When large companies build ecosystems, should small companies join? A role for open innovation

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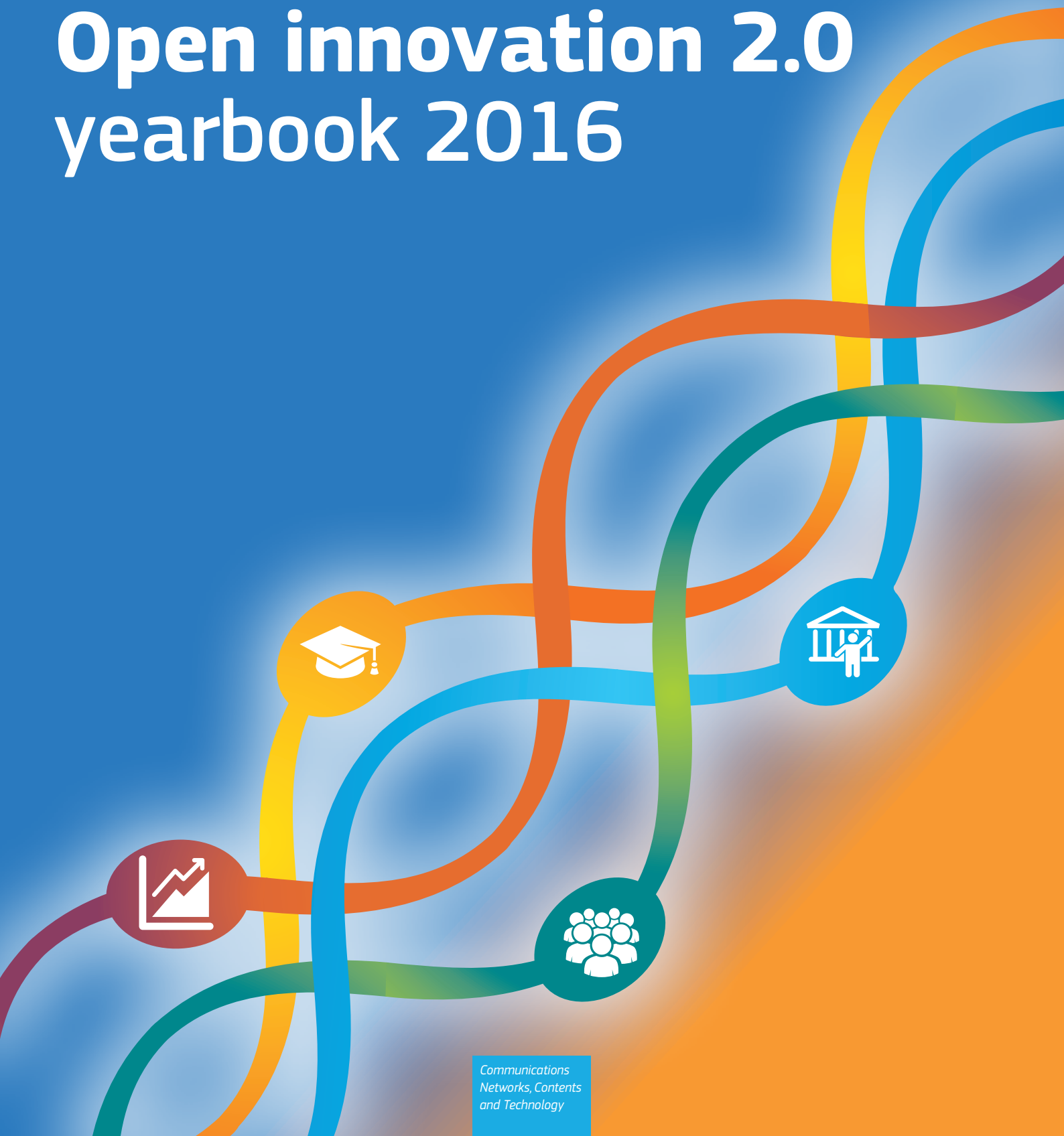

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Contents

FOREWORD 4

ACKNOWLEDGEMENTS 5

EXECUTIVE SUMMARY 6

CHAPTER I
ENGAGEMENT PLATFORMS AND BUSINESS MODELLING IN OPEN INNOVATION 2.0 ENVIRONMENTS 9

Engagement platforms and European innovation systems 9
A new mode of technical and societal innovation 16
Challenges of open innovation 22
Open Innovation 2.0 calls for magnetic organisations 28
Open data for open innovation 35
Thought piece on societal innovation and futurising 41
Open Innovation 2.0 and higher education 46

CHAPTER II
INNOVATION ECOSYSTEMS AND LIVING LABS CHALLENGED BY OPEN INNOVATION 2.0 49

When large companies build ecosystems, should small companies join? A role for open innovation 49
Open Innovation 2.0 and the digital single market 54
Power of user communities affecting decision-making in innovation ecosystems 59
The role of experimentation facilities in open innovation ecosystems for the future internet 64
Trends in the innovation ecosystem, startups and the industrial renaissance 71

CHAPTER III
FUTURE CITIES AND REGIONS IN THE CONTEXT OF OPEN INNOVATION 2.0 79

Smarter cities in the cognitive era 79
Designing a smart society 87
World cities that need transformation 93
Smart city network boosting open innovation 103
The Smart Countries and Cities Congress 105

Foreword

Dear reader,

Dear colleagues in Open Innovation 2.0,

I am delighted to write the foreword for the 2016 edition of the Open Innovation 2.0 (OI2) yearbook especially because we have all seen in the past year a lot of very positive developments in the open innovation sphere!

Open innovation, coined by Henry Chesbrough, is a phenomenon which was growing simultaneously with the living labs concept, and the European Network of Living Labs (ENoLL) was established in 2006 to be a new innovation policy instrument in Europe. These two phenomena interlink strongly in the OI2 where the 'people' component in the quadruple helix innovation approach is highlighted.

In 2015 the message 'Open science, open innovation, open to the world' gained popularity in a speech given by Commissioner for Research, Science and Innovation Carlos Moedas. This new drive will also strongly reflect the European policies on innovation, both strategically and operationally, through e.g. the mid-term review of the Horizon 2020 programme. The commissioner has called for input to the European Innovation Council processes, contents and operations. In parallel, openness and co-creativity is also launched in the horizontal European actions proposed by the senior adviser for innovation in the European Political Strategy Centre (EPSC), Robert Madelin.

These examples manifest the extremely strong drivers showing in everyday life when new innovation paradigms step aboard. This new collaborative spirit appears to be crucial in the process of making Europe more innovation-friendly and trying to make investments in innovation actions and infrastructures more impactful.

The technology and societal transformations we are in the middle of (clouds, Internet of Things (IoT), open data, big data, 5G), together with important political initiatives, like the digital single market strategy, are creating entirely new opportunities for new value creation in the shape of new markets, new services and new products in a co-creative manner where the users/citizens, industry, public sector and academia all have their role in this seamless collaboration.

I am happy to see that in this yearbook we have not only further developed our understanding on OI2, but we are also showing a wide range of practical examples where OI2 works. Despite all this, what is still in the core is the change of mindset for openness and curiosity and letting the innovation happen in the real world. Brainstorming, igniting new experiments and prototypes, fast scaling up, orchestrating, bridging and curating are the new approaches we all need to try, experience and analyse.

Wishing you all interesting reading in the company of Open Innovation practitioners!

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Executive summary

This year the Open Innovation 2.0 (OI2) yearbook focuses much on the operational aspect of showing how OI2 is done in practice, and how benchlearning can be used to cross-pollinate the impact of this new paradigm. The yearbook is divided into three main parts: engagement platforms and European innovation systems; innovation ecosystems and living labs challenged by OI2; and future cities and regions in the context of OI2 taking advantage of the open innovation approach in practice.

Chapter I. Engagement platforms and European innovation systems

The article by **Bror Salmelin** builds on the work which is being done in the European Commission on European innovation systems. The focus of his reasoning is on the case of platforms and their governance to achieve the environments for value creation innovation and business model innovation in a sustainable manner. The role of the different stakeholders in the innovation ecosystem is described in a new way illustrating the short, rapid innovation cycles needed to create new markets, and the longer cycles which design the necessary infrastructures and enablers.

The article by **Professor Martin Curley** is based on the 20 snapshots of OI2, a concept published for the first time in the first whitepaper on OI2. To make the OI2 concept easier to implement in practice, he introduces a design pattern where the most important processes and functionalities in OI2 are described, also by examples.

The transformation of the open innovation paradigm itself is described in the article by **Dr Petra Turkama** and **Dr Seija Kulkki**. Open innovation has matured to a mainstream innovation process for major companies and the public sector. Leading companies actively engage their customers and stakeholders in a co-creation process, while open consultations are becoming a norm in the public sector. The recent term 'Open Innovation 2.0' on the one hand highlights the advances in open innovation, and on the other makes a separation from the early open innovation concepts by von Hippel and Chesbrough that no longer explain the market nuances. The drivers for this transition and critical elements in the modern view for open innovation are elaborated in this article.

Professor Geleyn Meijer, Artemus E. Nicholson and **Ruurd Priester** focus in their article on open innovation and magnetic organisations on the transformation of organisation structures and behaviour. The text elaborates on the elementary conditions and drivers for large- and medium-sized organisations to be effective in OI2. The authors introduce the notion of magnetic organisations and argue that a right mixture of internal initiatives, entrepreneurship and a compelling attractive goal are needed to move ahead. Physics is used as an inspiration source for describing two conditions that can be analysed and used for organisational design. Theory of organisation entropy is used to develop the freedom to act and connect to the outside while the principles of magnetism are employed to focus on goal orientation and convergence.

Dr Timo Ali-Vehmas focuses on the data-driven innovation in his article. He draws an interesting parallel between traditional raw materials and data by claiming that life in general, and business life is no exception, has always focused on the new raw materials which can be transformed to valuable products and services to customers. The new raw material of the data age is the data. Therefore, it is not enough to complement the world we know with an additional data element but rather we need to place the data in the centre. Similarly, as our society is becoming more and more data driven and a larger share of our decisions, including also financial decisions, is based on the digital information we have available.

Professor Leif Edvinsson describes a new approach to societal innovation 3.0 and beyond. He sets the context in societal innovation at national level as well as how to progress with big issues on a global scale with open innovation. Societal innovation refers to a systemic change in the interplay of the state and of civil society. It is a relative of social innovation, but differs from it by considering the state to be an important co-creator in achieving sustainable systemic change. The prototyping might take place with impact investing models, circular economy, sharing economy and working together for the environment and the economy. A whole new prototyping paradigm, a glossary or taxonomy and metrics/key performance indicators (KPI) might be in progress for the innovation work of new ways of shaping and sharing the wealth creation.

Mika Alavaikko describes how a higher education institution (the University of Applied Sciences in Finland) is reforming the curricula and collaborative

environments both internally and externally using open innovation principles. The institution has developed blogging as the collaborative and sharing platform which has proven to be simple and also seamless enough for successful joint undertakings. As a consequence, the platform has also changed the teaching method and learning processes in the institution.

Chapter II. Innovation ecosystems and living labs challenged by Open Innovation 2.0

Garry A. Gabinson, Annarosa Pesole, Professor Alberto Di Minin, and **Cristina Marullo** tackle the problematic balance of small and large enterprises in innovation ecosystems and platforms. The rise of the open innovation paradigm has encouraged the creation of innovation networks (ecosystems) involving a mix of partners: universities, research laboratories, start-up companies, small- and medium-sized enterprises (SMEs), multinationals and governments. Physical proximity is an essential driver of open innovation effectiveness. It enables the exchange of ideas and inside/outside exploitation of knowledge and resources. This paper investigates how some large companies invested in key relationships with external innovation partners through the creation and the orchestration of open ecosystems (e.g. open research campuses). By contrast, small companies cannot afford to create and orchestrate their own local research ecosystem, but they do have the option to join or co-locate within existing ecosystems. This paper draws lessons from two of 13 case studies the authors collected, and compares and contrasts the experience of ecosystem builders and ecosystem joiners.

