refresh every 3 minutes and have date and time stamps.

The other notable transport data set, which was released in June 2011, is 'Cycle hire availability'. Bike locations can be found through a special website, where all the mobile applications are based [17]. The mobile apps, based on this data set, help users to find the closest cycle hire location and even indicate the number of free bicycles available there.

Figure 2: Traffic View London application for iOS, Chris Oklota


Observing existing mobile applications clearly indicates tendencies distinguishing the City of London case from other cities. First of all, for London, many applications are purely based on open data information. When comparing this to other EU Member State capitals, it is clear to see that the city has made great progress in reusing PSI: it can be safely argued that the UK Government is probably one of the most enthusiastic European official bodies in terms of opening its data sets.

London data sets on public transport allow third-party developers to create mobile apps showing the locations of underground and overground routes and services. Data is officially provided by TfL (Transport for London) and is also available in a desktop version [18].

Summing up, it appears that London PSI reuse is really focused on mobile apps and their potential. The number and diversity of apps, designed explicitly for mobile phones, are making the case unique in its pure nature of urban mobility especially driving growth among small and medium local developers catering for the market.

## Conclusions for the EU

Opening up city data sets increases democratic participation and transparency, while fostering services and product innovation. In a nutshell, the reuse of data allows a city to function more 'smartly', and related costs are low: data have already been collected for other primary purposes of the city, and expenses were covered by taxpayers' money. Furthermore, in some cases, new Web services are able not only to save the city money, but also to create new economic value for the citizens.

Public sector information and open data are ideal raw material for ICT urban development: numerous useful services increasing the comfort of urban mobility can be based on data collected by the city. In some cases, official authorities can share this data with third parties, giving them room for imagination and innovation.

## However, several issues remain

The 'data owner' and the decision-maker are natural gatekeepers for the use of open data. By deciding whether data can be opened or not, they actually shape the way a city is becoming 'smarter'. By implementing a 'top-down' approach, governments motivate citizens and developers to freely take advantage of open data. If a government has a rather passive or even defensive position in sharing its data, this can result in discriminatory data policy when access is exclusively for a single stakeholder, or a few stakeholders. Europe presents cases where local authorities keep public sector data closed.

City authorities should keep in mind that by giving exclusive data access to only one partner or a few partners, they pursue a discrimination policy and contradict Article 11 of the PSI directive (non-exclusive right to PSI). On the one hand, it can be enough for a small city to have only one official route planner: however, on the other hand, there will be no room for innovation. An open licence policy with attribution to the official source can be beneficial for both parties — developers and government. For developers, a licence provides confirmation of the reliability of the provided data; for the government, it creates extra trust from the citizen community as proof of transparency.

The PSI directive, as well as the deployment and implementation of its national counterparts, was based on the current existing legal framework for data protection [19]. Under the ongoing revision of the latter, a much wider definition of what constitutes personal data is envisaged and much stricter rules and provisions for use and processing are foreseen. If not carefully drafted, these new rules might become a major show-stopper by rendering it difficult or impossible to use formerly considered 'open or public' data and prohibit the development of innovative services for citizens around it.

## References

[1] The United Nations (2011), *UNFPA State of World Population 2011 Report*, The United Nations Population Fund (http://foweb.unfpa.org/SWP2011/reports/EN-SWOP2011-FINAL.pdf).

[2] European Commission (2010), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A Digital Agenda for Europe, COM(2010) 245 final of 19 May 2010 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0245:FIN:EN:PDF).

[3] Hollands, R. G. (2008), 'Will the real smart city please stand up?', *City*, 12(3).

[4] Komninos, N. (2002), *Intelligent Cities*, Spon Press, London.

[5] Schaffers, H., Komninos, N. (2011), 'Smart Cities and the Future Internet: Towards Cooperation Frameworks for Open Innovation', *The Future Internet*, Springer-Verlag, Berlin, pp. 431–446.

[6] Huijboom, N., Van den Broek, T. (2011), 'Open data: an international comparison of strategies', *European Journal of ePractice*, 12 (March/April 2011), pp. 4–15 (http://www.epractice.eu/files/European %20Journal %20epractice %20Volume %2012_4.pdf).

[7] OECD (2007), *Principles and Guidelines for Access to Research Data from Public Funding* (http://www.oecd.org/science/scienceandtechnologypolicy/38500813.pdf).

[8] Swan, A. (2012), *Policy Guidelines for the Development and Promotion of Open Access*, United Nations Educational, Scientific and Cultural Organization (Unesco) (http://unesdoc.unesco.org/images/0021/002158/215863e.pdf).

[9] Directive 2003/98/EC of the European Parliament and the Council of 17 November 2003 on the re-use of public sector information.

[10] Kroes, N. (2012), Speech on ePSI conference in Rotterdam March 2012 (http://www.youtube.com/watch?v=9Jq4Qy1UeAE).

[11] Uhlir, P. F. (2009), *The Socioeconomic Effects of Public Sector Information on Digital Networks: Toward a Better Understanding of Different Access and Reuse Policies: Workshop Summary*, US National Committee CODATA, in cooperation with the OECD, pp. 9–24.

[12] Bührmann, S., Wefering, F., Rupprecht, S. (2011), *Guidelines — Developing and implementing a sustainable urban mobility plan*, Munich, pp. 6–15 (http://www.mobilityweek.eu/fileadmin/files/docs/SUMP_guidelines_web0.pdf).

[13] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:108:0001:0014:EN:PDF).

[14] The official website of the UK Government (http://data.gov.uk/).

[15] The official website of the UK Government, Local Spending Data Guidance (http://data.gov.uk/blog/local-spending-data-guidance).

[16] Cabinet Office of the UK (2012), *Open Data White Paper — Unleashing the Potential* (http://www.cabinetoffice.gov.uk/sites/default/files/resources/CM8353_acc.pdf).

[17] The official website of Transport for London, Barclays Cycle Hire/Map (https://web.barclayscyclehire.tfl.gov.uk/maps).

[18] The official website of Transport for London, Live bus departures (http://countdown.tfl.gov.uk/#/).

[19] Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and the free movement of such data.

## *Contact*

**Maria Sashinskaya**
Open Data Researcher, IBM Belgium Academic Relations and Business Development Intern
sashinsm@be.ibm.com

**Corinna Schulze**
Governmental Programs Executive, IBM Europe
corinna_schulze@be.ibm.com

Disclaimer: The opinion expressed is those of the authors and does not reflect the official position of IBM.

## 3.5. Crowdsourcing in large companies

### *Introduction*

In all the hype around crowdsourcing and open innovation, we often don't hear very much about the possibilities and challenges related to its planning and implementation within larger organisations (companies or governments). Change can be hard for any organisation, but change in a large organisation where a crowdsourcing or an open innovation programme is going to impact personnel, processes and, sometimes, surprisingly large numbers of stakeholders can be received sometimes positively but sometimes also negatively. As such, despite the potential benefits to the organisation, properly socialising the concept, and defining a clean change management process is critical for realising the objectives.

This chapter will seek to answer the following three key questions that will be of most interest to large organisations such as corporations and governments.

1. What can crowdsourcing do for large organisations and how is it being used for marketing, product development, human resources, customer services, etc.?
2. What are some of the challenges large organisations face when considering and implementing crowdsourcing activities and how do those differ from the challenges in smaller organisations?
3. How do you overcome the risk-averse nature of large organisations when implementing what is inherently an open process that does not have the same controls that many other corporate programmes have?

We shall limit our focus to large companies even if some of the observations and remarks will be adaptable to government institutions and non-profit organisations.

### *What is crowdsourcing in 2012?*

As the phenomenon matures, the definition varies: crowdsourcing is one of those concepts that can be defined in at least two, diverse, ways. On the one hand, crowdsourcing is an engagement method whereby organisations (such as brands, companies, cities and entrepreneurs) seek input from communities of people. These communities can be open or closed, homogenous or diverse. Participants are invited to contribute ideas, solutions, or support in an open process whereby the elements of creativity, competition and campaigning are reinforced through social media to come up with more powerful ideas or solutions than could be obtained through other means. 'Ideation' is also a term used to describe the concept or process whereby crowdsourcing is used especially as part of innovation management.

On the other hand, crowdsourcing can also be defined as the division of labour by a distributed, multidimensional workforce (sometimes paid, sometimes voluntary), motivated to accomplish a set of tasks that combine to achieve an overall goal or solve a problem. This motivation can be financial, reputation-building, joy of participation or part of being a good citizen of a particular community (i.e. computer programmers 'tribe').

As Boutin wrote [1]: 'Crowdsourcing is a subset of what Eric von Hippel calls "user-centred innovation", in which manufacturers rely on customers not just to define their needs, but also to define the products or enhancements to meet them. But unlike the bottom-up, ad hoc communities that develop open-source software or better windsurfing gear, crowdsourced work in a corporate setting is managed and owned by a single company that sells the results.'

To paraphrase von Hippel, it relies on would-be customers' willingness to hand over their ideas (time, workforce, reputation, credibility) to the company, either cheaply or for free, in order to see them go into production for the benefit of themselves and other customers.

### *Crowdsourcing in a corporate environment*

The development of crowdsourcing can be seen as running in parallel to cloud computing as both were driven by the limitations of current business constructs or technological practices, and certainly by corporations' financial ability to keep up with change happening all around them. Before the cloud, companies preferred to procure and manage their own on-site IT infrastructure hardware. When business was slow, most of a company's computing resources (the processing power of its servers and the memory of its storage devices) would remain idle or unused. Conversely, the company's on-site IT infrastructure would probably be overwhelmed once business picked up. The main benefits of a cloud-based IT infrastructure is that it does not require new hardware purchases and has the flexibility to scale as required based on demand.

On the other hand, a business that does not use crowdsourcing will find that they have a challenge scaling the intellectual and physical capacity of

the organisation to meet demand in order to stay ahead. A company can't have all the right ideas, internally, all the time.

In the digital era that we currently live in, the paradigms of consumers, but also those of organisations and leadership, have shifted. Insular companies that once delivered branded products to the market now need to tap into a real-time marketplace that can be found online, offline and on mobiles in ways where the market controls what information they consume more than ever before.

This pace of change and shifting paradigms affects large organisations more acutely when there is a culture of thinking that all the answers to success reside inside the organisation — as they traditionally did. According to Benkly [2], the world is becoming too fast, too complex and too networked for any company to have all the answers inside.