In the article 'Open innovation and the digital single market' **Dr Gohar Sargsyan** focuses on the future cities and how open innovation can accelerate and focus the development. Her focusing sentence is 'Think big, start small, accelerate fast', which captures well the spirit of experimentation and prototyping in OI2. The approach suggests the importance of open innovation ecosystems and close and seamless involvement of citizens in the sustainable development of future cities.

Visnja Istrat elaborates on the power of crowds and communities in open innovation ecosystems, and on how the communities can be increasingly engaged in business model/value creation development. Networking and collaboration technologies are extremely effective ways of bringing experts together to perform new processes and to share experiences — both the success stories and the possible setbacks. People, also stakeholders, with common interests or related roles can form communities to learn from and support one another. Social media can also help in cases where creating a more collaborative culture is one of the major objectives of the change management. The subject is about the crowd of user communities that affects decision-making in innovation ecosystems.

Dr Hans Schaffers, **Michael Boniface** and **Scott Kirkpatrick** build their article on the success of FIRE platform and experimental approach. He argues that the approach is useful and needs to be further expanded to cover the new technology developments, but also to address the societal changes from an application perspective. Increasing focus on 'complex smart systems of networked infrastructures and applications' within the FIRE programme, the unique and most valuable contribution of FIRE should 'bridge' and 'accelerate': create the testing, experimenting and innovation environment which enables linking networking research to business and societal impact. FIRE's test beds and experiments are tools to address research and innovation in 'complex smart systems', in different environments such as cities, manufacturing industry and data-intensive services sectors.

The article by **Ylimaz Cakir** describes the development and transformations in the Turkish innovation ecosystem, taking the Başakşehir living lab as a focal point and as driver for the new ecosystems. He further elaborates that, where open innovation is foreseen, living labs have a central role in the Turkish strategic goals on innovation policy. The article also argues that living labs methodology, together with open innovation, is the transformative engine for industry and society.

Chapter III. Future cities and regions in the context of Open Innovation 2.0

Dr Mary Keeling is touching upon open innovation from a very interesting and important perspective. Cognitive technology brings new capabilities that offer the potential to transform the way work is done, the way services are provided, the way products are made and the way businesses and organisations of all sizes and in all sectors are run. Organisations can enable and accelerate innovation and growth as part of open innovation activities by pulling in capabilities from outside the organisation, and by active participation and engagement in cognitive ecosystems and collaborative networks. Cognitive capabilities are needed by businesses and organisations to make sense of the large and rapidly growing amounts of unstructured data and to shine a light on 'dark' data. In open innovation platforms, the open and big data, for example, will be the challenge to be used effectively for new markets, products and services creation. The article illustrates with concrete

examples how cognitive capabilities are used successfully in creating value for all stakeholders in the innovation ecosystems.

Drir. Rianne Valkenburg, **Drir. Elke Den Ouden**, and **Drs. Mary Ann Schreurs** outline the challenges of modern co-creation with citizens and the new design approach which is needed when applying OI2. Smart solutions enable citizens to become an active producer of societal value, instead of a passive consumer of government services. Redefining smart cities to a focus on quality of life for their citizens implies creating a smart society. In this transformation lies the design challenge of how to enable and engage all citizens to make use of the new possibilities and employ themselves. To really become a resilient city, a different approach is needed to engage the people.

Professor Carol Yeh-Yun Lin expands the previous work on national intellectual capital to city level. This is extremely important when setting regional and local development goals and measures, as structural intellectual capital seems to be the driver for the competitiveness and value creation also on city level. In the article the measures are discussed on a very practical level, opening a lot of opportunities to reinforce the most important drivers for value creation and well-being in society. Cities will become the unit of competition rather than nation states in the future. Attending to the intangible assets development may decide the future talent hubs of the world. There are abundant clues from the figures and tables presented in this paper.

In the article by **Dr Mika Rantakokko** a six-city collaboration network is described: a strategy for sustainable urban development carried out by the six largest cities in Finland: Helsinki, Espoo, Vantaa, Tampere, Turku and Oulu. By building the national network of open innovation platforms, driving new competence development, business and jobs creation will become more efficient. Utilising the wide variety of knowledge and specialisation in different cities, the best practices and concepts will be collected to form an excellent basis for a new type of city business modelling.

Jean-Pierre Euzen describes in his article the thinking and action behind the new birth of Paris to be one of the leading hubs of innovation in Europe. The regional approach is very interesting, and builds on a wide variety of physical spaces dealing with innovation already existing: living labs, fab labs, hackerspaces, digital factories, microfactories, co-working spaces, TechShop, makerspaces, etc. Their common objective is to promote innovation and entrepreneurship by leveraging collective intelligence and collaborative dynamics on the territories and form an essential part of the open innovation ecosystem. Integrating the activities under one umbrella makes the collaboration of these entities easier and we are getting closer to seamless infrastructure services for new entrepreneurship.

CHAPTER I

Engagement platforms and business modelling in Open Innovation 2.0 environments

Engagement platforms and European innovation systems

Abstract

This article highlights some recent innovation trends through the lens of open innovation and impact of innovation investments. Open Innovation 2.0 (OI2) stresses the importance of all stakeholders in the innovation: the users/citizens, the industry, the public sector and academia. In this article I elaborate the role of the stakeholders to achieve the boiling kettle of innovation ecosystems.

I focus on the case of platforms and their governance to achieve the environments for value creation innovation and business model innovation in a sustainable manner. The technology development is extremely rapid towards new technology platforms, but what is needed is the integration of them to enablers for new value creation.

Each of the stakeholders has their distinctive role in creating the critical enablers and fluidity of successful ecosystems. The focus in this paper is on creating the new industrial era with new kinds of products, services and entirely new industries too, rather than improving the old paradigm. We in Europe need to have an entirely new approach to value creation for all based on our industries, leading to the creation of new products and services in modern innovation ecosystems.

We have some conceptual forward-looking elements in the European innovation landscape, but now is the time to put that into practice. Only by looking at the innovation governance as enabler for the seamless interaction across the disciplines and different stakeholders can we move fast enough to respond to the challenges we face in societal and technological transformation. Or actually instead of challenges we should see this transition as a golden opportunity to reinforce the European approach!

Importance of online engagement platforms

Digital is the key driving the creation of the new: merging digital into tangible economy like in *Industry 2.0*, but also creating entirely new digital enablers based on the current technology transformation towards future internet, 5G communications, clouds, IoT and, last but not least, massive and open data. If this transformation is looked at in a compartmentalised technology-oriented way we miss the opportunity to create a holistic perspective of the transformative power of these technologies in all industry and society. We see a new set of enablers to more concretely build our OI2 approach in Europe.

The digitalisation also enables the creation of engagement platforms for new value creation for all stakeholders through new business models where the driving force is to win together. This also links to sharing economy developments, and even more importantly to issues the new technology brings forward through the societal change. Are we solving the right problems with our current actions?

As Commissioner for Digital Economy and Society Günther Oettinger says:

'Online platforms are playing an ever-more central role in the digital economy in a wide range of areas and are rapidly and profoundly challenging traditional business models. Some of these platforms can control access to online markets and can exercise significant influence. This raises important regulatory questions we will answer in a comprehensive assessment of the role of platforms in 2016' [1].

Can we use experimentation in the real world as the approach to see which aspects of the platforms and their functionalities are to be regulated, and where the markets can take the lead?

Taking the lessons when creating the mobile communications industry in Europe in the late 1980s into consideration, it is critical to share the basic technological developments on open platforms (where e.g. cross-licencing of the essential patents is fair/shared) and where standardisation on the functional level happens across the technology silos mentioned before. Functional integration is important across the technologies as modern applications are increasingly based on this new technology space.

Modular and functional approach: overarching the transformation of technologies and society

Functional integration leads to important issues on how to create the consensus for open platforms and environments in and for Europe. Technology interoperability is not an issue, but rather the creation of the open ecosystems and platforms in an integrated, holistic manner on functional level. What I mean by 'functional' is well explained in a report by Myriam Corral [2], published in the Open Innovation Strategy and Policy Group (OISPG) publication series, where OISPG elaborated, based on the public services structure, a meta-architecture of those functionalities which, like LEGO building blocks, could be configured to any service needed. The building blocks were functional, based on functional interoperability, and had no predefined technology base.

Figure 1: The modular structure for services of public interest. Each module is part of the functional interoperability scheme but the technology realisation is not defined

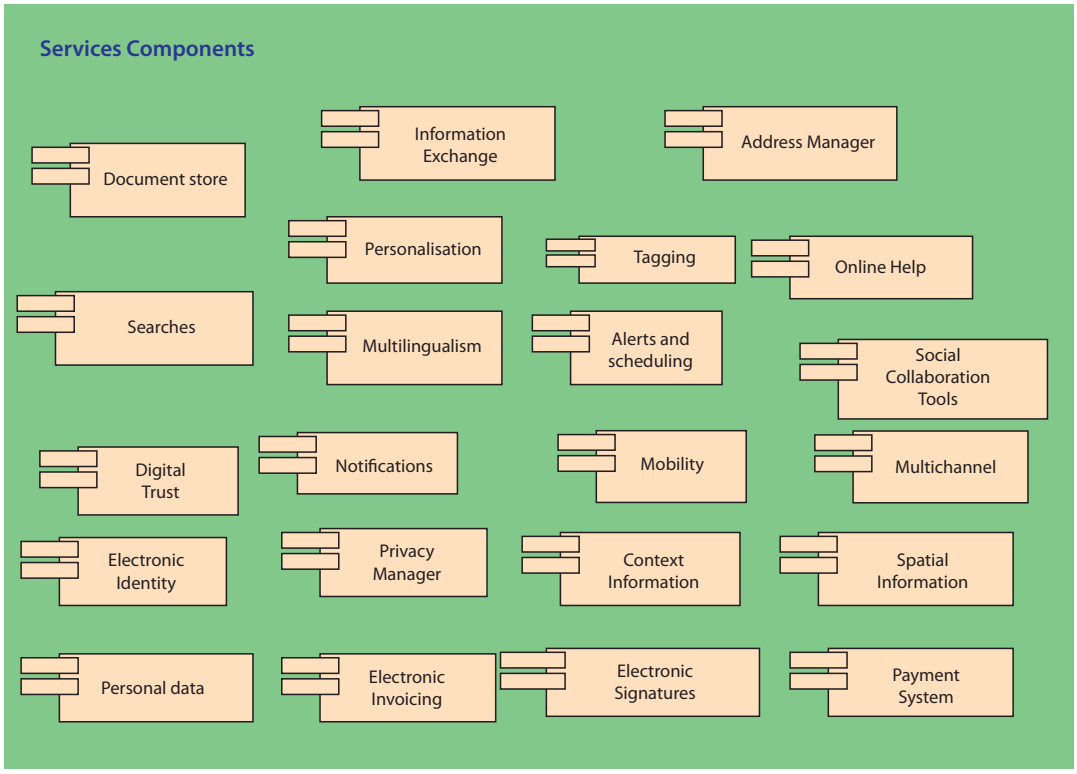


Figure 1 illustrates the functional structure of building blocks based on which services for citizens can be configured. The functional interoperability is essential as then we do not need to pay too much attention to the underlying technology base. When looking at these building blocks we can also observe that many of them are essential components in the digital single market actions. Examples that can be mentioned are identity management, security, privacy, electronic commerce, etc.