Table 1: Use of crowdsourcing for different purposes

| Purpose | Overview | Possibilities |
|---|---|---|
| **Human resources** | Larger companies benefit from an ability to engage employees in a meaningful way to help with the building of an effective organisation. Crowdsourcing offers a transparent and easy mechanism to manage and participate that doesn't suffer from other engagement mechanisms that lose their novelty after a while. If run properly, where companies act on suitable ideas, engagement will grow to include more members of the team as they see the value of participation.<br><br>Such programmes can be measured against trending employee satisfaction, turnover rates, etc. to determine their effectiveness. | Employee policies<br>CSR programme<br>Problem solving (happens still inside company's own boundaries) |
| **Product development** | Large organisations can tap into the rapidly changing market for ideas on new products or services, or ideas on how to evolve or improve current products. This market-driven crowdsourcing can then be directly linked to sales to determine the efficacy of the programmes. | Social Product Development sites like Dell's Idea Storm, Johnson and Johnson's Intelli-Ideas, Nokia's IdeasProject and Atizo — one of the multi-brand idea crowdsourcing services. |
| **Marketing** | A growing trend in the marketing area is to use crowdsourcing to design everything from logos and packaging to 'good enough' social media marketing content development (videos and banners for viral distribution, etc.) where challenges are posted and designs submitted by designers that subscribe to the service. The same is true for marketing research where distributed labour carries out the work.<br><br>The pressure on marketing to deliver in highly competitive markets with decreasing budgets has made this an option that organisations are considering — moving away from the traditional large agency model many have operated under for years. This activity can also include customers and partners who are often keen to get in on the action. | 99designs, Genius Rocket, Crowdsource.com, Tongal, Eyeka, etc. |
| **Operations/ logistics** | Problem solving and gaining efficiencies go directly to an organisations bottom line — especially when considering product-based companies. Squeezing costs out to achieve profit on each product is critical to survival and gains come often only through the solution of complex challenges. Crowdsourcing can bring together a diversity of backgrounds for solutions that might otherwise take more resources than are possible from a small team or organisation. | |
| **Finance** | The efforts to reduce cost are an important role of finance that is balanced by the desire of the customer facing parts of an organisation to not impact the customer experience or be detrimental to the product. Driving innovation in an organisation can also include finding cost savings or efficiencies that improve the bottom line and this is an area where answers can come from non-traditional sources.<br><br>ATTN! In this chapter we do not discuss a very interesting phenomenon called 'crowdfunding', a cousin to crowdsourcing and (paid, creative) crowdworking, as it would deserve a chapter of its own. | 3M |
| **Sales/ channel** | Effective organisations use their sales and channel teams to get information from the field on everything from the product or services, to packaging and delivery. This crowd has a unique perspective and can help marketing and operations teams more effectively do their jobs to improve efficiency and profitability. Closed crowdsourcing initiatives can bring insight into the 'on the ground' market response and be the catalyst for changes for improvement. | Intuit, SAP, Salesforce |

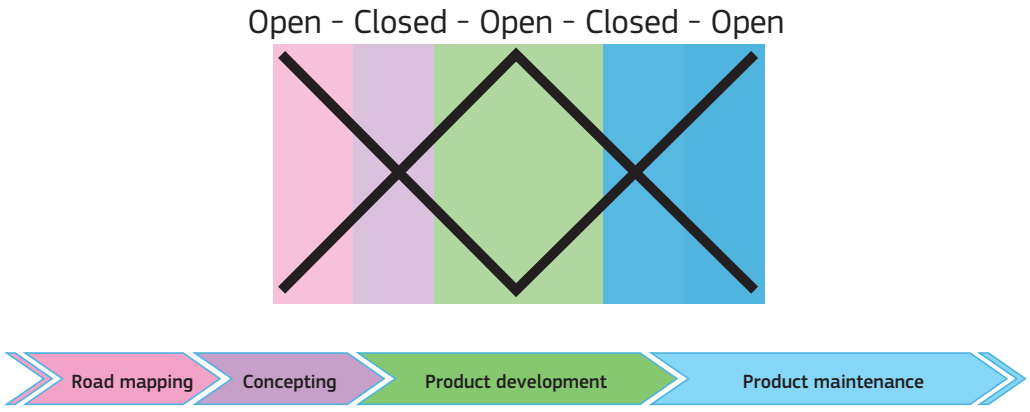
When digging deeper into how idea crowdsourcing could be used throughout the whole product development process, one needs to remember that decision-making is seldom, if ever, democratic in a corporate setting, and why should it be since the biggest singular resource provider is usually the company who ties the knots in the network (of participants like users, vendors, partners, etc.) in question.

Often, an SME will dare to try out new things that large companies only explore as 'one time blue ocean' projects or 'strategic experiments' and, courageously, bases its whole business model on crowdsourcing and openness. An SME worth following (as of late 2012) is in the mobile Internet and telecom industry called Jolla Mobile [3].

dollars. It can also be used to improve the return on investment of traditional campaigns. By bringing people's attention to crowdsourcing campaigns in offline engagement activities (e.g. calls to action to 'go online and vote for the change you want' positioned on offline media and even product packaging), the value and ROI of traditional engagement tools can be increased.

**Immediate**
While door-to-door and telephone campaigns provide representatives with immediate feedback, these methods, by necessity, reach only a small percentage of the target population. Combining these activities with crowdsourcing provides organisations with a more complete picture of ideas, opinions and

Figure 1:




Product development of a consumer electronic product: crowdsourcing (open) and harvesting ideas & decision-making (closed) can be used at different stages of the product development process — when appropriate. There is no need to be 'open' all the time.

## *Benefits of crowdsourcing for innovation and problem-solving*

In addition to the capabilities discussed above, crowdsourcing offers a number of benefits over traditional methods of fostering innovation or problem-solving, including the following.

**Long-lived**
Crowdsourcing can have a longer lifespan than traditional engagement methods, which tend to die out when the budget is spent and/or resources are reassigned. Crowdsourcing, on the other hand, evolves over time as new ideas, comments and people become engaged in the conversation. Once off the ground, crowdsourcing initiatives can become crowd-driven. As long as there is crowd engagement and interest, the campaign will live.

**Budget friendly**
Crowdsourcing uses networks of people and social media tools to spread the word about initiatives, projects and ideas. This makes it possible to create a far-reaching effort that stretches campaign

preferences. Crowdsourcing campaigns can deliver a broad understanding of general opinions very quickly which enables organisations to then leverage for further exploration as trends start to appear.

**Transparent**
Crowdsourcing provides the market with a new kind of transparency concerning large companies, brands, etc. It does so by enabling greater access to information and decision-making processes, as well as providing a platform for customers, prospects, employees, partners, and the public at large to participate in those processes.

## *Challenges and risks when practising crowdsourcing*

After pointing out the many advantages and excellent reasons to exploit crowdsourcing, it is not the patent solution to all. When practising crowdsourcing, we have identified at least three main challenges that large companies often encounter when looking at crowdsourcing from an internal or external perspective.

Table 2: Challenges of the company when practising crowdsourcing

| | |
|---|---|
| **CULTURE** | Is your organisation culturally open to input from outside? There is no point going down the crowdsourcing or open innovation path if your team is closed minded or will feel threatened. Managing change through effective communication and shifting culture is necessary to support teams to not only be open to input from the crowd, but also to energetically shepherd this innovation into practice. The ideas are only part of the solution so getting internal teams behind implementation should make the culture shift happen painlessly. |
| **RESOURCES** | Do you have the resources to investigate the ideas and innovation that come from the crowdsourcing endeavours? |
| **PROCESSES** | When letting your audience/crowd participate in the work of your company, are you authorised to change your ways of working so that their input can be fully exploited? How do you reorganise your existing assets (personnel, budget, vendors, etc.)? |

When companies consider crowdsourcing or open innovation programmes, invariably the conversation ends up on the risk to which the company is exposed. Some organisations have yet to understand how social media has changed the dynamics of relationships between markets and brands and still believe that they can control everything. This is not the case, as evidenced by the numerous fan sites that have tremendous following and where rumours and other conversations happen with no input from the brands.

The following risks should certainly be considered when launching crowdsourcing practices, but these can be managed quite effectively through clear strategy and effective communication from the outset of any initiative:

- confusion by the crowd caused by lack of clarity of the task given to it;
- low participation due to lack of awareness of the audience/resource that a company wishes to reach and their behaviour patterns;
- gamification by special interest groups or individuals;
- controversy over IP ownership after an idea is submitted, originality of idea (relates to ownership mentioned above);
- the crowd stops participating due to the perception that the organisation is non-responsive to their input;
- reduced internal capacity for innovation caused by a misdirected sense on the part of management that the 'crowd can do it all'.

## *Crowdsourcing best practices*

Just as crowdsourcing risks cannot be ignored, they shouldn't get in the way of enabling open innovation or engaging your audience at your company. Using your crowd to solve problems or to work with you is a great way to make your crowd feel included and empowered, helping boost brand loyalty.

One needs to know one's audience, the crowd, which shouldn't be too difficult for the company as it should know its stakeholders already. However, let's not forget Surowiecki's [4] classic, where he acknowledges that not all crowds are wise (e.g. a crazed mob) and where he describes four attributes of a wise crowd: (i) diversity of opinion: each contributor/source has private information or a personal interpretation of the topic; (ii) independence: contributors' opinions are not determined by those of others; (iii) decentralisation: contributors can specialise by drawing on local knowledge; (iv) aggregation: a mechanism is in place to gather private judgements into a collective decision.

Effective crowdsourcing leverages these attributes to gain more accurate insights into problems and solutions than can be achieved by making space available for people to drive innovation and be part of an engagement process.

After knowing the audience, a company needs to understand what it really wishes to achieve with crowdsourcing. Some organisations will create a mission statement or clearly outline the objectives so the design and evaluation of the activities are focused on success from the start.

There are a number of crowdsourcing best practices, whether for open innovation or citizen engagement, that should be considered as a way to reduce the risk for your organisation or extend your company's value creation. Since these endeavours require commitment to be executed successfully, there are a few questions you should be studying and answering as a starting point.

1. What is the question or challenge you are trying to address? Where you need value creation and capacity of your selected audience?
2. Who owns the crowdsourcing endeavour?
3. What are the clear steps an idea will go through once it is chosen? How will you make it happen even though it wasn't the idea chosen by the parties that will be involved in implementing?
4. How is the value/work input created by the crowd received and added to the benefit of

all stakeholders, including the crowd/audience itself?
5. What does success look like and where will success be documented?
6. What is needed to motivate participation? (A lot of research knowledge is available regarding social media participation, and crowdsourcing and working in particular.)

Crowdsourcing, for those who have not explored and exploited it as a way of creating value, is a bit like skydiving: you need to trust your crowd, your audience, your followers and fans, since they are the ones that represent the real value of your company. As stated in his book, Lindgaard [5] says a fundamental question is being raised (by Erkinheimo): who creates more value, a bored professional or an enthusiastic amateur?

## *References*

[1] Boutin, P. (2006), 'Crowdsourcing: Consumers as Creators', *Bloomberg Businessweek,* 12 July 2006 (http://www.businessweek.com/stories/2006-07-12/crowdsourcing-consumers-as-creators).

[2] Benkly, Y. (2007), *The Wealth of Networks*, Yale University Press.

[3] Jolla Mobile (2012) (http://jollatides.com/).

[4] Surowiecki, J. (2004), *The Wisdom of Crowds: Why the Many Are Smarter Than the Few and How Collective Wisdom Shapes Business, Economies, Societies and Nations*, Anchor Publishing.

[5] Lindgaard, S. (2012), 'Nokia: Engaging the passion of amateurs', interview with Pia Erkinheimo, S*ocial Media for Corporate Innovators & Entrepreneurs: Add Power to Your Innovation Efforts*, p. 17 (http://www.15inno.com/2012/08/16/freebooks/).

## *Contact*

**Paul Dombowsky**
Founder, Ideavibes
paul@ideavibes.com

**Pia Erkinheimo**
Head of Crowds & Communities, TIVIT Ltd
pia.erkinheimo@tivit.fi

## 3.6. Horizon 2020: Regional Innovation Ecosystems — from theory to practice

### *Three challenges to put theory into practice*

The name of the EU's new funding programme for research and innovation — Horizon 2020 — reflects its ambition to deliver ideas, growth and jobs for the future. The EU Committee of the Regions (CoR) has stressed that the key issues throughout Europe address ways of speeding up the implementation of the most relevant flagship activities, and ways of learning to exploit existing research knowledge by sharing best practices and other relevant knowledge. The CoR is challenging both the European Commission and the regions themselves to get the most out of Horizon 2020. Local and regional authorities face the challenge of developing cross-territorial and pan-European cooperation. In particular, they need to be able to develop joint platforms, such as innovation forums and test beds for cooperation, by integrating real and virtual worlds, in order to foster open innovation and regional innovation ecosystems. Active European cooperation would result in economies of scale and the creation of wider markets for local businesses and other local developments. Smart specialisation — as the key guiding principle both of Horizon 2020 and of cohesion policy — is opening up new avenues to all this [1].

Professor Martin Curley, Director of Intel Labs Europe, challenged the readers of the EU Open Innovation 2012 yearbook with his message: 'Open Innovation 2.0 could be defined as the fusion of Henry Chesbrough's open innovation concept and Henry Etzkowitz's triple helix innovation concept. Triple helix is about achieving structural innovation improvements through proactive collaborations between industry, academia, and government. The impact of this collaborative innovation goes well beyond the scope of what any organisation could achieve on their own' [2].

Effective regional innovation ecosystems (RIEs) work through the three Horizon 2020 pillars — Excellent Science, Industrial Leadership, and Societal Challenges — to address local problems, regional issues, and grand societal challenges. Innovative *practice* is important here. Looking at RIEs and their role as Europe's pioneering innovation hubs, we see unique possibilities to lift strategic planning above the level of policies and papers in order to achieve innovation outcomes that can be experienced on the street. Increasingly, innovation ecosystem thinking is being described — and prescribed — for RDI organisations, business clusters, and regions. Now that the concept appears in policy and strategy papers, it is time to address the practice beyond the theory.

Back in 2008, Professor C. K. Prahalad challenged universities to create a new role for themselves by defining three critical aspects of innovation and value creation: (i) value will increasingly be co-created with customers; (ii) no single firm has the knowledge, skills, and resources it needs to co-create value with customers; (iii) the emerging markets can be a source of innovation. And one of his main conclusions should be considered especially thoroughly when creating the new role for universities: the competitive arena is shifting from a product-centric paradigm of value creation to a personalised experience-centric view of value creation [3].

In this article, we want to deepen this approach to open and societal innovation by referring to the results of CoR European workshops and using examples of work at Finland's Energising Urban Ecosystems programme (EUE), the Aalto Camp for Societal Innovation, and the New Club of Paris. In this way, we hope to sketch a practical framework for meeting the challenges of the CoR, Curley and Prahalad.

The world is moving towards an era of true value network competition and advantage, where innovation and knowledge brokering will take place in increasingly open, shared settings. Digitalisation and globalisation have changed the business world in a few years. Companies and other organisations create value through networks in which they cooperate and compete simultaneously. The future success of innovation ecosystems is measured increasingly in innovation actors' abilities to connect and manage their talent, partnerships, clusters and practical innovation processes — in integrating the local knowledge base into the global innovation power grid. Active networking relationships with global top-runner environments boost local abilities to attract a continuous flow of global players [4].

Modernising the triple helix concept will not take place on its own. Strong commitment to collaborative change, together with the prioritisation of appropriate measures, is needed. Good methods needed for implementation will be developed and the use of any necessary instruments will be partly financed through the EU cohesion policy funds.

Transferring the scope of the Digital Agenda for Europe, one of the seven EU flagships, to a local and regional level is an obligatory step to be taken. Active development of regional innovation ecosystems and local digital agendas based on smart specialisation are needed, as well as strong conceptualisation and good orchestration. This includes a definition process, as well as action plans and strategic roadmaps, to enable decision-makers to recognise grand societal challenges, translate them to regional and local priorities, and commit to renewal — often up to the level of radical renewal.

In this article, we interlink Aalto University's bottom-up activities with the strategic targets of the surrounding region. The specific requirements are addressed by developing mental models, working practices and a culture of partnerships. The key to success is to work at all of these in close collaboration with political decision-makers, private and public sector stakeholders, as well as with researchers and students. This can be accomplished:

- with the help of testing and implementing demonstration projects related to sustainable development: studying, piloting, demonstrating and verifying new models;
- in collaboration with the significant businesses, universities, and research institutions in the region: partnerships to create a working culture, innovative concepts and methods to support them;
- by developing the decision-making processes needed to address societal challenges: using the best international knowledge and collaboration expertise, developing the required competencies and methods to support decision-makers [5].

Based on recent developments in European regional innovation ecosystems, the CoR rapporteurs on Horizon 2020 and public procurement arranged a workshop on defining key instruments for future European policies, held on 26 March 2012. The outcomes are summarised as a set of recommendations for regional actors and EU-level policymakers (Table 1). The importance of better cooperation between regions and reducing the research and innovation divide were stressed.

Table 1: Recommendations for regional actors and EU policymakers [6]

| | |
|---|---|
| **Recommendations for regional actors in Europe** | |
| 1. | Regions in Europe need to develop Local Digital Agendas and Regional Innovation Strategies (RIS3) to increase their economic growth potential and to implement EU policy on the ground. |
| 2. | Regions in Europe need to move on to a 'Quadruple Helix model' of innovation. |
| 3. | Regions in Europe should call for `Territorial Pacts' within National Reform Programmes to implement Europe 2020 targets on the ground. |
| 4. | Regions in Europe need to develop Regional Innovation Strategies (RIS3), based on smart specialisation, in order to secure innovation funding from EU budgets post-2014. |
| 5. | Regions in Europe should strive for societal innovation, through Living Labs, test beds and open innovation methods in regional innovation policymaking, taking the citizens on board. |
| 6. | Regions in Europe should build on dialogue, collaboration and co-creativity to learn from best-practice and exit the economic crisis together. |
| 7. | Regions in Europe should foster a new innovation mindset, towards demand and problem-driven innovation, strengthened entrepreneurship, education and bridging the digital divide in society. |
| **Recommendations for EU-level policymaking** | |
| 8. | EU-level policymaking should increase research and innovation budgets across all spending areas with specific reference to Horizon 2020 and cohesion policy. |
| 9. | EU-level policymaking should put a stronger focus on bottom up policies and regional innovation ecosystems development. |
| 10. | EU-level policymaking should increase the quality of support and guidance for regions to access European funding. |
| 11. | EU-level policymaking should increase assistance for regions to run pilots and demonstration projects including more support for open innovation strategies. |
| 12. | EU-level policymaking should increase budgets for entrepreneurial education to advance in |
| 13. | Innovation cultures at the regional level through education at secondary school and university level. |
| 14. | EU-level policymaking should develop new forms for high-level regional and territorial leadership in research and innovation strategies. |
| 15. | EU-level policymaking should focus on innovative procurement development including more training to improve regional competences and simplification of procedures. |
| 16. | EU-level policymaking should stress the importance of European-wide collaboration and transnational cooperation projects between regions building on innovation support and smart specialisation strategies. |

The thrust of the recommendations for regional actors is that they need to make use of diverse European instruments such as Local Digital Agendas (LDAs), Regional Innovation Strategies based on smart specialisation (RIS3) and Territorial Pacts, in order to accelerate smart growth by fostering a new innovation mindset, strengthening entrepreneurial discovery, building on dialogue, enhancing collaboration and co-creativity, learning from best practice, and taking new actor groups on board in striving for societal innovation. For their part, EU and regional/local policymakers should actively create conditions in order to put a stronger focus on bottom-up policies and regional innovation ecosystem development, increase assistance for regions to run pilots and demonstration projects, and advance innovation cultures at the regional level through increasing entrepreneurial education at secondary school, vocational school and university levels.

This resonates clearly with insights coming from the work of the New Club of Paris, with early results from Finland's EUE (Energising Urban Ecosystems) programme, and the ideas actualised through ACSI (the Aalto Camp for Societal Innovation). Examples are described at greater length in the following sections.

## *The practice of realising regional policy renewal*

**Europe needs pioneering innovation regions**

Regional innovation ecosystems support larger national and pan-national innovation systems, and they can pioneer innovations of many kinds. They are essential learning arenas for building the future of Europe.

Europe needs pioneering innovation regions. The CoR has called for pioneering regions to form European consortiums integrating different capabilities to create groundbreaking societal innovations for Europe-wide use. It also calls for increased performance capabilities of regions and cities to use the Horizon 2020 programme and other similar initiatives. The focus should be, in particular, on making full use of digitalisation and new key enabling technologies to modernise regional innovation policy. Furthermore, the CoR encourages the regions to move towards open innovation, within a human-centred vision of partnerships between public and private sector actors, with universities and other knowledge institutions playing a crucial role [7].

A Europe built on innovative regions is a Europe of many possibilities, resilient in the face of societal challenges, global competition and financial uncertainty. A Europe of diverse regions can leverage diversity, moving at different speeds along diverse paths in the future. This is the reality that an Innovation Union faces. Within this diversity, different regions will play different roles on the road ahead. One role of crucial importance is that of the pioneer, the region that explores new ground, sets examples, shows the way, and prepares the ground for others. Pioneering innovative regions can take advantage of their capacity to experiment and their drive to excel, to become forward camps on the journey that other regions will eventually make from local improvements to regional welfare, a journey that builds European prosperity through balanced contributions.

Pioneers establish themselves in previously unknown environments — be they physical, cognitive or conceptual territories — and discover how to engage the actors in experiments aimed at making the territory fertile ground for further development. They are innovators, restless by nature: 'boldly going where none have gone before' is characteristic of the pioneer temperament. But moving ahead of events into the future is not the only thing pioneers do: they also know they must first learn how the worlds they explore could actually work. New knowledge is turned into daily practice. Their experiments may not always succeed but when they do, they result in a better quality of life, concrete examples and scalable processes, preparing the way for others to follow. So they stay to reap the early rewards before moving on. In this sense, 'boldly going' goes hand in hand with 'boldly staying'. And others do follow, translating lessons learned into daily practice. In this way, impossible dreams become possible.

Translating these metaphors to actual regional ecosystems requires courage, curiosity and creativity skill sets. Resistance to change can be widespread, even where major business and government stakeholders acknowledge the importance of innovation. Pioneering is a challenge, and following after is easier than the initial pathfinding. The knowing–doing gap must be bridged: producing policy papers and well-wrought strategic planning reports is not the same as realising them in practice. Collaboration provides its own obstacles: the need for trust, respect and mutual understanding among partners; speeding up is easier alone than in tandem. The gravity that keeps our feet on solid ground can often translate into reluctance to experiment or boldly act, and must, at times, be overcome. None of this is ever easy.

**Ramps to escape the resistance to change**

How does a pioneering innovation region develop the momentum to accelerate innovation and escape the gravity of resistance to change and reluctance to act? The simple answer is that regions can do this in the same way pioneers do: by hard work, using relevant resources, appropriate skills, and proven practice, and engaging broad segments of the population to make the journey together. This means investing in practice. Pioneering regions work with methodologies of change to engage people, define shared purpose, create conditions for good collaboration, build capacity, showcase examples, and show the way forward. This section of our paper indicates how some of this proven practice can be directly applied to help pioneering innovation regions ramp up to leverage research excellence, industrial leadership and the power of people to create social and societal innovations.

Launching new initiatives is a necessary part of societal innovation and, in many cases, acceleration is needed to escape the gravity of forces holding innovation back — the resistance to change, the reluctance to act, the fear of failure, the uncertainty of risks. Ramps are one of our oldest 'technologies' for reducing friction, and they can be useful tools to overcome the resistance of gravity. The New Club of Paris encourages creating 'ramps' for societal innovation.

The New Club of Paris (NCP) is a global network organisation working as an *agenda developer* for knowledge societies. Established in 2006, its goal is to help countries, regions and organisations make the transition to a knowledge society. The NCP does not provide answers, but develops frameworks for asking powerful questions. Clear metrics and cutting-edge research are part of their arsenal of instruments, and its members have extensive experience with using intellectual capital instruments. Building on this experience, and based on lessons garnered from many decades of members' practice, the NCP has been successful in developing effective instruments for innovation in knowledge societies, using research and metrics to support processes of engagement, participation and change. To address the challenges of accelerating innovation in pioneering regions, the NCP proposes a focus on practical actions, applying existing knowledge and change methodologies in supporting regions to address actual and pressing issues. They suggest that regions can create ramps for societal innovation, using co-creation principles to prototype processes that can already provide societal outcomes even as they develop. Diverse change technologies are available for the ramp, focusing on practical actions such as:

- engaging key players in the ecosystem;
- creating awareness, interest and conditions to 'go beyond';
- enabling deeper understanding of issues, broader societal contexts, opportunities and possible consequence of choices;
- closing the gap between talking, thinking and theory by probing, prototyping and practice;
- creating fast cycles of prototypes for rapid realisation.

Specifically, a region would be able to work towards developing a *culture of innovativeness* driven by entrepreneurial spirit, thus creating conditions for key entrepreneurial processes such as exploring, discovering, and pioneering to succeed. Within this culture, the engagement of stakeholders in participatory processes is central. This could be accomplished in a prototyping context, accelerating the process of engaging stakeholders and citizens, taking advantage of existing investment choices, reducing political risk and industrial lock-in, and speeding up the learning process. The movement from intent to implementation can be conceptualised as a possible 1-year work process to take intent to implementation (Table 2). In this process, the ramp is both a conceptual — but also a physical and virtual — location where both work place and work process facilitate people to focus on the nuts and bolts of concrete experimenting [8].