The recent technology development enables the realisation of those functions more easily than before; e.g. the cloud enables global accessibility to the roaming data needed for service integration, IoT enables the integration of multilevel sensory data to automate some of the features in the functional modules, etc. Open data is also important when we develop these modules further. What we see today is the platforms being dominated by large players creating (closed) platforms for their own ecosystems. Good examples of these are e.g. companies like Apple and Google but also many players in the sharing economy like Airbnb, Uber, BlaBlaCar, etc. In this game the platform is integrating the content/service providers to their own ecosystem. This is also seen in the development of the platform-dominating companies being valued to several billion euros, and the number of these unicorns grow very fast, from a few to more than a hundred in 2015. One can justifiably ask if these platforms and unicorns have any analogy to the e-commerce bubble we had in the beginning of the century where empty expectations collapsed very fast.

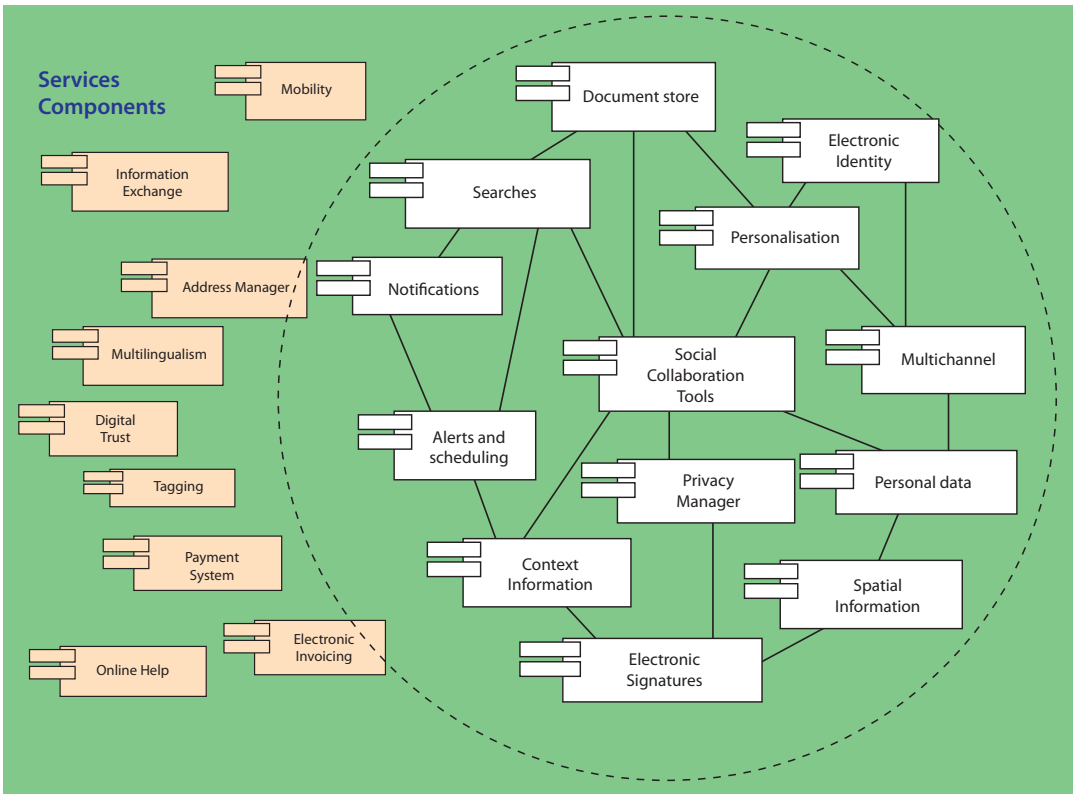
E-platforms: part of the creative and shared commons in Europe?

Can and should the European approach be different? Can we see the platforms as part of the creative and shared commons in Europe as we did with the mobile communications basis? Can we build on platforms being closer to cooperatives for their collaboration partners sharing the wealth and success to the users and content providers? What is the sustainable European approach to platforms? How can block chain technology be used to increase the very important peer-to-peer trust in open platforms?

What I see as a challenge is to combine the new technological driver with the changing societal needs to create innovative, even disruptive, solutions based on the new enablers. Can new service and platform architectures be developed fast enough, and how can the full benefit of the digital single market be captured with the new functional, open approaches?

When further elaborating this approach from a societal context we can identify the social collaboration toolset — modules which compose additional functionalities when co-creativity, collaboration and community building are needed. This leads to the need of new modules focusing on collaborative and participative innovation aspects as shown in *Figure 2*.

Figure 2: Collaborative modules are added for co-creativity and innovation



It is noteworthy that this basic, conceptual user-driven approach stems from the report by OISPG in 2010 [3] where the user/citizen-centric perspective of new business models was described by the reverse innovation pyramid [4]. Again, and repeatedly, I need to highlight that these platforms are technology agnostic, and therefore the interoperability enables all sizes of companies and even individuals to operate in this innovation sphere. There are no lock-in technologies one dominating company could use, as today is still sadly the case.

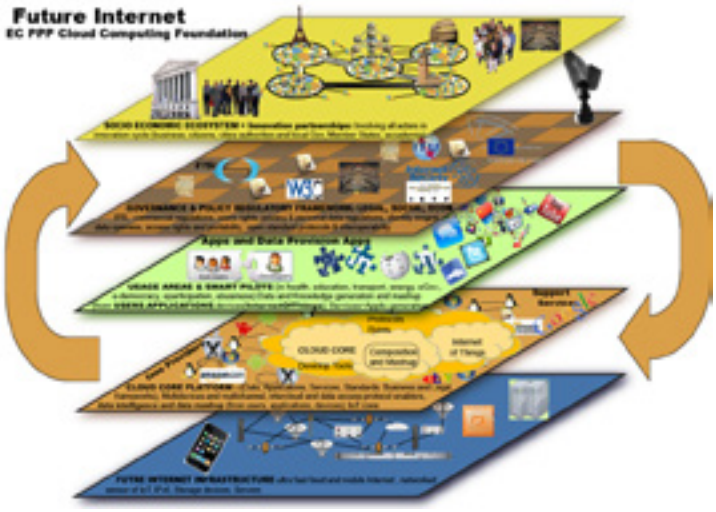
Governance of platforms and environments for innovation

Europe has huge potential to use the technology transformation of digital technologies, if at the same time it takes on board the quadruple helix-user co-creative approach for new markets and services. I firmly believe that the user co-creativity is increasing in importance, especially when we are creating the 'new', as mentioned in the introduction. In the traditional triple helix approach we too easily fall into the win-lose game against the existing competitors. However, in Europe we need to progress in areas where we do not have any competitors yet.

Common vision is needed to make the synergies between the actions across stakeholders and ecosystems. Strong vision requires a wide set of interrelated actions driving to the same direction, but also having competition among themselves. Here the OI2 approach steps in. Based on common goals, different approaches in various contexts are experimented, and from those the most successful ones are rapidly scaled up, to be built upon in the next phases.

A good illustration of this can be seen, for example, in the Future Internet governance where the basic technologies develop quite independently and the governance on the upper layers determines the functionalities and ways of application of the single building blocks. This is well illustrated in *Figure 3* displayed in Francesca Bria's article [5]. The digital single market actions of the European Commission reinforce this kind of coordinated governance integrating the technological and policies development for entirely new types of services, products and foremost value creation processes in and for the society.

Figure 3: Future internet as an example needs several layered governance processes from technical and functional interoperability to the mastering of the internet as an omnipresent platform for value creation



This approach could also lead to purpose-driven companies rather than money-driven ones only; in purpose-driven companies the societal impact and longevity of the life span is increasingly important and is leading to societal and business sustainability.

The rules of the game are designed based on the values driving the society on the highest governance level of these platform ecosystems. One strong option to consider is collaborative cooperatives as intermediaries instead of the current money-driven ones.

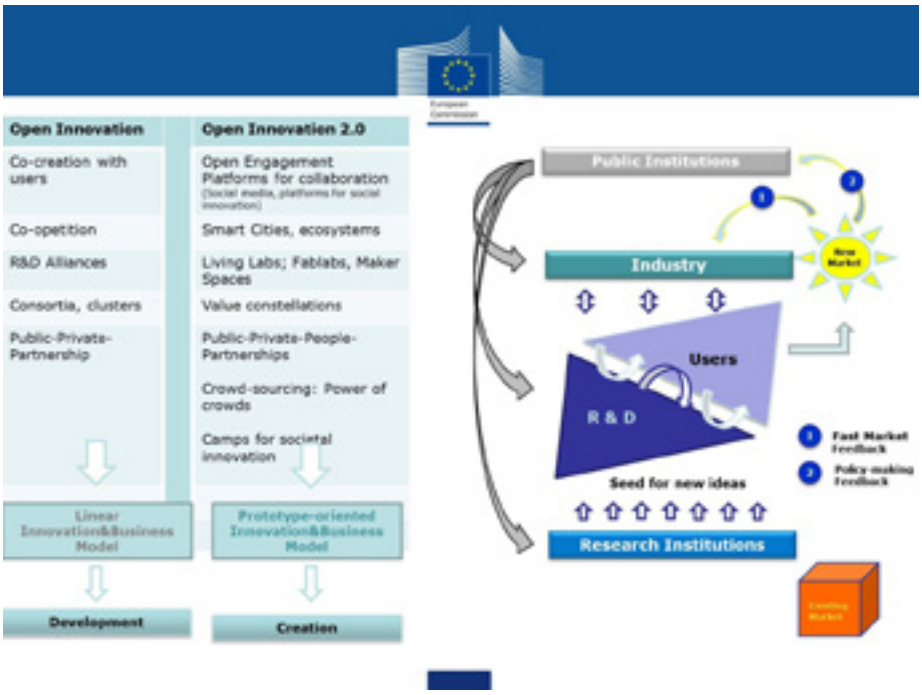
A concrete example of emerging platform consolidation can be seen in recent developments around Fiware.

- Fiware and the European Data Portal [6] will collaborate to bring free data to the growing open community of thousands of Fiware developers, startups and new users in Europe and worldwide. These open more than 250 000 datasets available through a multilingual interface of the European Data Portal and come from public organisations in the EU, and it is available for use and reuse for commercial or non-commercial purposes.
- Fiware and TM Forum [7], the global industry association for digital business, have joined forces to speed up the development of new smart city applications. This partnership will enable more efficient management of municipal services in areas such as mobility, water, waste, energy and environmental management, and will also pave the way for the development of smart applications by third parties.
- The Things Network [8] and Fiware Lab NL [9] have recently announced the creation of an open IoT platform. The two initiatives will create together an open IoT platform so developers will have meaningful sensor data to work with in the Fiware Lab to create new solutions for smart cities, healthcare, agrifood and more.

Short and long innovation cycle

The role of the different stakeholders to create these environments and processes for creating new markets, value and services can also be illustrated with the following picture.

Figure 4: The short innovation cycle with experimentation enables the creation of new markets and extended products (product and services integrated) and the long innovation cycle creates the framework for creating new seed and the infrastructures needed for innovation ecosystems.



The research institutions/community is bringing new seed into the innovation system which interacts with the real world (users) via Research and Technology Development, and Innovation (RTDI). The users based on this interaction act as a piloting and experimentation environment creating new markets for policies, products and services. The cyclic innovation can also be initiated by co-creativity of the users. What is important is that we have the fast cycle of new market creation where users and the industry are key. In addition, we have longer cycles where infrastructures (conditions for innovation) are created, where the public sector has an important role to foster new seed to grow, to do infrastructure investments and to create favourable conditions for frictionless processes in the faster innovation cycle.

Focus in this diagram is on the creation of the 'new', but of course the users' behaviour is strongly affecting the old existing markets in their renewal.