Table 2: Possible 1-year work process to realise pioneering innovation regions in practice

| 90 day start-up process to create the societal innovation ramp | | | | | 9 month follow-through |
|---|---|---|---|---|---|
| Engaging stakeholders | Mapping the context | Exploring the context to understand the challenges | Reframing issues and problems | Creating the ramp | Harvesting ideas and energy for fast prototyping, rapid realisation and early results |
| Weeks 1–2 | Weeks 2–4 | Weeks 5–6 | Weeks 7–9 | Weeks 9–12 | Weeks 13–52 |
| Focused conversations | IC mapping | Round table | ACSI Societal Innovation Labs | Future Centre sessions | Diverse follow-through activities and many fast prototypes: ACSI camps & SI Labs, Future Centres / Living Labs |
| Issues & ideas | Navigational markers: where we come from, where are we going | Preparing the agenda | Energise people & reframe the challenges | Preparing for enacting the decisions | Prototyping and testing promising solutions, working in innovation networks and communities |
| Regional and external actors and stakeholders | | Key decision makers and entrepreneurs | Local and external experts | Regional and external actors and stakeholders | Directly involving all regional stakeholders in the RIE |

**A renewal process for regions**

In a 12-month process to pioneer regional innovation in practice, regions could consider the following.

- Create focused *conversations* to stimulate 'thinking beyond' and energise entrepreneurial spirit.

  The focused conversation is being used in the Skåne Region of Sweden to address issues of the innovation economy in such a way that Skåne can better focus on the opportunities and challenges in its work, and ask and explore the questions required to help realise its ambitious vision. The conversation is aimed at moving participants beyond their usual ways of looking at innovative regions, the knowledge economy, their own aims and ambitions, and what may be needed to achieve the region's goals. It is a process of pre-thinking issues, objectives and challenges: not simply talking about the next brain park or innovation centre one could establish, but looking beyond today's dominant logic, yesterday's decisions and participants' personal beliefs into what different futures may hold.

- Change the narrative through enhanced awareness of context and issues, based on *intellectual capital mapping and forecasting*.

  The National Intellectual Capital (NIC 40) index and books, researched and written by NCP members, use IC metrics and mapping to understand the dynamics of change that regions undergo. Intellectual capital describes the source of the competencies and capabilities deemed essential for national economic growth, human development, and quality of life. The results of national level intellectual capital studies and ranking provide a direction for nations — and clusters of nations — to benchmark and to make wise decisions for the effective investment of intangible assets and their development in the era of the knowledge economy. The index gives statistically validated reports on intellectual capital indicators for 40 countries, based on research findings of 14 years: it identifies intellectual growth patterns and details about the impact and implications of these patterns for innovation, business creation, competitiveness, growth, and development [9].

- Organise *regional round tables* to help decision-makers and key stakeholders to interpret the maps and metrics, and more clearly understand the potential impact of policies, technologies, and strategic choices.

  The round table process consists of a dialogue between local and international experts in knowledge policies and decision-makers. Experience shows that this kind of dialogue enables relevant issues for the continuing transformation of a region into a knowledge society to be identified and

prioritised. Recommendations can be proposed and discussed in terms of suitability and practical implementation. Finland was the first country to organise a round table with the NCP (in 2005). This process, documented in the report *Five Steps for Finland's Future*, contributed to a knowledge-minded innovation programme inspired by its recommendations. Since then, NCP round tables have been held in Morocco, Serbia, Malaysia and Austria, and a bilateral round table between France and Germany is currently running.

- Use *ACSI camps* and *regional SI Labs* to engage citizens, researchers and experts to work collaboratively on reframing issues and creating early prototypes.

  ACSI is an action-learning camp addressing societal concerns in a new and highly effective manner: it initiates a 12-month process empowering people and organisations to think and act in concert, applying innovation skills and mindsets to address challenging real-life issues. Participants create a shared understanding of how opportunities for societal innovation emerge and how to use them constructively. Methodologically, ACSI acts through the *Knowledge Triangle*, combining research, education and innovative practice to develop prototypes for systemic societal renewal. The goal is to break new ground and transcend traditional (social and societal) borders to create new ways of thinking about the issues addressed. Integrating students, researchers, innovators, artists, and working life experts from various disciplines and many countries creates synergies and multi-perspectives leading to new ideas. The core of ACSI is an 8-day camp that has been organised three times in Finland, and will move to Sweden this year. Short forms called Societal Innovation Labs (SI Labs) are being prototyped in South Africa and other locations. These 3- and 4-day labs focus on developing the mindset and skills needed for pursuing systemic change.

- Make use of *innovation-enabling environments* such as *future centres* and *Living Labs* to directly involve key stakeholders in addressing issues, prototyping promising solutions, and testing them in practice.

  These innovation-enabling environments are facilitated working and meeting environments that help organisations to prepare for the future in a proactive, collaborative and systematic way. They provide facilitated high-tech/high-touch environments to create and apply knowledge, develop practical innovations, bring government in closer contact with citizens and connect end-users with industry. Their core business is engaging stakeholders in developing innovative solutions to challenging business, organisational or societal problems. People are central to this solution-seeking process. Future centres typically deal with the development of new visions, policies, products and services, translating strategic goals and intentions into actionable plans, and creating breakthroughs in stuck situations. They stimulate cooperation *within* and *between* organisations, enhance open innovation and participative design through collaboration with citizens, end-users, and stakeholders, and provide process space to test prototypes in practice.

Such a process could help regions to move decisively from strategic plans to strategic action. It would create early exemplars of successful practice, using research and knowledge to tackle societal challenges at the regional and local level, and contribute to helping Horizon 2020's three-pillar focus to achieve its promise of strong societal impact.

During the EPP (European People's Party Group)/CoR Open Days seminar on the importance of innovative regions and cities for territorial development, attended by more than 150 participants in October 2012, presentations described relevant factors for maintaining open innovative regions. Michael Schneider, President of the EPP Group of the Committee of the Regions, set the tone when he stated that 'to reach the Europe 2020 targets, increasing bottom-up collaboration is a must … Piloting and experimenting, entrepreneurial discovery and societal innovation all have their role to play'. He concluded by saying that 'further policy development must be based on shared ownership and integrating political decision-makers'. Speakers emphasised that Europe needs pioneering regions and cities. Entrepreneurial spirit, open innovation, and cooperation between different sectors are vitally important to achieving the targets of Europe's 2020 strategy. The NCP ideas resonate strongly with these sentiments.

The seminar pushed the boundaries of traditional gatherings by encouraging collaborative participation through a 'Meshmoon' virtual world, developed for use in Finland's Energising Urban Ecosystems

programme (Figure 1). Participants were given the opportunity to interact with and prioritise seminar conclusions. They strongly supported the notion that practical work processes need to directly involve all relevant actors for open innovation to be a success. Participants concluded that 'an innovation culture is essential for successful open innovation — equally as important as the focus on technology.' In the words of Gohar Sargsyan, Senior Member of CGI Group Inc. and Steering Committee Member World Smart Capital: 'Think big, start small, accelerate fast.'

Figure 1: Virtual world for real-time workshop participation


Building this innovation culture by leveraging the entrepreneurial spirit of Europe's pioneering regions and directly engaging the diverse stakeholders of the innovation ecosystem in the practice of innovation is certainly one important step on the way forward.

## *Espoo T3: Implementing the Knowledge Triangle in regional innovation ecosystems*

**Knowledge Triangle**

The CoR proposes five specific measures to be applied as widely as possible in Horizon 2020 programmes. One of these is the 'Knowledge Triangle', which should be one of the key principles throughout the entire Horizon 2020 programme, not just in the European Institute of Innovation and Technology (EIT). Each project should plan activities to implement the 'Knowledge Triangle.' This Knowledge Triangle (KT) — focusing on creating more synergy between research, education and innovation — has already been on the educational policy agenda for several years, but what does it mean in practice? The European Council, in its conclusions of 26 November 2009, stated the following regarding the development of the role of education in a fully functioning Knowledge Triangle:

'If the European Union is to be equipped to meet the long-term challenges of a competitive global economy, climate change and an ageing population, the three components of the knowledge triangle must all function properly and interact fully with each other.'

The conclusions urged the EU and the Member States to establish the following seven priorities for action.

1. Developing more coherence between policies in the field of education, research and innovation.
2. Accelerating pedagogic reform.
3. Partnerships between universities and business and other relevant stakeholders.
4. Measures to develop an innovation culture in universities.
5. Creating incentives for universities to develop transferable knowledge.
6. New approaches to quality assessment.
7. Developing the EIT as a model for the future.

Aalto University, together with CESAER and EUGENE [1], organised several workshops to review the experiences of applying the KT principles in practice in 2011–12. According to the CESAER policy paper *Stimulating the Modernisation Agenda for Research and Technology* [10], the KT means special emphasis on new developments and more impact in:

1. value creation based on better use of intangible assets;
2. new processes and methods for university–industry collaboration;
3. systemic change: focus especially on societal innovations.

CESAER defined 12 principles and practices in more detail under these three headings. The most relevant with respect to this article are now summarised.

There is a need for dialogue and sharing expertise, and through that for the modernisation of the triple helix model. The new learning environment is based on a culture characterised by learning and working together, and by research, development and innovation. Students need to be motivated to think outside of the box, and take initiative and responsibility for collaborative learning. Bringing together theory and practice is essential in implementing the Knowledge Triangle.

Supportive structures and funding are basic enablers of innovation in university–industry collaboration. Bring together students and companies and create an interdisciplinary culture where dialogue and new thinking can take place. Provide places and opportunities for co-learning and create facilitator roles. The entrepreneurial mindset should be promoted throughout all learning environments, teaching methods and practices at the university, and it must be integrated with all activities — for students, staff and faculty.

The major issue in promoting an entrepreneurial mindset is attitude. An entrepreneur is an innovator, creating something new and making things happen. This requires high ambition, motivation, positivity and risk-taking. This also requires the renewal of operational culture and procedures, especially when it comes to enhancing synergies between research, education and innovation activities, and to significantly strengthening collaboration with other actors of the society. Innovation activities embrace not only corporate and organisational processes, product and service innovations, but also societal innovations. In societal innovations, there is always a structural or systemic dimension, influencing societal operations on a large scale.

**The Espoo T3 regional innovation ecosystem**

The most visible example of new innovation-focused developments in the Helsinki Region is the Otaniemi–Tapiola–Keilaniemi area, which is known as T3: science (Tiede) in Otaniemi, art (Taide) in Tapiola, and business (Talous) in Keilaniemi. Already, about half of all the high-tech innovations in Finland originate in the T3 area, which is also called the 'Innovation Triangle'. The international success of individuals and companies in T3 is of paramount importance for Finland as a whole. Huge investment — an estimated EUR 5 billion within the next 10 years — is taking place in the area.

Today, T3 is also northern Europe's largest science and technology centre, accommodating more than 30 000 professionals and students in the field of technology. In addition, there are more than 5 000 researchers and more than 800 companies located in the area, including the global headquarters of Nokia, Kone, Neste Oil, Rovio, Fortum and Huhtamäki. Microsoft, DuPont, Bayer and Nissan are just some of the more than 100 foreign companies based there. Furthermore, Otaniemi — with the Aalto Venture Garage and Start-up Sauna — is a booming location for start-up companies.

In 2009–10, the City of Espoo concluded an extensive expert study, *The Well-Being of the Metropolis*. The study explored how human potential, every region's primary resource, could be developed and utilised in a sustainable way. One of the key questions was: how can we further develop the main responsibility of the state or, in many cases, the municipality, to identify and unleash hidden and essential resources such as individuals' time and interests?

This study, together with other regularly defined competitiveness strategies of the Helsinki Metropolitan Area, contributed to conceptualising the EUE research programme. The Helsinki Metropolitan Area is clearly a knowledge hub: this is indicated by several international benchmarking studies and rankings. However, other well-known examples of such hubs are stronger than the Helsinki Region in terms of resources, population numbers as well as location.

(1) CESAER is a not-for-profit international association of leading European universities of technology and engineering schools/faculties at comprehensive universities and university collages. EUGENE is a thematic network aiming at improving the impact of European engineering education (EE) on competitiveness, innovation and socioeconomic growth in a global context.

The active agents of the metropolis constitute its innovation ecosystem. It is, above all, a localised network of actors, one where new ideas emerge and organisations are hosted to put them into practice. The innovation ecosystem has two interconnected characteristics. It offers the services and partnerships required for developing successful innovation activities. In addition, it offers a rich community of skilled people who can create new ideas and develop them into practical solutions.

Conceptualising Regional Innovation Ecosystems (RIE) is a way of understanding and strengthening the region's ability to nurture new innovation and strengthen competitiveness. Companies that commercialise innovations are one of the main actor groups, but they are not the only one. The various RIE actor groups can best be described as diverse researcher networks, developer networks, user networks and producer networks, all of which are needed in order to quickly produce and spread new competitive products and services, and push other innovations to market. Municipalities — especially when creating prosperity in an economically and ecologically sound way — no longer function primarily as service providers, but operate as enablers of innovative reforms and developers of renewal capital.

Applying the KT principles in practice has shown that the following elements are essential in creating regional innovation ecosystems: shared vision, a favourable atmosphere for discovery and entrepreneurship, collaborative learning and knowledge co-creation, joint concepts and mental models, a systemic culture of change management and orchestration, motivating users as innovators, commitment to long-term change, accepting even radical innovation, piloting and rapid prototyping, and the optimised full use of digitalisation as an all-permeating resource.

The orchestration of knowledge, skills, competencies and activities is needed to coordinate complex projects and create new innovation capabilities. Advanced leadership and managerial competences are needed to orchestrate interdisciplinary, intersectoral and intercultural communities. Bottom-up (instead of top-down) and user-centred thinking boosts innovations and enables the implementation and dissemination of innovations. This clearly opens a new and challenging role for universities: to take a key position in orchestrating such interactive processes and involve all actors of the triple helix in a balanced way.

## *Finland's EUE research programme*

**Ambitious first-year challenges**

Finland's Energising Urban Ecosystems (EUE) programme has brought together a broad group of researchers, innovators, business interests and civil sector participants to pursue its ambitious objectives. This 4-year research programme, organised through RYM SHOK, the Strategic Centre for Science, Technology and Innovation for the Built Environment, is a EUR 20 million programme financed 50 % by industry and 50 % by Tekes, the Finnish Funding Agency for Technology and Innovation. It brings together cross-sectoral, interdisciplinary research teams to study, develop, deploy and test hypotheses, in this way accumulating knowledge for joint outcomes. The EUE programme model, with four interlinked work packages, is an example of a functional, scientific co-creation process, utilising participatory research design to create industrial added value, thus addressing EU and global strategic needs. Preliminary plans for this programme were described in our 2012 yearbook article [5].

The research case is the T3 area in Espoo, Finland's most significant concentration of innovation activity and an ideal landscape for prototyping potentially valuable innovation methodologies and technologies in real-life test beds. Within the EUE programme, the RIE work package has brought together diverse technologies and methodologies for new urban design and development. In this innovation-enabling environment, the EUE programme can demonstrate how to effectively implement the key enabling success factors of the Europe 2020 strategy, and how an updated triple helix model supported by the Knowledge Triangle approach can enhance collaboration between the city, universities, research institutes and diverse enterprises throughout this regional innovation ecosystem.

The EUE programme has been under way since May 2012 and has moved forward in a number of ways, including its scientific research on regional information modelling integrated with virtual reality applications. In so doing, the EUE programme is addressing the CoR's request presented in its Opinion on the Digital Agenda for Europe. The CoR called for new concepts of Building Information Modelling (BIM) to be extended to regional and urban planning. The CoR pointed out that the new developments could serve as a shared knowledge resource for an area, forming a reliable basis for life-cycle analysis, user-driven business process development and value-creating decision-making [11].

The EUE research programme is using cutting-edge techniques for spatial data acquisition. These are applied to, and combined with, concepts for a digital ubiquitous ecosystem in Espoo City T3 area. The target application will be a mobile and virtual smart city model with geospatial virtual knowledge elements. Specific attention will be paid to aspects of usability and innovative visualisation for various user needs.

By capturing the city's geometry and characteristics through laser scanning, the resulting model can be applied in an information modelling process to conduct different kinds of analysis. The virtual — possibly, photorealistic — models used as the basis for the regional information model create a virtual city, geometrically accurate and visually close-to-identical with the real one. This enables city planning, built environment and real estate management professionals, as well as decision-makers and citizens, to use the model for diverse purposes. An integral part of the ongoing RDI process is the Meshmoon online virtual reality hosting system, which is based on on-demand cloud-hosting technology and the open source realXtend Tundra software.

The EUE programme's initial results have also made diverse issues and challenges explicit. It is clear that one of the key challenges now is orchestration. Innovation in networks cannot always be managed: often orchestration — the process of creating conditions and support infrastructure whereby innovation can emerge and be sustained — is required. Many innovation management processes in organisations are reasonably well understood and documented, while the processes of orchestrating open innovation networks and innovation ecosystems are neither well documented nor understood adequately. The processes involved in creating, supporting and maintaining a regional innovation ecosystem in which diverse actor groups participate — large industries and SMEs, local municipality bodies, knowledge institutions with diverse researchers working in a range of different fields of expertise, and many other actors — are often complicated, sometimes complex, and need to be developed *in situ* as the ecosystem itself emerges.

**Orchestration is not the same as management**

As in many large innovation programmes, participating actors have the ambition to collaboratively create innovative products and services which can be applied locally and compete in global markets. In practice, however, participants tend to focus on their own tasks, sectors, organisations and disciplines, working to optimise their own work, often with inadequate attention for the work of network partners (in other work packages, and elsewhere in the ecosystem), who, on the surface, seem to be dealing with different issues altogether. The deeper the focus, the more difficult it is for results-oriented researchers and business interests to develop the trust, respect, and mutual understanding needed to overcome the effects of their working silos: inadequate communication, insufficient connection, ineffective search facilities. Typical problems encountered are that the entire ecosystem suffers from their inability to find answers to questions that their network partners have already answered, and that the wheel is too often reinvented. All can benefit from support infrastructure and facilitation that enhances the required sharing of knowledge, resources and results. This is the primary task of good orchestration.

Orchestration is not the same as management. In an innovation ecosystem, it is not possible to *manage* many aspects of the innovation process. Orchestration is needed; this relates to both:

1. the capacity to create conditions where the diverse parties can work together with the right balance of inner and outer focus and, thus, reinforcing both their own work and benefiting the ecosystem as a whole; and
2. the provision of supporting service infrastructure to help sustain effective operation within the system.

One needs to know how to organise the right methods, tools and facilitation processes to help projects and partners achieve their objectives. The methods may range from tools and technologies for creative problem-solving, user-centred co-creation, building synergies and breaking silos, to finding ways to deal with resistance to change and create breakthroughs in stuck situations. In addition, a systemic learning infrastructure is needed to ensure effective learning, and to facilitate entrepreneurial learning — the rapid application of lessons learned within the ecosystem so that projects and players can systematically benefit from each other's experience and expertise. Processes for benchmarking (accessing and applying relevant and inspiring lessons and good practice from diverse sources around the world) and bench-learning (a collaborative, symmetric learning process based on peer-to-peer exchange) are also essential.

Modernising the triple helix means engaging in a transformation process for the systemic development of regional innovation ecosystem. Orchestration activities should be developed up to the level of *smart orchestration*, which implies:

- active cross-sectoral communication to reduce overall ambiguity;
- coupling the sector-specific needs and requirements for a unified ecosystem structure; and
- leading the shared development of the pro-innovation culture and joint processes towards regional ecosystem excellence [12].

In practice, this refers to diverse skill sets, mentality issues, methodologies and tools, which need to be actively applied to orchestrate joint processes in the ecosystem. The processes, and especially those needed to build mutual understanding and trust, must be facilitated.

**An EUE innovation: the Urban Mill as an urban innovation and co-working platform**

One of the first visible outcomes of the EUE programme is the Urban Mill (UM) concept. The UM concept aims to become one of the most interesting global focal points for urban innovations. The UM started operations in January 2013 by connecting the core Finnish urban built environment innovation actors together. On the semantic level, the UM combines Research and Innovation Service (RIS) offerings and, on the pragmatic level, physical and digital SPace-as-a-Service (SPaaS) processes. UM activities are integrated into, and offered through, its 1 300 $m^2$ smart co-working space on the Aalto campus and its virtually tailored 3D mirrors.

From the research and innovation perspective, the UM connects four wide research domains, their actors and global networks. These domains are: (i) Built Physical Environments; (ii) Ubiquitous and Ambient ICT; (iii) Urban Services; and (iv) Human Life in Urban Environments. From the thematic innovation point of view, the UM's agenda is driven by its private and public partners' long-term strategic needs. The provisional innovation themes for the year 2013, based on a EUE feasibility study, are: (i) Shared resources and services; (ii) Sustainability issues of smart connected cities; and (iii) (Service) Innovation ecosystem leadership. The UM is not the main working location for its research partners. Actual research activities are networked to the UM and distributed from partner co-locations. Local research in the UM co-working environment is only carried out for special inter- and cross-disciplinary niche research questions, through trialogic co-creation events, and when validating research outcomes together with users and innovation and business communities.

The UM's operational concept brings together research institutions, enterprises, public bodies and individual people using or co-developing the services offered. From the institutional point of view, the UM conducts multifaceted quadruple helix collaboration, which is an enhanced triple helix process modification, in which citizens and other users of the urban environments are tied to the UM's research and innovation cycles in real city-life contexts and in different process life cycle phases. Enabling services of the UM support co-learning, co-design and co-effectuation. As a connected smart environment, the UM also acts as a supportive node for the thematic creative social networks of its users, and as a two-way interface to relevant macro-context digitally linked open data sources. This extensive connectedness supports space usage experiences and its users' own micro-context transformations before, during and after events held in its physical or virtual premises.

As a space concept, the UM represents contemporary holistic third generation science and innovation space-as-a-service thinking, which integrates thematic content communities with blended dual-mode (virtual/physical) spaces, and offers this whole-of-four as a productised flexible service for its owners, partners and networks. The UM is fully open and configurable for its owners and partners, and semi-open and flexible for its connected network actors, who are interested in joining and exchanging their contributions through this thematic focal point of people, knowledge and activities.

Physically, the Urban Mill is located in the same building complex as Aalto Design Factory (ADF) and Start-up Sauna (SS). Together, these three co-working spaces make up a physical Knowledge Triangle complex, with focused spaces for education (ADF), research (UM) and innovation (SS). All these places and their semantic agendas are led by multidisciplinary and multi-talented communities of practice, and collaboration on these premises is channelled through shared boundary objects. This fresh human-driven orchestration practice transforms the traditional institution-centred Knowledge Triangle approach into a human-driven Knowledge Pyramid trialogue [13].

**Relevance to Horizon 2020**

Thinking of the challenges of the CoR that Martin Curley and Professor Prahalad described at the beginning of this article, we see diverse aspects of the relevance of the EUE programme to Horizon 2020.

Professor Prahalad challenged universities to reframe their role in terms of innovation and value creation. This changing role is exemplified by Aalto University. In the EUE programme, we see how value can be co-created with customers and stakeholders, how the orchestration of support

infrastructure between participating partners can create synergies in using knowledge, skills, and resources to co-create value with customers, and how experience-centric models value creation can be applied.

Collaborative innovation goes beyond the scope of what organisations can achieve on their own, and Martin Curley challenged researchers and practitioners to actively integrate open innovation concepts with triple helix thinking in order to strive for structural innovation improvements through the proactive collaboration of industry, academia and government. This integration is embedded in EUE practice, where large and small firms, Aalto University, and the City of Espoo work closely together. Proactive collaboration is the promise of practice within EUE activities.

The CoR sees the challenge for local and regional authorities to develop cross-territorial and pan-European cooperation and, in particular, joint platforms, innovation forums and test beds for cooperation to foster open innovation and regional innovation ecosystems. Espoo's T3, with its integration of virtual and physical worlds in a street-side test bed, is an example of how this can be an effective tool for enhancing innovative capacity.