In *Figure 4* I also explain that depending on the sector the balance between the various quadruple

helix players is different, especially when we see the Research and Technology Development (RTD) component in creating the new (industries, services, products).

This kind of division of roles and identifying long and short innovation cycles helps us also to better consider the short-term operative objectives from the long-term challenges and opportunities. It leads to the question of balance between these two.

Shorter-term policy goals lead to rather well-defined innovation agendas, like in Horizon 2020. The key questions, however, are if we can have enough serendipity in these operational programmes and if we can properly take on board longer-term trends at an early enough stage.

Are we solving the right issues? Long-term cycles

The new platform economy leads to new opportunities for the various stakeholders due to the new enabling digital technologies. The technology palette has a transformative power beyond the modernisation of current services and structures.

The digital single market, platforms and rapid technology development are all simultaneously leading to new, disruptive problem settings in the long-term innovation cycle.

A smart cities example

It is said that digital connectivity kills cities. The impact of connectivity replacing physical mobility leads to new city structures and new models for city planning. In the discussion we increasingly hear about edge cities replacing megacities. Edge cities are 60 000-100 000 population cities which are well connected and self-sustained. In the vision of Garreau [10], megacities will break into smaller cities. In Tokyo, an example told by the largest local construction companies, the change of job nature will likely need the mixed use of high-rise office buildings and the establishment of several edge cities within the metropolitan area. E-commerce, local service accessibility, goods delivery based on drones or nearby 3D printing are all information and communications technology-related technologies shaping modern cities and must be taken into account when designing future actions. Serendipity and disruptions characterise future city developments more than we now see in our programmes. Topics like autonomous or self-driving cars will make rapid progress but will only likely be very partial solutions in the radically changing city-planning landscape. Communications infrastructures will likely be much more important than mobility infrastructures. Infomobility solves the mobility issues we have in the current mobility landscape.

Do we have enough of 'against the mainstream research'? Do we have the courage to face the unexpected? We need to have new design in the research and innovation landscape where projects are allowed to have uncertainty, and not only linear extrapolations of the past with well-defined roadmaps.

Conclusion

It is important to build the innovation capability in Europe based on OI2 and functional interoperability of integrated technological platforms such as IoT, clouds, open data and 5G. The joint undertakings in these areas are ensuring a strong foundation. Integrating these transformative technologies enables new value-creation models for businesses and society.

A new European innovation governance structure is needed, with an open and exploratory mindset open for challenges and disruptions.

In order to fully achieve this, a strong joint movement is needed to create the open innovation ecosystems based on common architectural approaches on meta-level, enabling fast development and experimentation of the emerging solutions, in turn making a fast scale-up of possible successes. As indicated before, all the stakeholders have an important role in creating these environments and making them feed new ideas, concepts, products and services — all in a co-creative mode.

A good and recent development of embracing the innovation aspects in Horizon 2020 are the innovation radar activities where the innovation aspects of the Horizon 2020 projects are assessed by independent experts during the project, and not only *ex post*. Lessons learnt can be fed into existing projects but especially into new programmes to increase their impact. Due to its methodical approach, OI2 will likely increase in importance when the impact is measured.

We are on a very good path integrating the pan-European, regional, national and local activities with a common vision for the future of Europe. Thinking in innovation systems is taking on board the newest developments as well as policies and funding instruments.

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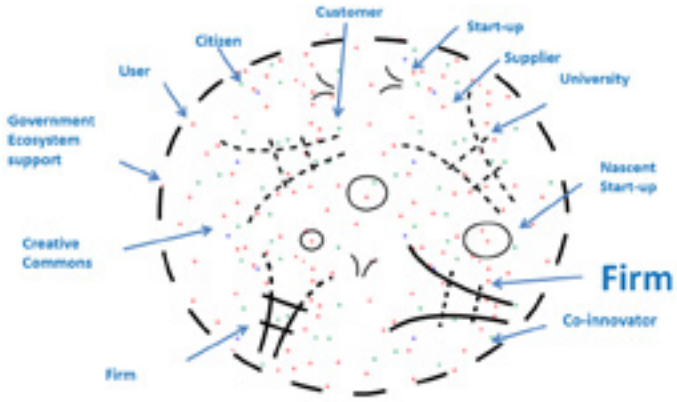
A new mode of technical and societal innovation

Open Innovation 2.0

Abstract

A new mode of technical and societal innovation is emerging, with blurred lines between universities, industry, governments and also featuring users and indeed communities as innovators. For example in Brixton, United Kingdom, a broad set of stakeholders including Lambeth Council, Transport for London, companies and most importantly schools and children are fusing participatory design, data and play to co-design urban services that approach sustainability through community sensing, data visualisation, behaviour change and ambient technology in what is an illustration of Open Innovation 2.0 (OI2) in action. OI2 is a new mode of innovation based on principles of integrated collaboration, co-created shared value, cultivated innovation ecosystems, unleashed exponential technologies, experimentation and focus on adoption and sustainability. OI2 is rooted in a vision of sustainable intelligent living where smart solutions are developed and diffused meeting needs while being resource- and environmentally efficient. OI2 also promises significant improvements in the pace, productivity, predictability and profitability of our collective innovation efforts.

Figure 1: OI2 — a new milieu



Enabling forces

The collision of three mega trends, Moore's law, mass collaboration and sustainability, each of which are mutually reinforcing, is creating a unique opportunity for us to leverage our collective intelligence and energies. Here the nature of innovation changes from a linear to a non-linear process to drive innovation and deliver structural outcomes far beyond the scope of what any one organisation or individual could achieve on their own. Significant technological innovation has ensured that Moore's law continues to hold true to essentially deliver the doubling of compute performance delivered at less or equal cost every two years or so. The new innovation revolution is enabled by increasing levels of connectivity and catalysed by the emergence of exponential technologies such as Internet of Things (IoT), clouds and open data. Thus, ordinary things from dishwashers to cars become smart, connected and collaborative. When smart things and indeed people are connected the intrinsic intelligence and our collective execution capability is multiplied exponentially.

Not only is there great opportunity to create and extract value, particularly of challenges when data is shared, aggregated and analysed across domains, but a transformation opportunity also exists to create new high-frequency, high-precision management control circuits in societal level systems, where previously only open-loop control was possible. A simple example is a gully signalling to a city management system that it is blocked, whereas a more complex example is a dynamic congestion-based charging system which automatically adjusts, changes traffic flow and offers park-and-ride incentives based on parameters such as levels of traffic and air quality in a city.

The European Internet Foundation (EIF) has proposed for the next decades a paradigm of a world driven by mass collaboration, enabled by the

ubiquitous availability of high-speed, high-capacity digital networks and services. The EIF predicts the inexorable spread of purpose-driven online collaboration as the role of networks evolves from enabling not just communication and transactions, but also value creation through collaboration. We have all witnessed the phenomenon of 'social production', whereby people contribute to generate economic value and where there are few or no monetary incentives involved with the ongoing evolution of Wikipedia and the development of Linux being primary examples.

We will see mass people-to-people, machine-to-machine and machine-to-people collaboration. Sometimes this collaboration will be proactive creative collaboration, where individuals as part of a community or as part of more formal innovation configurations will co-design and co-create solutions such as a new city services or the transformation of an electrical grid. At other times we will give permission to our devices to collaborate together to figure out an optimum solution to a given scenario, for example real-time car-to-car communication and collaboration to determine the best sequencing of traffic at an upcoming junction to minimise transit times. The EU FP7 total elastic adaptive mobility project (TEAM) is focused on developing cooperative systems for energy-efficient and sustainable mobility, with drivers, travellers and infrastructure acting as a team — adapting to each other and to the situation and creating optimised mobility conditions. The TEAM solutions are currently being piloted in several European cities including Athens and Turin, with players such as BMW, FIAT, Volvo and Intel involved, as well as the municipalities and citizens, naturally.

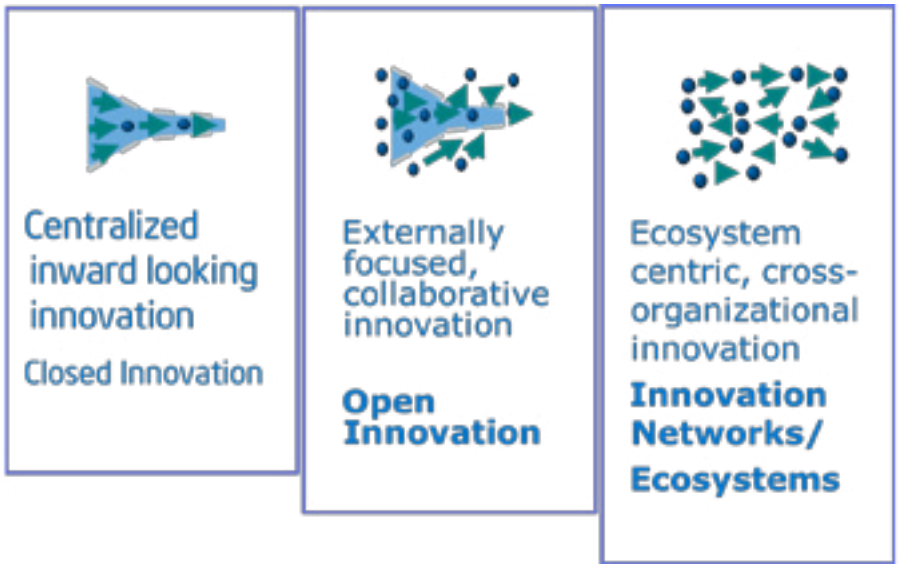
With the adoption of the new UN sustainable development goals, the recent Paris COP21 agreement and the increasing trend of extreme weather events, individuals and communities are becoming more sustainability focused. In parallel, there is a slow but growing recognition of the need to move from the 'take, make, dispose' mode of today's linear economy to a circular economy that preserves and enhances natural capital. The nirvana of sustainability is the ability to decouple growth from resource consumption and environmental impact, and knowledge-driven entrepreneurship provides a potential pathway to achieve this. Former EU Commissioner for Research Máire Geoghegan-Quinn's statement that 'knowledge is the crude oil of the 21st century' aptly describes the opportunity. By leveraging the astonishing possibilities enabled by Moore's law and harnessing the collective intelligence and energy of people and machines worldwide through mass collaboration focused on new solutions which are intrinsically sustainable, we may be about to witness something akin to a pre-Cambrian explosion of impactful innovations.

Similar to the Gutenberg invention of the printing press, the invention and evolution of modern computing and communications technology is a fundamental disruptor to the fabric and nature of society. We have all witnessed how industries such as the music- and book-selling industries have been transformed through ICT led by companies such as Apple and Amazon. This is Schumpeter's 'creative destruction' at work, or it could alternatively be termed 'digital Darwinism'. However, the next phase of digital transformations will deliver significantly more value, will be more difficult orders of magnitude and will require significant citizen involvement to maximise the chances of success. Transformation of our cities, energy grids and healthcare systems will ultimately evolve through a process of emergence; however, the opportunity exists to proactively take charge and move much more quickly to the benefits promised by these transformations. OI2 is an emerging innovation mode which is based on an evolving set of design patterns, i.e. general reusable solutions to commonly occurring problems which can accelerate the delivery of innovation benefits.

The importance and evolution of innovation

It is easy to see why many people are drawn to technical innovation, as according to the Organisation for Economic Cooperation and Development, it is the leading contributor to growth in developed countries. In the United States 75 % of the GDP growth since World War Two has come from technological-based innovation, according to the United States Department of Commerce. In the last century it was often a brilliant scientist at Bell Laboratories or an IBM lab which drove new inventions and subsequent innovations. Then along came Open Innovation, which was neatly conceptualised by Henry Chesbrough and is about a systematic process where ideas can pass to and from different organisations and travel on different exploitations vectors for value creation. Open Innovation was based on the idea that not all of the smart people in the world can work for your company or organisation and that you have to also look outside the organisation for ideas. Procter and Gamble are frequently referenced as a role model for practicing open innovation and their 'connect and develop' open innovation strategy has resulted in almost 50 % of their new products coming from ideas and innovations which started outside of the company.

Figure 2: The evolution of innovation. Source: Salmelin, EU Open Innovation Strategy and Policy Group



The discipline of innovation is constantly evolving and now the combination of exponential technologies, together with participation of actors from across value chains, is creating a new primordial soup which creates an environment to yield evermore complex and compelling innovations. Indeed the unit of competition is changing in that it is no longer how good an individual company or organisation is, but the strength of the ecosystem in which they participate in is often the differentiating factor for great success, mediocrity or even failure. Witness the decline of once-leading mobile phone handset companies like Nokia and Blackberry, and the unprecedented success of the Apple iPhone and various Android-based handsets. A key differentiator has been the strength, incentivisation and nurture of the ecosystem developing and using the products. Organisations can no longer afford to do it all on their own as innovations are so interconnected and are often composed of intelligent combinations of emerging and existing solutions and building blocks.

OI2 — A new mode of technical and societal innovation and an emerging pattern language

OI2 is a new mode of technical and societal innovation. The notion of a community or ecosystem co-innovating together is central to the new mode of innovation. The Innovation Value Institute at Maynooth University and the Alcatel-Lucent-led Green Touch consortium are two examples where a global community innovating together has driven strong results. The metaphor of linear momentum applies well here, being the product of mass by velocity, so the ecosystem with the greatest number of participants who are co-innovating the fastest will likely ultimately be the most successful. Implicit within is the recognition of the power of the crowd and the growth of both crowdsourcing and crowdfunding as a leading indicator for the future importance of mass collaboration.

Given the array of opportunities that is available, how can these opportunities be most efficiently and effectively harnessed? Innovation itself is a risky business with high failure rates; however, the application of innovation design patterns can substantially improve the productivity of collective innovation efforts. The EU Open Innovation Strategy and Policy group has been studying, practicing and publishing an annual open innovation summary for over five years and is attempting to codify this new mode of innovation into a new emergent pattern language, i.e. a series of design patterns. Design patterns are nuggets of knowledge and help us remember insights about design and can be used in combination to help innovate solutions. The goal of this effort is for open innovation to become a discipline practised by many rather than an art mastered by few.

This new era of co-innovation requires a culture shift with a requirement to move somewhat away from Adam Smith's 'invisible hand' where the self-interest of actors in an economy leads to some common benefits and more to a 'sharing economy' perspective based on a principle of shared value where actors proactively collaborate and innovate based on a common **purpose**. Having a shared purpose is the foundational pattern of the new mode of innovation whereby shared vision and shared value underpinned by shared values is at the core of successful large-scale innovation. Where efforts are aligned using a compelling shared vision, people's efforts and intellect are harnessed through commitment rather than compliance, resulting in strong synergies. Synergy is simply the cooperation or interaction of a number of organisations that

results in an effect or impact greater than the sum of the individual efforts, and this is a core goal of the OI2 approach.

The following *table* shares 10 of the elemental design patterns that are distilled from our observations, research and practice in open innovation.

Table 1: 10 elemental design patterns in open innovation

Number	Pattern	Characteristics
1	Purpose	Shared Vision, Value and Values
2	Partnering/Participative Innovation	Community, ecosystem-centric collaboration based on longer term win-win relationship based on shared risk and reward. User-led Innovation, All innovating together to achieve synergies
3	Platform	Foundation for co-innovation, enable network effects, both technology platforms (e.g. Cloud, IOT etc) and Business platforms (e.g. Apps economy etc)
4	Innovation Possibilities and Discovery Driven Planning – 10 types of Innovation	10 core types of innovation from business model innovation to product, process, user experience innovation etc. Planning when there is much uncertainty, Adapting plan in real-time to new learnings
5	Proactively Design for Adoption	Design for adoption, User/Citizen led Innovation, models for imitation, (Utility, ease of Use, User Experience, Ubiquity)
6	Prototyping	Early sample or model, rapid iteration and experimentation
7	Pilots/Proof of Concepts	Experimenting in the wild with test deployments in living labs, evaluations scale, parallel, non-linear innovation
8	Productization	Converting prototypes into viable commercial product/services, scaling and providing infrastructure to enable robust global operation
9	Product Service Systems/Servitisation	Extending products to services for sustainability and profitability, Designing solutions which are better, easier to use and more resource efficient that prior solutions, towards the circular economy
10	Processes	Having repeatable processes for innovation rather than ad-hoc, viewing innovation as a capability, delivering innovation results which are more predictable, probable and profitable

These are evolving elemental design patterns which we believe will prove to be useful in helping ensuring the effectiveness and efficiency of collective innovation efforts using the OI2 mode. They encompass many of the key characteristics of OI2, which we have described in previous OI2 yearbooks and papers, and will evolve and can be defined with more precision in the future. We would like to present these as early design patterns of an emergent pattern language for OI2. A pattern language is a method of describing good design practices within a particular field of expertise and is often presented as a network of patterns that call upon one another to add synergistic value.

Designing for adoption

Innovation can be defined as the creation and adoption of something new for the organisation or individual that adopts it. Solutions that are designed to provide utility and to be easy to use while providing a great user experience are much more likely to be adopted, e.g. the Apple iPod. Many companies including Intel had MP3 players in the market well before Apple but were not successful.

By using a platform which allows easy co-innovation and is subject to a network effect, one can significantly increase the rate of adoption and hence the rate of value creation for everyone, with the Apple iPhone and App Store being examples of this.

Designing for sustainability

Developing a **product service system** is a core OI2 pattern to support sustainability. Product service systems are a new innovation pattern which looks to move organisations from delivering products to delivering products/services and have more sustainable consumption and supply. The IoT is a fundamental enabler of this pattern which is also sometimes called servitisation. Rolls-Royce's 'Power by the hour', whereby the company sells hours of flight time rather than jet engines, enabled by advanced telematics, is the most commonly referenced example of this pattern.

Some auto companies are looking to see how to change their business models. Daimler's 'car2go' car service is an example of when the motivation of the business changes from maximising sales and thereby the consumption of physical resources to

maximising the utilisation and the longevity of the assets, thereby also minimising the consumption of non-renewable resources. In the case of car2go the vehicles are also often electric vehicles. Broader adoption of this model requires buy-in from consumers that a car is no longer something that we need to own but that we could instead buy mobility as a service.

High-frequency, high-precision control systems for societal-level systems

Our ever-increasing connectivity, the ever-increasing power of compute and the emergence of the IoT, with everything from cars to electrical substations to washing machines, is creating the opportunity to introduce high-frequency and high-precision closed control systems into societal systems which were previously in Open Loop. For example, the electrical grid has been designed as a one-way linear system where energy is generated in bulk capacity and then distributed (quite inefficiently) through high-voltage, medium-voltage and low-voltage distribution systems. With the increasing availability of local renewable energy (wind, solar, etc.), smart home systems and smart heat-storage systems, the opportunity exists to redesign the grid creating value for all participants, lowering costs and making the overall solution more sustainable. One Horizon 2020 project with a set of stakeholders from across the energy value chain, from generators to consumers, called 'real value' will research and demonstrate this across 1 250 homes in Germany, Ireland and Latvia. This model is an example of the emerging concept of collaborative consumption.

At the core of these kinds of innovations are the twin ideas of systems of systems and closed-loop control through enabling functions of acquisition, analytics and actuation. Data are acquired from a thing or system, and then analytics are performed to provide decision support which can then drive actuation to change parameters to effect service improvements or efficiencies. The integration of these three capabilities enables the creation and operation of high-frequency and high-precision management control circuits. An example of such a system of systems would be a dynamic congestion-charging system in a city which dynamically updates congestion charging based on parameters such as localised air pollution and weather and traffic measurements to help optimise real-time traffic flows and improve commute times while minimising the environmental impact. The operation of such a system will also create a lot of big data, and the use of machine learning and offline analytics can create a second-order feedback loop which can drive further system improvements based on insights garnered.

Conclusion

According to Steven Carter, author of 'Where good ideas come from?', the great driver of scientific and technological innovation has been the historic increase in connectivity. Indeed, we are witnessing what Kurzweil called the law of accelerating returns with each new innovation building on prior innovations and also often becoming infrastructure for future innovations. The OI2 innovation paradigm is based on extensive networking and co-creative collaboration between all actors in society, spanning organisational boundaries well beyond normal licensing and collaboration schemes.

Looking forward, we need to collectively adopt the mindset of shared vision and share value, and build innovation strategies and ecosystems to tackle the major societal problems. For example, we could agree to strive to create and build the equivalent of a Moore's law and an ecosystem to deliver healthcare transformation — systematically and continuously finding technology interventions which will improve the quality of life and the quality of care which, when cumulatively added, help create longer and healthier lives — a key role of the citizen would be taking more individual responsibility for their health. In parallel, there will be difficult challenges to solve in areas such as security, standards, trust and privacy as more and more systems are open and interconnected. However, this should not stop us making progress.

Ultimately it is not just about open innovation, but openness to innovation. Peter Drucker wrote that culture eats strategy for breakfast every time, highlighting the importance of culture to the success of any strategy. Fostering a culture which is open to innovation and risk-taking is important. Increasingly it seems there is a growing appetite for citizens to be involved in larger innovation efforts, as exemplified by more citizen science initiatives. In a Dublin City Council survey of visitors to a future cities exhibition in Dublin in 2013, over 90 % of respondents felt that Dublin should be used as a venue for testing experimental solutions and would be willing to participate in the experiments themselves. The United Kingdom government's whitepaper on community engagement 'Communities in control: real people, real power' also indicates that there is a desire from the top for more community and personal engagement.

Denis and Donella Meadows wrote in 1972 that

> 'Man possesses, for a small moment in time, the most powerful combination of knowledge, tools and resources the world has ever known. He has all that is physically necessary to create a totally new form of human society — one that would be built to last for generations. The missing ingredients are a realistic long-term goal that can guide mankind to the equilibrium society and the human will to achieve that goal'.

Strange that this statement seems even truer today and yet the progress made has been disappointing. We have the technology and now we have an emerging innovation methodology. We have to take the opportunity of a lifetime, in the lifetime of this opportunity. The technology is certainly ready — are we?

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Challenges of open innovation

Abstract

Throughout its short history, open innovation has created enthusiasm, setbacks and certainly many valuable experiences from numerous reference cases around Europe and beyond. The opportunities and limitations of the concept are well known, and the attitudes toward openness are becoming increasingly pragmatic and realistic after the initial hype and excitement. However, we argue that despite best intentions, open innovation remains mostly technology driven and emphasise research, development and innovation (RDI) around individual technologies and their functionalities. The open innovation is still 'half-a-way' from being open in terms of understanding human and social behaviour. With human and societal challenges in mind, the chapter suggests that with the aid of advanced digital technologies we can elevate the level of open innovation projects to thoroughly resonate with the needs and the consumption patterns of the citizens and societies, and thus enable a significant impact on societal transformation and industrial renewal.

Introduction

Open innovation concepts and methodologies have evolved significantly in the recent decade. This can be accounted for in significant investments in open innovation research and policies as well as new enabling technologies and tools. Open innovation is broadly accepted as a major driver for improved customer value and choice, adaptation of new technologies and processes and a means to democratise decision-making and societies. Numerous new, sophisticated innovation models, concepts and communities of research and practice have sprung from the original concept of open innovation and continue to shape our conceptualisation of relationships between companies, the public sector, citizens and other institutions.