Looking at the relevance of the EUE programme to Horizon 2020, we see a number of important aspects, including:

1. the example of a pioneering innovation region: how to create and maintain an effective regional innovation ecosystem;
2. Espoo T3 as a test bed for specific innovative practices: developing realistic, close-to-the-street innovations in practice, with measurable effect on the lives of citizens and stakeholders;
3. many of the technologies, methodologies, working processes and collaboration models developed here can be applied in other European regions;
4. the scaling of relevant concepts, working processes, results, and research questions is possible: lessons learned here could become lessons to be learned elsewhere.

A unifying theme of the three challenges is collaborative cross-border innovation practice. Activities for crossing borders within the EUE ecosystem are essential ingredients of the RIE orchestration model, while pan-European cooperation and test beds can be addressed by the kind of scaling described below.

**The potential for scaling**

Scaling to other regions in Europe means co-creating opportunities for entrepreneurial learning among different regions. Three *workbenches* are relevant here: benchmarking effectiveness, bench-learning — which refers to learning together from work in progress — and bench-doing, which means addressing open questions proactively in jointly initiated projects carried out together.

Sharing work-in-progress with the aim of continuously improving work processes is a cornerstone of open innovation practice. Scaling of this kind requires partners in different parts of Europe with comparable ambitions around creating and maintaining regional innovation ecosystems. These would not be programme or project partners in the traditional sense, but rather partners in an international learning community focused on improving their own innovation ecosystems through collaboration learning. The EUE programme sees opportunities for its own programme for sharing knowledge about its processes with other partners in entrepreneurial learning relationships. These opportunities are also relevant throughout the diverse realms of Horizon 2020 and Cohesion Policy funding.

In considering scaling of this kind, there are two relevant aspects.

- What to scale: processes.
- What to learn: patterns.

In the EUE programme context, insights gained from the development and use of many work processes, methodologies and tools for creating and maintaining innovation ecosystems, for orchestrating support infrastructure, and for facilitating partners and internal processes, would be relevant for this kind of scaling and co-creative learning. In addition, specific technologies developed by various researchers and companies — even in beta versions — may be appropriate for scaling as well.

One of the potential benefits of this kind of scaling is the insight gained about the patterns of working with innovation processes. Once we understand and document the patterns emerging within the Espoo T3 innovation ecosystem, scaling to other regions would allow researchers to discover if the similar patterns apply, for example, in other regions of Nordic countries, or other European regions, or Europe as a whole. Are there typical Finnish, or Nordic, or perhaps European-wide patterns of innovation ecosystems, and what consequences do these have for our work?

Working with patterns is not a new phenomenon. Since the last century, the idea of identifying and using patterns of human and social behaviour has fascinated social scientists in diverse domains. There has been a lot of work done by systems-oriented social scientists in different domains to recognise and order patterns of human, social and societal behaviour. The work of anthropologist Alfred Kroeber in 1950s and 1960s argued in favour of distinguishing three levels of patterns:

- cultural patterns, describing behaviours manifested in local cultural situations;
- systemic patterns, that are broader normative patterns manifested in similar cultures and societies with shared historical roots;
- universal patterns, common to human cultures.

The work of Christopher Alexander on the pattern language of buildings and the built environment, first published in the 1970s, has influenced a generation of architects and planners, and inspired practitioners and researchers in many other disciplines to find and organise patterns in their fields. Software engineers have been very active in defining patterns and co-creating pattern languages relevant to diverse aspects of their work, including computer languages and man–machine interfaces. Economists regularly search for patterns to formulate and reinforce their theories, while some historians describe their work as the discovery of patterns that play a role in the rise and fall of societies and civilisations. Recent works by Jared Diamond, Ian Morris and Frances Fukuyama provide examples of this [14].

One example that recently surfaced in the EUE context concerns the challenges for scaling urban innovations, as reported in the recent work of Finland's City Innovations project [15]. Many of the challenges discussed mirror similar scaling issues relating to disseminating other kinds of innovations in other cultural contexts. Are these cross-cutting cultural patterns? If so, labelling them as such would provide relevant anticipatory power to projects working on urban innovation: if they often or always occur, what kind of measures can we take in advance to counter their effect?

Are there similar insights to be gained on how effective regional innovation ecosystems emerge, how to orchestrate them, how to anchor scientific excellence and industrial leadership in regional initiatives, what conditions further social and societal innovation, and how best to work collaboratively, across borders of all kinds, to address the Grand Challenges of Europe?

Research questions around the applications of pattern recognition and classification in cross-cultural innovation would provide much useful knowledge for cross-cultural and pan-European collaboration in this field. Horizon 2020 initiatives focusing on this could take our insights in regional innovation ecosystems further in the coming period.

### *The road ahead: focus on orchestration to increase the societal impact of research*

Orchestration is a key process for maintaining effective innovation ecosystems. Once actors are able to find each other, communicate effectively, and understand each other's questions, interests, and needs, trust and mutual respect can grow. Collaborative learning becomes possible, and the investment of time, effort and attention participants need to make in order for collaboration to be successful can begin to pay off. Support infrastructure — methodologies, technologies, tools, activities, and shared spaces (both physical and virtual meeting and co-working spaces) — are important to facilitate communication and to build shared understanding. An adequate orchestration toolbox contains concepts, methods, tools and interventions for use in appropriate situations: advanced search facilities for locating people, ideas, and resources; facilitation techniques — and facilitators — for enhancing productivity and innovation; systemic learning infrastructure for enabling entrepreneurial learning; enabling workspaces for enhancing collaboration; and rapid demonstration activities for showcasing research results. Rapid conducting is required to oversee the synergies between projects and activities, and to effectively target opportunities for increasing organisational impact, business potential and value creation. Rapid intervention will sometimes be required to allow internal work processes to run as effectively as possible: rapid problem-solving as first-aid in response to emerging issues and problems; and rapid problem-anticipation to anticipate potential obstacles and proactively help projects deal with them before they become problems. Together, this forms the basis for the support infrastructure that enables orchestration to increase the societal impact of research. And it belongs on the 'ramp for societal innovation' that is — or should be — part of every regional innovation ecosystem.

Beyond this, the right attitude is required, and diverse skill sets are needed for pioneering and discovery. Discovery skills as described by Dyer, Gregersen and Christensen (2009) form part of the creative intelligence of innovative entrepreneurs. These skills work together to create what the authors call 'the innovator's DNA' [16]. This idea

was used to design the original ACSI concept, and has been adopted in developing ACSI-style interventions for the EUE programme. Two additional aspects were added to the original five, creating the concept of an innovation dynamo to challenge the thinking of T3 ecosystem participants.

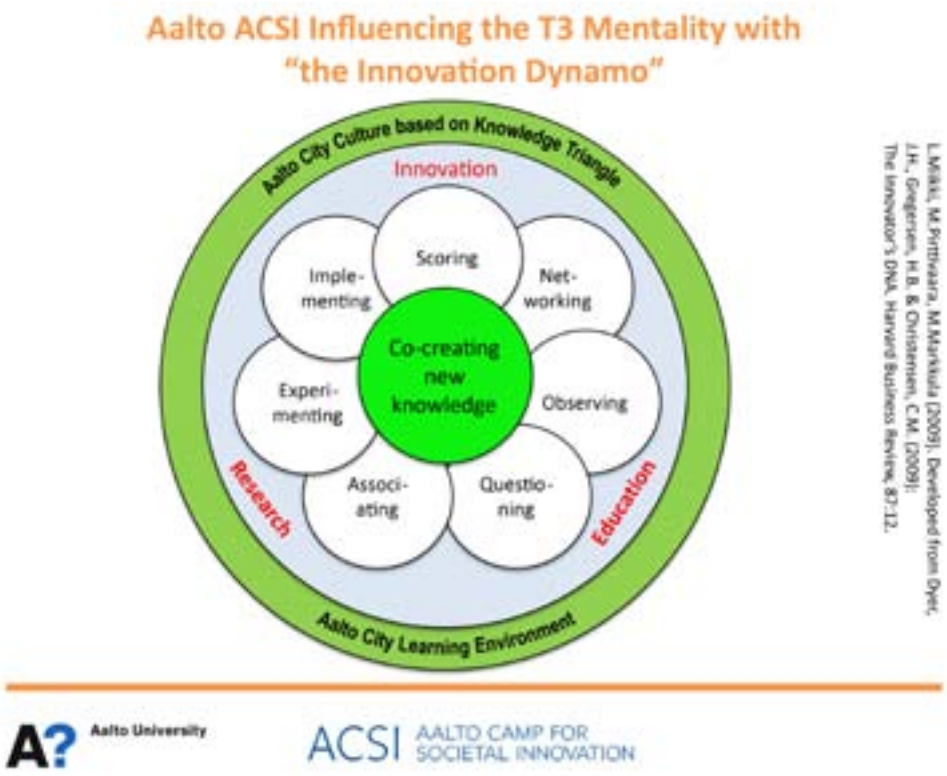
The Innovation Dynamo (Figure 2) harnesses the five discovery skills to two aspects of the innovation process essential to realising innovation in practice: implementing and creating impact.

- *Associating* is the ability to make connections, linking seemingly unrelated issues and ideas in new fruitful combinations.
- *Questioning* leverages the power of provocative questions to create new perspectives and modes of thinking.
- *Observing* is the key to understanding how things in the world work, and why people behave as they do.
- *Experimenting* means going with best guesses and not being afraid of failing your way forward. It is an essential skill of innovators.
- *Networking* allows us to tap into collective and distributed intelligence for insight, explanation, expertise, and inspiration, as well as critical thinking.
- *Implementing* is the litmus test for innovators — realising a good idea in practice.
- *Creating impact* — and *celebrating* it. This is the proof of the pudding: does a new product, service or realised idea actually create value for its users — and for the ecosystem? If it does, then we should celebrate it, making it clear to all those involved that this innovation works.

This is how the Innovation Dynamo generates innovation power and the energy required to maintain the ecosystem. Working with these skills, pioneering innovation regions are able to leverage their potential to create societal impact.

Changing mindsets is an important and often difficult aspect of the innovation process, but it is essential both on an individual and a collective level. Thinking in outcomes instead of outputs, and thinking in ecosystems instead of areas, is required for progress to be made and pioneering regions to prosper. Moving from proprietary ownership to open innovation, from personal interest to partnership, from following to initiating, from risk-aversion to experimentation — these are building blocks that the culture of innovation Europe is looking for, and which the Horizon 2020 programme hopes to achieve. They mark

Figure 2: The Innovation Dynamo



shifts in deep understanding that are necessary in order to create value in society.

Metaphors such as the Innovation Dynamo, the pioneering region, the ramp for societal innovation, the Espoo Innovation Garden (a 3-day EUE-related workshop held in January 2013), and the image of T3 as a 'lighthouse for innovative practice in Finland and Europe', are importance vehicles for creating shared stories of what is important in a region, and can help focus energy and attention. The innovation ramp feeds people, innovative impulses and engaged energy into the process. Test beds allow ideas to be tried and improved with the people they are intended to reach. Demonstrations of what projects are achieving — even if only a prototype, and far from complete — add excitement to the mix, and communicate to partners that *something* is happening.

Bringing people, programmes, and pioneering regions together is an important way to diffuse innovation expertise throughout Europe. Bench-learning and bench-doing will accelerate knowledge dissemination. Doing things on the right scale and in the appropriate place will allow regions to get the most out of future smart specialisation strategies. Scaling will provide insight into what is regional, national or transnational in innovation processes. Horizon 2020's focus on excellence allows vanguard regions to exemplify what is possible, and through its 'stairway to excellence' concept help other regions to benefit from effective research infrastructures and orchestration processes, in order to reduce the innovation divide.

These are some of the ways in which the challenges of the opening chapter — challenges relevant to pioneering innovation regions and innovation ecosystems across Europe — can be met.

## References


[1] EU Committee of the Regions (2011), Working Document on Horizon 2020, Rapporteur Markku Markkula, *Opinion CdR 402/2011*.

[2] Curley, M. (2012), Introduction, *Open Innovation 2012*, European Commission, p. 5.