We argue for 'the second wave' of open innovation that is facilitated by ongoing digitalisation, cloud technologies and consequent new capabilities. They provide significant opportunities for stronger demand and market-driven approaches; we may create, in collaboration with people, citizens, users and customers, new market dynamism and experiences that can be 'individualised' and socially patterned. Consequently, the technologies — especially their design rules for integration — are created downstream from market knowledge, not only the other way around.

That is why we propose this open innovation concept of being: (i) relational (human, social, institutional and firm-to-firm); (ii) around ecosystems of industries, cities and regions or institutional, developer and social networks; and (iii) challenge driven aiming at solving major economic and social challenges of our time. One of the challenges is the speed of development; technologies, markets and industries change their relations, offerings, structure and processes very dynamically. Open innovation should be sensitive to the time dimension of the initiatives, when to launch the strategic RDI for systemic transformation, how to manage the RDI process to 'fit the cause of events', and how to implement the outcomes in a timely manner. The issue is to facilitate the renewal of markets, industries and societies in a way that it improves even the life of human beings and the development of all-inclusive, participative, open and reflective societies.

The paper also contributes to the existing knowledge base of service innovation processes, draws attention to the time dimension and relationships between institutions, individuals and open innovation communities, and supports the design of sustainable next-generation open innovation ecosystems.

Evolution of open innovation in Europe

In the late 1990s, the phenomenon of open innovation emerged simultaneously with the spreading of internet and mobile technologies. The new digital technologies created need and inspiring opportunities for new value creation — after decades of closed science and corporate research and development (R & D) — and for opening the innovation and development processes to the public. In the beginning, the opening referred to collaboration with business-to-business or lead customers in the development of new products, technologies and services. It also meant gathering direct feedback from markets, customers and users of the usability and experience of products and services, especially in the early phases of innovation and market adaptation. So what is the relation between the diffusion of internet technologies and open innovation today? Co-creation and innovation takes place on technology platforms that bring together technologies, developer communities and customers. Developing such platforms requires thorough understanding of industrial, organisational, social, institutional and human behaviour that relate to processing knowledge and information. These platforms have been understood not only as technologies but as

facilitators of human and social interactions, knowledge creation and innovation.

Firstly, the opening of R & D took place between companies; it became a process of co-creation of products and technologies [1, 2], but soon after we saw the opening of broader RDI processes with lead-user communities and consumers [3]. In the early 2000s, open innovation became included in policy processes. In addition to traditional technology-related innovation policies, cities, regions, nations and even the EU promoted wider social and economic transformation through innovation policies that addressed society- and industry-level renewal through engagement of firms, public agencies and citizens.

These innovation policies emphasised demand and user-driven, open and participatory RDI with real-life experimentation and piloting with citizens. In addition, globalisation and European single market development created a need to conduct wide-scale RDI for scalable solutions over many markets and industries, with unified standards and regulations for volumes of scale; this gave a strong stimulus for launching international networks such as Innovative Regions, Smart Cities and the European Network of Living Labs (ENoLL). The idea was to develop, 'from the very beginning and by their very DNA', markets, industries and societies that are locally anchored but both international and globally connected. Currently, the open innovation has matured into a mainstream innovation process for both corporate and public sectors. Leading companies actively engage their customers and stakeholders in the co-creation process, while the public sector has adopted open consultations as part of regular policy cycles.

Digital transformation and open innovation

The ongoing digital transformation offers great opportunities to renew dynamism in European societies and economies. Digitalisation has properties of being instrumental in changing the underlying foundations and structures of industries, economic activities and societies. It offers Europe an opportunity to develop a new globally competitive industrial dominant design [4] that is human centric, systemic and even socioeconomic by nature.

Digitalisation is not only related to individual products, devices or technologies; it is about shared systems or integrated infrastructures, i.e. how products, technologies, economic and social activities, organisations and institutions collaborate and relate to each other. Digitalisation is about underlying, enabling technologies, like cloud computing, that foster industrial, social and economic transformation through new virtual platforms that bring about new digital value creation processes as well. This strengthens generative capacities between and within organisations, human and social networks for communication and collaboration in knowledge and information production and transfer.

We argue that the digitalisation brings about a new open innovation model that lets us separate and integrate in a new way (in cloud) virtual and physical interaction layers, where the interactions and co-creation follow different logic and rationale. That is why we propose re-conceptualising the drivers, actors, critical incidents and impacts of physical and virtual ecosystems and open innovation interventions, and noting the special characteristics of virtual ecosystems. So the digitalisation creates two inspiring, powerful, parallel and interrelated 'dynamic platforms' for open innovation: (a) a technology-enabled virtual platform where firms, cities, regions, public agencies and other 'platform providers' may co-create dynamic new ecosystems for value creation; and (b) a service and content creation and delivery-driven platforms of citizens as co-creators or 'users' who in addition to firms, cities, regions and other players can participate in value creation — also for themselves.

Furthermore, in today's economies and global marketplace, megatrends and transitions occur in months rather than years. New, ever-more complex and connected product introductions are introduced at an accelerated rate, leading to a highly volatile technology landscape. An example of this is the estimate that Facebook today would cost only about EUR 500 000 to make. Thus the value is not with the technology of the company, but with the users and business models [5]. Value networks are ambiguous, with low entry barriers and industrial symbiosis, which leads to a continuous re-configuration of industry segments and changing market dynamics and revenue models. The recommendation is to adopt a 'holonomic' way of thinking, a dynamic and authentic understanding of the relationships within a business system, and an appreciation of the whole.

The following *table* details the main drivers for the new open innovation era. The drivers are intertwined, e.g. with consumption patterns changed radically since the 1990s with the adaptation of mobile internet technologies, and markets transformed following the new forms of consumerism [6]. This, in turn, has steered technological development to better respond to customer needs.

Table 1: Drivers for the new open innovation paradigm

Drivers	Concepts	Elements
Societal Drivers	Servitisation	Share economy, as a service consumption
	Sustainability	Circular Economy, resource efficient, resilient economy
	Globalisation	Mobility, competition, economic interdependency
Technical	Digitalisation	Cloud, IoT, mobility, virtualisation
	Price of technologies	Affordable, ubiqenous solutions
	Mobility	Mobile access, new consumption patterns
Market	Ecosystem-based services	Collaborative development, business models
	Platform-based technologies	Dominant standards, interoperability
	Shortening life cycles	Intensified competition, continuous improvements
Cultural	Social media	New connectivity, perception of privacy, opinion shapers
	Customer driven development	Co-creation with customers
Political	Inclusive regulatory process	Citizen empowerment, participatory consultations
	Demand side instruments	Drive adaptation, sustainability, innovation
	Strong interventions	Incentives for renewal, shared vision

We have learned that RDI of ICT-based infrastructures [7] or platforms often emphasise design rules that integrate industrial activities or technologies and operate on different layers and specifications of platforms. If the underlying virtual platforms are 'the shared capacity and capabilities' of companies, other organisations, social networks and people to collaborate, we argue that especially those layers of platforms that are close to services and business models may benefit from specifications or design rules derived from market, user, human and social behaviour. There are many cases where new digital infrastructures or platforms benefit from deep 'internal' structural and processual integration that reflects human, user and market behaviour. Today, with social media and other means of public participation and crowdsourcing, this would be a natural path to follow.

The parallel virtual and physical open innovation processes have much of the same characteristics, but the critical success factors somewhat vary. The following *table* highlights the differences between the processes.

Table 2: Actors, relationships and activities in physical and virtual co-creation arenas

Ecosystem Characteristics	Physical	Virtual
Venue	Living Lab , real life environment	Technology Platforms
Methodologies	Focus Groups, Ideation Workshops, Use of Props, User Observations, Makers Spaces, Fab labs,..	APIs, Apps, GUIs on technology platforms, on cloud, social media
Actors	Orchestrator, developer, user, technology and service provider, public sector, property owner, limited number of actors	Platform owner, developers, users, broad communities
Relationships	Medium to long term, clear roadmaps and sustainability plans	Ad Hoc
Activities	Experimentation	Configuration
Applications	Smart City, business networking	IoT, open source development, cloud
Outcomes	Improved physical service, product, policy recommendations, business models	New services, enabling technologies
Critical Success Factors	Interactions, integration to legacy systems, shared vision, policy support, user acceptance	Interoperability, standards

The presented *table* highlights the added complexity of open innovation in a physical context, where the number of actors and relationships is higher and the investment is heavy. In the emerging new open innovation paradigms, the virtual and physical interaction layers can benefit from two-way dialogue and closed-loop learning. Physical products and assets can be augmented with virtualisation and life cycles prolonged with supporting services and new business. Virtual development processes, in turn, can apply learnings from the user-driven service development, and thus reduce the gap of virtual and physical service experiences. The needs and expectations of the users or contributor are still the same regardless of the point of delivery.

If we cultivate the thinking even further, we may distinguish virtual layers that are mainly created through designs' rules related to technology and virtual layers that are created on human and social behaviour. What an opportunity to have an integrated 'sphere of RDI' where these two collaborative dynamics for value creation merge!

Value creation through collaborative platforms

We have argued that digital transformation opens new avenues also for perceiving the value creation; the value is created through parallel interactive 'platforms' and their integrated systemic-level solutions, as well as through accumulated value in relationships and their constitution, in addition to functionalities of technologies and services. Opportunities for value creation are offered by dynamic constellations for collaboration both at physical (technology-provided) and consequent virtual layers as well as at socially and institutionally constituted 'layers for open innovation'; consequently, the value is increasingly created in virtual networks, where physical objects connect seamlessly and can be re-configured to serve customer-specific contexts and needs. These technology translation processes — guided partly by human and social behaviour — in the virtual world follow different laws from the ecosystems in a physical context, and thus should be studied with different assumptions, heuristics and methodologies.

We argue that the tipping point of technology dominance and virtualisation has been reached, and the new communities of users prefer customised experiences and relationships. These trends create friction in service design and business models, and again open up opportunities for open and shared service models. The categorisation and roles of users and developers need to be defined in more detail and distinct models developed for each group depending on their expectations, maturity and willingness to engage in open innovation. Furthermore, with increased valuation of support and customer service, we witness also the return of human-to-human services, instead of automated or self-services. As today the consumption is increasingly based on economies of functionality in rent, rather than ownership, we need to reconsider our perception of value creation based on contracts (like the much-published Airbnb concept). Customer needs may be fulfilled by 'as a service' rental or pay-per-use consumption models, which are more sustainable and scalable.

By and large the dynamic interaction between technology-driven platforms and human- and socially driven platforms of collective co-creation represent a new dynamism in value creation. This calls for rethinking the sources and sustainability, efficiency, productivity and also new discovery-driven methodologies for managing the new cyber-physical ecosystems [8].

Role of cities and regions

In Europe, the openness of RDI and the participation of cities, regions and citizens into the development of better societies and economies has stimulated shared visions of socioeconomic development for the well-being of human beings, that is by its very nature knowledge and innovation driven, transformative and participative [9]. The ideal is to create human-centric reflective societies and economies that promote an all-inclusive engagement of private and public stakeholders as well as citizens, improve participative democracy and reflect these properties even in their very core activities such as research and innovation. These qualities would give Europe a unique profile on the global innovation map where the United States competes through corporate-driven RDI, science and technology and China has a mixed open/controlled model of central government-driven science, technology and corporate RDI aiming at sustainable growth after a period of sustained growth [10]. Open innovation is in the heart of this process and therefore it is essential to understand the extended opportunities that advanced technologies have opened for the concept.

We proposed that the open RDI around societal challenges starts with open, society-wide dialogue for shared challenge definition and vision creation. We have also proposed that the process continues with open experimentation of potential solutions. We deploy open, dialogical, participative, big data, design and large-scale experimentation and piloting methodologies. While applying this approach we also promote open economy and society development and forms of participative democracy. People and organisations learn from each other,

share views and visions of challenges ahead and strengthen the sphere of economic and social choice. People become subjects, not objects, of their lives. As Sen [11] argues:

> 'What choices one can make in life is dependent on the society we live in'.

We may even turn the argument of Perez [12] that technological advances drive societal development the 'other way around'. We may learn to bring about societal challenge-driven industries, technologies, firms and jobs.

We argue that cities and regions are 'best positioned for RDI in this regard' and could be the open ecosystems that solve societal challenges and create new forms of value creation and scalability of social, economic and industrial activities. As internationally networked, they could also create new social and economic dynamism, well-being and wealth and value creation — locally and globally. However, this may call for greater independence for cities to create their own international, public services, technology, industry and innovation policies. They also need organisational, institutional and funding arrangements of their own to fulfil the tasks related to solving societal challenges through participative and open innovation.

One highly visible example of the open innovation community is the international network of smart cities, and consequent emergence of the term human smart cities. The concept highlights challenge-driven innovation, where the initiatives should build on shared values and jointly created visions for the cities. Decisions and choices for technologies and processes are driven by sustainability, convenience, economic growth, stability and quality of life for all demographic groups. Focus is on lean innovations that can be scaled on different application areas and context with little effort. This transition is enabled by changed mindset, roles and enabling technologies [13].

The new Kalasatama (fish harbour) area of Helsinki is a representative example of a human smart city innovation platform. The Kalasatama neighbourhood is designed as an experimental innovation platform for co-creating smart urban infrastructures and services. This old harbour area was transformed into a modern housing area through open consultations and piloting with all quadruple helix stakeholders in an open living lab setup. By 2030 Kalasatama will serve as a home to 20 000 residents and offer jobs for 8 000 people with advanced smart infrastructure and pioneering concepts for open data-based services. The vision for Kalasatama is to add to the convenience, experience and sustainability in a scale that enables residents to gain an extra hour of their own time every day. The development is challenge driven and open for all contributors.

Smart Kalasatama is funded by the European Regional Development Fund, the City of Helsinki and the Ministry of Employment and the Economy. The project is coordinated by Forum Virium Helsinki. Experiments include electric car-charging stations, a solar power plant, a pop-up library, maker spaces, smart containers, smart home concepts, heat pumps for ICT server rooms and vacuum waste disposals. Kalasatama is a longitudinal commitment to co-creation from quadruple stakeholders. With true citizen-driven development goals, applications of open data, open technology standards and sustainable solutions it represents the new open innovation concept at its best on both virtual and physical layers.

Conclusion

We have argued that the digitalisation opens new platforms for both technology-driven and socially driven open innovation. We have also argued that there are new opportunities for open innovation to balance and integrate these approaches and offer opportunities for new value creation, global competitiveness and scalability, as well as all-inclusive development towards open economic and social dynamism that promotes participative democracy. We also discussed new platforms of virtual co-creation as ecosystems that would benefit from human-, social-, market-, user- and customer-driven approaches and specifications applied in physical co-creation initiatives as well. The increased migration of physical and virtual worlds also calls for new policy instruments for providing incentives for open processes and interfaces. This is an area where the open innovation community can make a significant contribution in the coming years in continuing to shape our conceptualisation of relationships between companies, the public sector, citizens and other institutions, and build stability and quality of life for all demographic groups.

Europe has the opportunity to transform the foundations of its industrial dynamics towards new dominant designs that are globally competitive, human centric, systemic and even socioeconomic by nature. This is possible through digitalisation — perhaps for the first time in economic history. One may argue that until now the industries did emerge, evolve and change through introducing new innovative products or technologies that did spread, scale up and diffuse over time — through a kind of natural, evolutionary and adaptive process. Today, we have the opportunity — through a wide-scale experimentation, collaboration and ecosystem

approach — to make society-wide economic, industrial or other system-level changes. Today, we can transform industries almost consciously! However, we do that by engaging our people and societies into knowledgeable and dynamic co-creation that has the potential to transform our economic and social dynamism as well.

This has a major impact on our industrial, technology, urban and innovation policies, as well as on open RDI itself.

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Open Innovation 2.0 calls for magnetic organisations

Abstract

A globalised economy, digitisation and disruptive competition from unexpected actors — private and public organisations — result in high pressure to change. There are plenty of dramatic examples of once-proud brands that have disappeared and many calls for action for those that are still around. But changing an organisation is a challenging task in practice. External developments are moving fast while internal inertia of people and processes seems to slow down any capacity to adapt.

Open Innovation 2.0 (OI2) is a paradigm strongly rooted in our 21st century society and will affect all of our 20th century organisations, both private and public. It is essential that these organisations appreciate the disruptive capacity of OI2 and understand the elementary conditions that are needed to adapt, to reap the benefits of OI2 and to be a leading brand in the 21st century.

Introduction

This contribution focuses on the elementary conditions and drivers for large and medium-sized organisations to be effective in OI2. The authors introduce the notion of magnetic organisations and argue that the right mixture of internal initiatives, entrepreneurship and a compelling attractive goal is needed to move ahead. Physics is used as a source of inspiration for describing two conditions that can be analysed and used for organisational design. The theory of organisation entropy is used to develop the freedom to act and connect externally, while the principles of magnetism are employed to focus on goal orientation and convergence. Practical implementations of these principles are given to illustrate how a balance in entropy and attractiveness helps these magnetic organisations to flourish and contribute in an OI2 society.

Figure 1: Magnetic organisations as a metaphoric formula

A renewed interest in corporate innovation

What innovation is, how it functions and how it can be stimulated has been fundamental to organisation theory, business schools and policymaking.

Nowadays, a wealth of ideas and initiatives focus on startups and greenfield innovation; how businesses can be set up and supported and how they can grow. This is not, however, the subject of this study. We focus on the stage at which a business is mature, when, from a start-up, an organisation has been formed with people, processes, ways of working and culture. A corporation can thus be a commercial corporation or a public one.

This may not be the most attractive topic in the public space nowadays. For many years (from the early 1990s onwards) the leading theme in renewing our society and keeping our economy competitive has been focused on renewing our large industries, stimulating their research and development (R & D) capacity and aligning our universities to that end. A typical career for graduates has primarily been to seek employment in these large corporations and from there to contribute to society. Starting a new business did not rank very highly.

This trend changed with the rupture of the internet bubble in the early part of the 21st century and following the financial and economic crisis. Gaining employment in large corporates was difficult to achieve and corporations did not prove to be the society renewals that were hoped for. As a result of this, starting a new business became the credo. And with good reason: Microsoft, Apple and later Facebook showed that entrepreneurial spirit and a garage were all that was needed. We are in a phase now where focus on entrepreneurship and a start-up mentality are peaking.

But small companies get bigger: just as we have seen with Microsoft, Apple and Facebook. They become the new corporations. So the question of how to innovate within our corporate is back. For instance Google, another new corporation, introduced an often quoted 1 day a week free research as innovation methodology, whereas Apple started

a religion to keep its market share. The new corporations also operate in an open innovation society: they keep a close look on innovations outside their corporate wall and absorb new acquisitions within their own services and brand.

In a way, the new corporations are all representing an IT-intensive sector and since our whole society is becoming a digital one, the new corporations may pioneer the guiding principles that underpin the innovation processes. Looking for sustainable innovation models in corporate settings is becoming a trending topic once again.

This study focuses on the following two types of corporate innovation.

1. Industrial corporations with an R & D culture. This is the world of Unilever, pharmaceutical, car and aerospace industry. The leading trend here is to move from closed innovation to open innovation [1]. Make the shift from R & D in isolation and secrecy to embracing the customer as co-developer. Models to describe this open innovation shift are provided by Curley and Salmelin [2].
2. Professional services organisations with strong individual-led innovation culture. This is the world of hospitals, financial services firms, engineering, media, education and IT services. The individual professional leads innovation and its practices. Although innovative on an individual scale, the organisation as a whole is often conservative and immobile. The consultancy sector in particular is suffering from a lack of a sustainable innovation model.

This study focuses primarily on the latter, the professional service organisations. In earlier papers [3], the characteristics of the IT-based services firms have been identified and the need for a sustainable innovation model described.

The innovation pyramid is upside down; a new role for corporations

Throughout recent decades the role of capital and infrastructure in driving innovation has decreased to make room for the role of 'the ideas' and the 'knowledge to realise it' as leading differentiators.

Ideas and knowledge are linked to people, not to organisations. People that have ideas and know how to realise them have a competitive advantage. Organisations no longer make the difference. In the growing service industry of digital design agencies, for instance, the brands that are 'hot' one day will typically only remain as such for a limited time; perhaps for as little as one or two years. A hot new brand with a unique proposition will replace them soon enough. What is interesting to see, however, is that the people behind these brands, the key designers and producers, are often the same. They mix in different circles and settings, but are united by their shared knowledge and ideas and not by the brands they work for at any given time.

Does this then mean that there is no role for the corporate organisations in realising consistent innovations anymore? Yes, there is. Corporations must now take on a new role. After the reversal of the innovation pyramid [4], the role of the organisation has changed from initiator and producer of innovations to being the up-scaling partner for services and products that individual people have conceived. It is the powerhouse that allows small innovations to be amplified and made available to many to create a wide-scale impact.

From the perspective of the organisation, the creators of these innovations consist of their own employees, those working at partner organisations, university associates from a collaborative project and notably the same people that used to consume the end products. It is the critical mass the crowd creates that leads corporations to react and renew. The organisation is the breeding ground for this crowdsourcing and, importantly, it provides the scale to make investments in time and infrastructure to realise ideas.

The new corporation plays a further role here too. It can provide an inspiring environment for these people to create and share knowledge. This environment can provide meaning to ideas and can give a common drive to the people associated (not necessarily as employees, but the crowds) with the organisation. This unleashes a drive to apply their creativity and energy to serve a cause that they would not be able to serve on their own. Creating better medical services for all, reinventing education for a new generation, growing socioeconomic wealth or making better product services in our daily life are good examples.

The innovation sourced by a crowd associated with an organisation is an instance of OI2. And the question is: what does corporate crowd-sourced innovation look like? How can it be described and modelled?

Characteristics of a future-ready Open Innovation 2.0 organisation

Given that innovation in an organisation that embraces OI2 and displays many characteristics of crowdsourcing, it is challenging to look for models that describe these crowdsourcing mechanisms — a model that identifies the dominant mechanisms and describes their relationships. Other issues

relate to how these mechanisms interact, which ones add to a more productive innovation outcome and which ones work the other way round.

Innovation modelling has a long tradition and, as with many organisation theories, it is the readiness for practical application that contributes to the body of knowledge and adoption by practitioners.

First, let us focus on the state of the art and distinguish four types of approaches in innovation practice:

1. innovation initiatives as separate programmes;
2. the set-up of a new organisation entity focused on innovation;
3. a top-down or bottom-up reorganisation to innovate the organisation;
4. acquisition of startups or innovative niche players.

These approaches are found in common practice in many corporations and, interestingly, in their current form provide a disturbing picture. Recent surveys [5] confirm this. The majority of organisations are not capable of becoming future-proof. Even if they are capable to a certain degree in doing so, they fail to deliver results fast enough [6].

In short, all of the mentioned approaches are too one sided. They have the following few things in common.

- They do not look into their organisation and identify where the right energy is present and how best to tap into it.
- They seem to have a specific innovation in scope, instead of growing the organisation. For instance the digital savviness of experts and managers on various levels is crucial for future success.
- They do not consider the customer to be completely central. At most, a business case perspective is taken, but the results for all innovations cannot be predicted upfront.