[3] Prahalad, C. K., Krishnan, M. S. (2008), *The New Age of Innovation*, McGraw-Hill, pp. 1–25.

[4] Launonen, M., Viitanen, J. (2011), *Hubconcepts — The Global Best Practice for Managing Innovation Ecosystems and Hubs*, Hubconcepts Inc., Helsinki, p. 331.

[5] Markkula, M., Kune, H. (2012), 'Pioneering regions and societal innovations as enablers for the Europe 2020 strategy', *Open Innovation 2012*, European Commission, p. 56.

[6] Tuffs, R., Markkula, M., Hoyer, B. (2012), 'Workshop Horizon 2020 and Pre-commercial Public Procurement – Defining Key Instruments for the European Future', unpublished.

[7] EU Committee of the Regions (2012), 'Opinion of the Committee of the Regions — Horizon 2020', Opinion CdR 402/2011 final.

[8] New Club of Paris (2013), 'Implementing Pioneering Innovation Regions' (forthcoming, unpublished).

[9] Lin, C. Y., Edvinsson, L. (2011), *National Intellectual Capital: A Comparison of 40 Countries*, Springer.

[10] CESAER (2011), CSI — The CESAER SMART Initiative, *Stimulating the Modernisation Agenda for Research and Technology*.

[11] EU Committee of the Regions (2010), 'Opinion of the Committee of the Regions on the Digital Agenda for Europe', Opinion CdR 104/2010 final.

[12] Viitanen, J., Markkula, M., Ripoll Soler, C. (2013), 'The Changing Realities in the Systemic Development of Regional Innovation Ecosystems: From "Triple Helix" to RIE', forthcoming article in 'The Knowledge Triangle'.

[13] Mikkelä, K., Miikki, L. (2013), 'The New Role of Space in Implementing Knowledge Triangle', forthcoming article in 'The Knowledge Triangle'.

[14] Joustra, D. J., Kune, H., De Vries, C. A. (2011), *Pattern Language for Sustainable Spatial Development*, Report for the Dutch Ministry of Infrastructure and the Environment.

[15] City Innovations model (http://www.kaupunki-innovaatiot.fi/in-english).

[16] Dyer, J. H., Gregersen, H. B., Christensen, C. M. (2009), 'The Innovator's DNA', *Harvard Business Review*.


## Contact


**Markku Markkula**
Advisor to the Aalto Presidents, Aalto University
Committee of the Regions, Member, Chair
EPP/CoR Task Force Europe 2020
markku.markkula@aalto.fi

**Hank Kune**
Director, Innovation and Enterprise, Educore
Founding Partner, Future Center Alliance
hankkune@educore.nl

## 3.7. FI-WARE Open Innovation Lab: innovation-enabling capabilities for third parties on the Future Internet

### *Overall context*

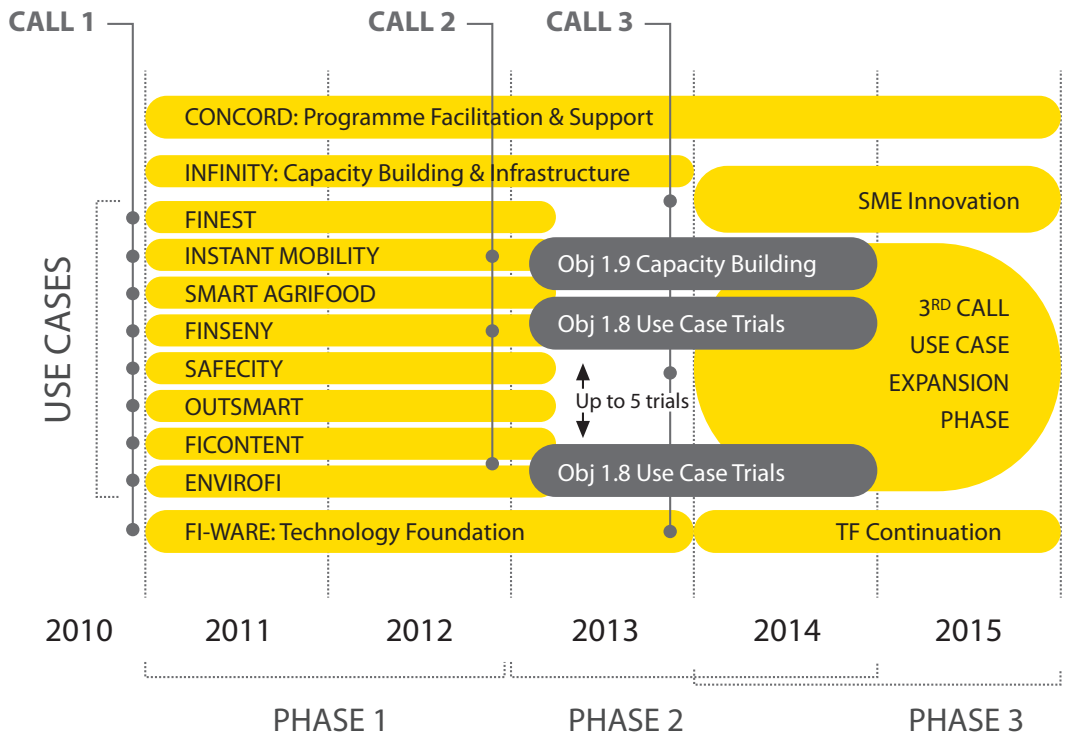
Over the last years, the European Commission has funded a myriad of R & D projects that fall under multiple areas. Within the specific domain of ICT, projects have traditionally focused either on very specific technological fields or on sectorial aspects. In both cases, the success of these initiatives has been poor if we measure them on the basis of bringing value to the market. And it is true ... it is not easy to bridge the gap between research and innovation. Many consortia have come up with particularly good protocols, hardware or software systems, and new paradigms ... to name just some categories of possible results. Nevertheless, very few of these groups have made a real impact outside the papers. This *impact* factor has become crucial in order to assess the performance of research projects. This is not only important in order to show evidence of an appropriate way of spending public money in research activities, which can be a need for public institutions, but also to demonstrate that organisations involved in those projects make good use of those resources to become more competitive.

### *Future Internet PPP: an opportunity to reinforce European competitiveness*

Precisely because of the crisis and the increasing importance of gaining competitiveness, the EC launched, at the end of 2008, several initiatives known as PPPs (public–private partnerships). One of these relates to Future Internet technologies. Its main goal is to improve the competitiveness of European companies in two ways: make Europe a leader in the technology as such (more information about specific technical domains follows) and significantly improve the positioning of EU companies in sectors such as transport, urban security, environment, logistics, media, agri-food and energy by adopting such technologies and maximising the use of the Internet as a new framework in which to do business.

The FI PPP programme [1] will run for 5 years with projects selected through three calls for proposals that establish the major phases of the initiative. Figure 1 shows the structure of the projects and their execution in this context.

Figure 1: Structure and timing of the FI PPP [1]



We are now approaching the end of the first phase, where the set of coordinated projects should provide: (i) the definition of requirements from the different sectors that could benefit from the use of Future Internet technologies; (ii) the specifications of the capabilities that are specific to an application domain; (iii) the specifications of the capabilities that could be considered horizontal to the various sectors; and (iv) the implementation of basic functionalities that could be considered core enablers (either hardware or, mainly, software) to generate innovation in those sectors.

Sectorial projects, known as Use Cases, are contributing to the first and second points, while the so-called Future Internet Core Platform is mainly responsible for the third and fourth points.

The Future Internet Core Platform ([1]), from now on referred to as FI-WARE [2], is the major building block of the FI PPP programme from the technological point of view. FI-WARE is intended to answer the needs of European companies in a new ICT landscape that can be a great opportunity if it is well understood or a source of death in the business context if companies do not manage to adapt to the new market conditions. Some of the trends that have guided FI-WARE in its conception include:

- the flexibility introduced by cloud computing and open service delivery platforms, which have changed provisioning models to on-demand, pay-per-use, XaaS (Everything-as-a-Service) models;
- communication technologies, including both the core and the access networks, especially in what concerns the bandwidth of mobile networks;
- the Internet of Things (IoT), as a phenomenon where physical and virtual worlds meet, enabling an explosion of potential applications; and, finally,
- one of the consequences of having everything connected to everything, things and humans, either through sensor networks, social networks or any other physical or virtual mechanism … the challenge of Big Data or, in other words, how to manage, store, and process the huge amount of data generated by multiple sources if their variety, velocity or volume cannot be treated with state-of-the-art technologies.

All these trends have led FI-WARE to define a technology ecosystem that capitalises on major European achievements in those areas in order to **strengthen enabling innovation capabilities.** It is not by chance that we have selected these words.

- *Strengthen innovation:* FI-WARE is not a pure research exercise, not even an initiative to develop technology: FI-WARE should enable business out of research. The close collaboration with Use Case projects will facilitate the understanding of the real needs of users. Involvement of users in the development cycle from the very beginning was already anticipated by the Living Labs methodology as a key success factor [3] [4] [5].
- *Enabling capabilities:* FI-WARE will provide the basis for others to participate in the ecosystem. It provides the main building blocks, but its openness will allow other ICT players to contribute to further developments on top of those pieces and furthermore, will act as engine for companies outside the ICT sector (the aforementioned representatives of main industrial sectors in Europe) to innovate through Future Internet-enabled applications and services.

### *A deeper look at FI-WARE concepts*

FI-WARE will be open, based on elements called Generic Enablers (GEs) which offer reusable and commonly shared functions serving a multiplicity of Usage Areas across various sectors. It is the ability to serve a multiplicity of Usage Areas that distinguishes GEs from what would be labelled as Domain-specific Common Enablers (or 'Specific Enablers' for short), which are enablers that are common to multiple applications but all of them specific to a very limited set of Usage Areas.

Key goals of the FI-WARE project are the identification and specification of GEs, together with the development and demonstration of reference implementations of identified GEs. Any implementation of a GE comprises a set of components and will offer capabilities and functionalities which can be flexibly customised, used and combined for many different Usage Areas, enabling the development of advanced and innovative Internet applications and services. The FI-WARE architecture comprises the specification of GEs, relations among them and properties of both.

The technical chapters currently covered by this initiative and a brief description of those are depicted in the following.

- Cloud Hosting — the fundamental layer which provides the computation, storage and network resources, upon which services are provisioned and managed.

([1]) Future Internet Ware or FI-WARE is an IP project funded by the EC under the topic FI.ICT-2011.1.7 Technology foundation: Future Internet Core Platform of FP7-2011-ICT-FI. It is coordinated by Telefonica and involves major European telecommunications operators and IT companies. The project started in May 2011 and will run for 3 years. Further information is available on the project website (http://www.fi-ware.eu/).

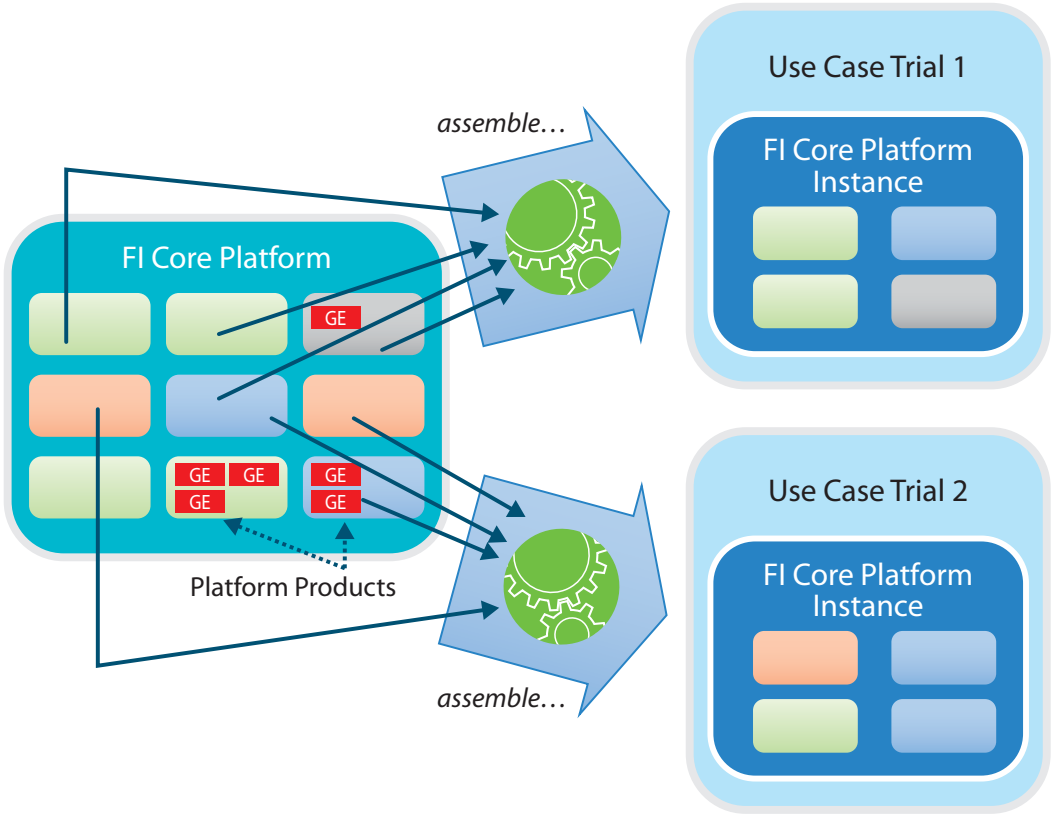
- Data/Context Management — the facilities for effectively accessing, processing, and analysing massive volume of data, transforming them into valuable knowledge available to applications.
- Applications/Services Ecosystem and Delivery Framework — the infrastructure to create, publish, manage and consume FI services across their life cycle, addressing all technical and business aspects.
- Internet of Things (IoT) Services Enablement — the bridge whereby FI services interface and leverage the ubiquity of heterogeneous, resource-constrained devices in the Internet of Things.
- Interface to Networks and Devices (I2ND) — open interfaces to networks and devices, providing the connectivity needs of services delivered across the platform.
- Security — the mechanisms which ensure that the delivery and usage of services is trustworthy and meets security and privacy requirements.

For any stakeholder interested in contributing or using FI-WARE technology, the most relevant aspects to keep in mind are: (i) FI-WARE provides open specifications (meaning that anyone can provide implementations of those specifications apart from those reference implementations provided by the FI-WARE partners, therefore avoiding vendor lock-in); (ii) FI-WARE promotes interoperability through standardised application programming interfaces (APIs) that should ease work of application developers in the Future Internet context; and (iii) FI-WARE is the only initiative supported by major telecommunications and IT vendors in Europe that fully exploits the convergence between technical pillars such as cloud computing, the IoT, networks, data and services, providing a single entry point to a huge spectrum of development resources, open to a wide community with the main goal of serving as innovation catalyser.

Not all GEs have to be used together: for a specific organisation, it could be more interesting to use a combination of some GEs from cloud computing and FI-WARE together with some GEs from the IoT. This leads to the concept of an FI-WARE Instance, which refers to the deployment of a set of GEs. The FI-WARE consortium is committed to providing a FI-WARE Instance that includes all the GEs defined by the open specifications. This complete FI-Ware Instance has been called the FI-WARE Testbed to illustrate its nature as experimentation platform.

The FI-WARE Testbed, however, will briefly be open to third parties through the innovation ecosystem coined as the Open Innovation Lab.

Figure 2: FI-WARE Instance [2]



### *The Open Innovation Lab: innovation-enabling capabilities for third parties*

If we come back to the motivation of the FI PPP in general, and FI-WARE in particular, we are obliged to make a critical analysis of how feasible it is that the joint effort of major stakeholders in Europe ends up in increased competitiveness of European companies in ICT, as well as in domains like transport, energy or smart cities, to name a few.

There are some elements that will have a clear impact on this goal.

- **Benefits and competitive advantage of the results with respect to existing solutions in the market**: the first condition for Europe is that the technical outcomes of this initiative are excellent and can be considered attractive by the different targeted communities.
  - FI-WARE has carried out a deep analysis of the market and has defined the value proposition of the expected outcomes. The technical roadmap does not only address current bottlenecks at technical level, but also the needs and requirements of the Usage Areas, as immediate users of the solutions.

- **Conditions under which results can be used**: this leads us to the critical point of openness. Open and interoperable solutions are a must to succeed in the current environment. Furthermore, licences and pricing schemas have to be very clear, as well as any dependence that may arise when using these components, including sustainability. All this differentiates this initiative from usual R & D projects funded by the EC so far, since it gives priority to market adoption and the usage of results. It implies the clear definition of *terms and conditions* as well as business models, going further than ever in the commercialisation of results.
  - Each of the GEs specified by FI-WARE is accompanied by clear information on terms and conditions. This is ongoing work for which user feedback will be extremely valuable.

- Sometimes, technical added value is not enough to convince others. The aforementioned GEs and the ecosystem could be conceptually relevant as an engine to promote innovation, but besides the commitment of the leaders (companies involved from the very beginning in FI-WARE) there is a clear **dependency on the community of supporters, including collaborators/contributors and users**.
  - Involvement of users in early phases appears to be of utmost importance. Besides an intense marketing campaign, a closer relationship with third parties will be needed. The instrument that has been defined by FI-WARE to achieve such relationship is the **Open Innovation Lab**.

The Open Innovation Lab is, as the name says, a 'place' where any organisation interested in the Future Internet will have access to all of the results of the FI-WARE initiative and will have the mechanisms to test the technology, provide feedback and actively participate in the subsequent versions of the technological framework. Interested parties will receive guidance and will be provided with incentives to make use of the FI-WARE GEs.

From a technical point of view, the Open Innovation Lab will be the FI-WARE Testbed, but open to third parties (anyone who has an interest without any restriction of being a partner of any project or programme whatsoever). The technical facilities will be accompanied by the necessary tools and mechanisms to facilitate setting up and running experiments as well as to better understand the possibilities of the technology to foster innovation in different business environments.

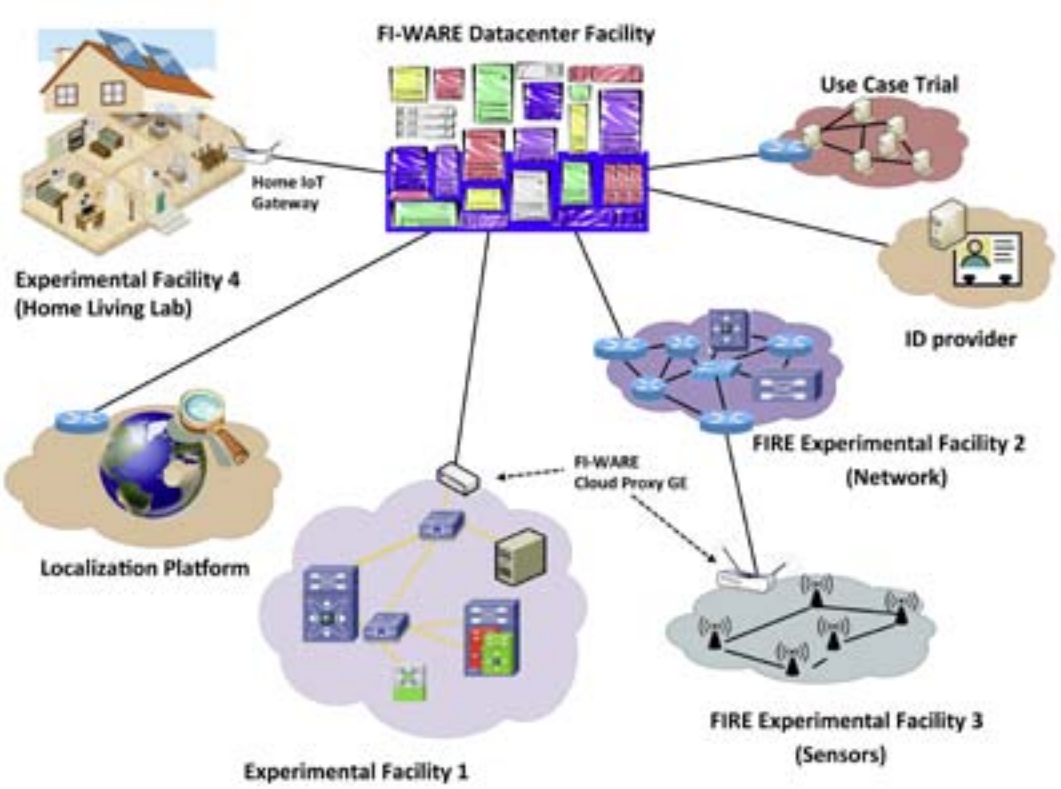
The FI-WARE Testbed is a complete FI-WARE Instance, meaning that it will comprise reference implementations of the all the GEs defined in the FI-WARE Architecture.

The FI-WARE Testbed's main basic infrastructure will be hosted by a centralised dedicated data centre following industrial principles of operations, where FI-WARE partners could be involved as well as external organisations; negotiations will always be driven by the benefits of the approach for the users and external parties, providing maximum guarantee for service provision.

In the course of the coming months, it is expected that the Testbed will benefit, as needed, from external facilities such as those provided by FIRE ([2]), in an attempt to take advantage of other research activities supported by the EC. Figure 3 illustrates the basic topology of the FI-WARE Testbed with the envisaged relationships to other experimentation platforms.

([2]) FIRE is an initiative at EU level that intends to create a multidisciplinary research environment for investigating and experimentally validating highly innovative ideas for new networking and service paradigms. FIRE promotes the concept of experiment-driven research, combining academic research with the wide-scale testing and experimentation that is required for industry. FIRE works to create a European Experimental Facility, which is constructed by gradually connecting and federating existing and upcoming test beds for Future Internet technologies.

Figure 3: FI-WARE Testbed: overall topology [2]




## *Where are we now? Next steps*

This article describes an ecosystem that will offer innovation-enabling capabilities to any stakeholder interested in gaining the maximum advantage of Future Internet technologies.

The business environment has dramatically changed, driven by the possibilities of a new ICT landscape. Those who are not able to adapt to such context will suffer the consequences to the point that they may not even be able to compete in the market anymore.

This has already happened to many companies. This has already affected many industrial sectors. It is, therefore, a need and not an option.

FI PPP and FI-WARE specifically offer Europe a great opportunity to invest in long-term added-value assets that will allow Europe to gain competitiveness again and make an impact on our economy.

It is not an easy endeavour though, and will require the following, among other things.

- **Leadership** and commitment, accompanied by technical excellence.
- Definition of the right **incentives to promote the usage of results** before they become fully operational. This may entail supporting measures such as the incentives governments are putting in place to foster open data or pre-commercial procurement to enable faster adoption of cloud computing. These two examples could inspire actions in this domain.
- Convincing messages on **benefits for all the involved stakeholders including, and in particular, SMEs**. This initiative is justified if it reaches critical mass. Therefore, it is required that this community pays careful attention to the multiplying effect that capabilities to generate Open Innovation could have on third parties. As many experts declare [6] and experience shows: **the more open the scenario is, the more innovation and growth we will achieve**.

## References

[1] http://www.fi-ppp.eu/

[2] http://forge.fi-ware.eu/plugins/mediawiki/wiki/fiware/index.php/Main_Page

[3] European Commission former Directorate-General for the Information Society and Media, Unit F4 New Infrastructure Paradigms and Experimental Facilities (2009), *Living Labs for user-driven open innovation — An overview of the Living Labs methodology, activities and achievements*.

[4] http://livinglabs.mit.edu/

[5] ISTAG EAR working group report, *Involving users in the development of Ambient Intelligence* (http://www.cordis.lu/ist/istag.htm).

[6] IBM Global Business Services (April 2010), *Telco 2015 — Five telling years, four future scenarios*, IBM, NY.

## Contact

**Nuria de Lama**
Atos Representative to the European Commission, Atos Research and Innovation
Nuria.delama@atosresearch.eu

European Commission

**Open Innovation 2013**

Luxembourg: Publications Office of the European Union

2013 — 107 pp. — 21.0 × 29.7 cm

ISBN 978-92-79-25864-0
doi:10.2759/87245