There are several characteristics mentioned in contemporary management literature [7] that apply to future-ready organisations. They stress:

- flexibility (learn quickly from mistakes and be able to adjust and adapt along the way to changing circumstances or different customer needs);
- create openness (co-create with different market players like customers, partners, suppliers or other complementary organisations that add value to the offered products and services; so decrease your organisation boundaries and let other insights and ideas in);
- entrepreneurship (strive to be a pioneer, be willing to take high risks, challenge your current business model and be disruptive yourself);
- right leadership (be good at encouraging and nurturing innovation and remove the elements that kill innovative processes within your organisation);
- customer centricity (put the customer at the heart of everything you do).

All of these elements are worthwhile and certainly true in becoming ready for the future. But we do think there is more to a future-proof organisation than the following commonly found items.

- The current wave of the agile way of working proves to be successful in solving long-lasting change initiatives or IT programmes. One element in particular which is very important is to be more agile, that is to form multidisciplinary teams that combine the expertise and competences of various people to work closely together and come up with solutions that otherwise — in traditional functional teams — would not have come up.
- Organisations need to become digital savvy on various levels — in particular the senior management. They must be sufficiently savvy to truly understand the challenges and possibilities that innovative, digital technology represents. And to act accordingly to shape the innovative organisation.
- In every organisation change happens where the energy of the people is high and the momentum is right. Those are the conditions to realise change, but they often quickly fade because of an organisation's structures and old traditions. What companies need to do is focus on an energy-driven environment. They need to think outside organisational structures and give space to employees to be creative and resourceful without dealing with too many organisation boundaries.

The magnetic organisation

All of these characteristics come together in the concept of the magnetic organisation. We describe this new organisation model with two dominant phenomena inspired by physics, namely 'entropy' and 'magnetism'.

Innovation entropy

Entropy is a measure of disorder within a system. High entropy indicates lots of disorder in a system, as opposed to low entropy, which indicates rigid structures. The notion of 'entropy' stems from thermophysics where it is, among others, applied to explain the behaviour of heat flow between objects, stating that heat will flow from warm objects to

colder objects, increasing the total disorder of the system. In information theory, entropy is a measure of information. Albeit with an inverse relationship: the more entropy, the more disorder and thus less information. Many scholars have also applied the notion of entropy to describe phenomena in human organisations [8]. This is a challenging field and has led to various uses of the term.

In this paper the notion 'innovation entropy' is introduced. It is a measure for the inherent innovation behaviour of people or groups of people. Low innovation entropy means that people are stuck to what their job description or task tells them to do and have little or no intrinsic drive to try something else. The organisation does what it did yesterday. No risks are taken nor improvements sought. A high degree of order is observed.

High innovation entropy means a lot of drive to change individual or group behaviour and many initiatives to try something else. People act and create, but in no particular direction. There is a high degree of disorder.

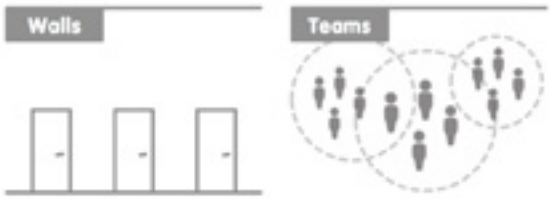
There is no prescription of the amount of innovation entropy that an organisation needs. Too little of it is no good, but too much is equally damaging.

The second thermophysics law states that entropy will at best stay what it is, or an increase can be translated to organisations as well. It then states that people or groups of people will effectively always tend to increase disorder. It is up to the organisation to accommodate this tendency. Put in a different way, people will act, either inside or outside the organisation, either with it or against it.

For an organisation to be effective in open innovation, the innovation entropy needs to be managed. It needs to break down inhibitors that keep people in their cubicles or rooms with doors closed. An organisation must ensure a lively debate on what can be changed and stimulate experimentation, whilst being able to manage a cooldown if experimentation is uncontrolled. This happens when the amount of initiatives and autonomous behaviour is accelerating beyond control. Typically, a happy medium is reached when there is a spontaneous formation of teams that formulate project ideas and initiate experiments. These teams are formed of people across the internal and external boundaries of the organisation and accept responsibility for spending their own and the organisations resources. They are willing to explain their findings and accept that there may be an end to their team effort if there is no greater benefit for others outside their own group.

Managing the innovation entropy is a process of give and take. At times the organisation needs to free up energy and create more disorder, followed by periods of 'cooling down' when ideas and experimental results are evaluated and pruned.

Figure 2: Open innovation requires open team interactions instead of walls and closed doors



What is needed next is a mechanism by which the innovation entropy of people or teams becomes directed instead of a random movement that may produce a lot of 'heat' but leaves the organisation as a whole stuck in the middle.

Magnetism to describe the attraction

Magnetism is a class of physical phenomena that is mediated by magnetic fields. A magnetic field creates a well-defined attractive force on objects that are susceptible to magnetism, like many metals. The magnetic field can be created and maintained by an electrical current through a coiled wire or by a permanent magnet — so-called ferromagnetism. The force of the magnetic field can be very powerful, like in electric motors, magnetic resonance imaging scanners or household permanent magnets. The force reduces quickly, typically in the order of the square distance or faster, and is effective on short distances up to centimetres for practical use in attracting and moving objects with a mass of several grams or more.

The effect can be felt on larger distances too, albeit on a subatomic scale, in moving electrons in an electromagnetic field (radio). On a terrestrial scale, it is our Earth's magnetic field.

The magnetic field and its attractive force form a powerful model of the attractive force that is

needed in an organisation to get people in motion and to direct this motion towards a common goal. This is illustrated with a metaphor.

Suppose the people in an organisation that move by themselves or are latent movers — the organisational units (OUs) — are represented by metal balls. Each ball can move on a flat surface freely. The surface can be the bottom of a box, representing the organisation boundaries when we think of closed innovation within a corporation, or the surface can be a large table in case of OI2.

What are the effects of the attractive force and how does it translate to an organisation?

- The attractive force results in a real change in the orientation of the individual OU. If they move already, their direction is diverted towards the magnet. If they were still inert, they may come into motion. In organisation terms this means that an attractive vision will 'pull' the OUs in a given direction.
- The attractive force can be amplified to have greater reach by applying a stronger magnet. This means by making the already attractive vision more compelling and/or communicating the vision more powerfully, it will have a direct effect.
- The attractive force can be induced in other OUs so that they too execute an attractive force on yet other OUs (this is because a magnet induces a magnetic field in the metal balls themselves. They provide an attractive force on others again). In an organisation this means that the vision is further distributed by ambassadors who pull others in the same direction.
- The attractive force can travel towards the OUs (moving the magnet closer to the metal balls). By bringing the attractive vision close enough, OUs will experience the attraction. Managing communication in intensity, frequency and clearness varies the effect of the attraction.
- Some negative effects can be identified too. Exerting the attractive force too close to the metal balls will make them accelerate towards the magnet and get stuck to it. This stops all free motion of the OUs. The entropy is zero and no innovation can be expected.
- Likewise, a magnet applied at too large a distance or infrequently has no effect on the metal balls at all. Although there is an attractive vision represented by a magnetic field, the effect on the OUs is zero. They either move freely around like before (innovation takes place in all directions), or they do not move at all (no innovation takes place).

Figure 3: Open innovation needs to be pull driven instead of driven by top-down push

In an OI2 organisation, innovation entropy and magnetic attraction are the two controls that matter the most. It is the task and challenge of people in leadership positions to make use of these controls and balance their adjustments. This is not an easy task and it is one which requires a new look on what leadership is. The good news is that it is already happening, as is demonstrated with the following practices.

The magnetic organisation in practice

Magnetism explained

The magnetic field and its attractive force as a model for understanding the innovation behaviour in an Open Innovation 2.0 setting, finds strong practical support from recent marketing and innovation diffusion theory [9].

Inspired by Simon Sinek's TED Talk [10] about the 'Golden Circle', many organisation have come to understand that people ide strongly identify with the purpose of an organisation than with the actuals products or services it brings to the market. In his famous talk Sinek introduced a simple model of three concentric circles with the Why at the centre and the How and What in the second and third circle. Sinek:

> 'Every single person and organisation in the planet knows what they do 100 %. Some know how they do it, whether you call it your differentiating proposition or proprietary process or USP. But very few people and organisations know why they do what they do. And by why I don't mean to make a profit — that's a result. It's always a result. By why I mean, what's your purpose? What's your cause? What's your belief? Why does your organisation exist?' [11]

Sinek argues that the strength of an organisational 'Why?' defines the level of identification with the organisation amongst internal and external target groups. The golden circle model [12] has gained much popularity over the last few years. Within the Netherlands the model has become a dominant branding workshop methodology.

The magnetic organisation model explains the underlying mechanism for this popularity because the 'Why?' is a practical implementation of the attractive force. It provides direction for people in what they do and how they do it.

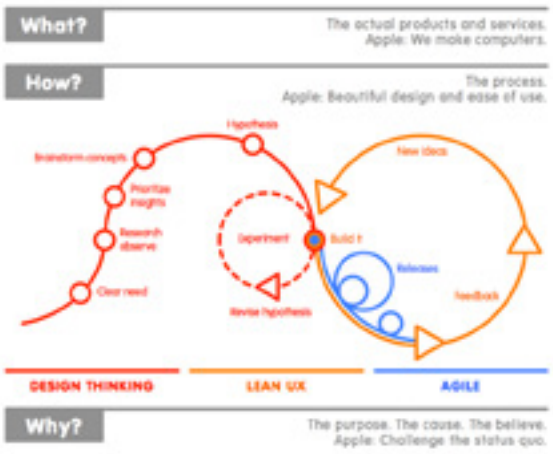
Entropy explained

In addition, the concept of entropy has also been translated into practical terms. One example is from the systems design and creative thinking community. Bud Cadell [13] proposed a model for systems design by placing design thinking, lean start-up and agility into one process model. It links the recursive and iterative functions of these methods to each other. At any given time, divergence (disorder) and convergence (order) are alternating.

In summary, the two practices can be combined into one another: Sinek's 'Why?' serves as an attractive force, while Cadell's process model manages entropy on the 'How?' level within Sinek's model.

The *figure* below depicts this combination and illustrates the implementation in the case of Apple computers.

Figure 4: A practical implementation of the metaphor



Conclusions and Outlook

To understand the workings of products and services creation in an OI2 network of small- and medium sized enterprises, knowledge institutes and citizens, the magnetic organisation model is presented. It fills the void in innovation modelling frameworks stemming from the fact that in OI2 networks there is an absence of hierarchical structures, checks, balances and control flow. These structures are the underlying organisational principle of a classic corporation. The idea of a 'corporation' gets a new meaning in OI2. It serves to provide up-scaling, critical mass and focus. It acts as a breeding ground for renewal and entrepreneurship.

Innovation in the context of the new corporation is described by the notion of innovation entropy and attractive field. These two measures act directly upon people and fit well with the reverse innovation pyramid that is characteristic for OI2 organisations.

Practical support for this applicability is found in the approaches of Sinek in the why-what-how organisational drivers and Cadell's construct of iterative systems design.

It is the ambition of the research collaboration of the authors to formulate an organisation model with characteristics, variables and constants that can be interpreted in terms of measurable quantities within the organisation. Such quantities are those that can be determined by means of observing, measuring, interviewing and analysing the organisation data and their behaviour. This will aid the organisations leadership to balance the two controls and perform well in an OI2 setting.

Three case studies are to be executed in 2016 to validate the expressive power of the magnetic organisation model and to illustrate how a balance in entropy and attractiveness would help these magnetic organisations to flourish and contribute in an OI2 society. A workshop methodology is under

construction to make these insights available in training and consultancy.

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Open data for open innovation

Abstract

Quadruple helix and Open Innovation 2.0 (OI2) are powerful concepts to describe the role of actors and their behaviours in a modern knowledge-based society. The importance of data is recognised widely but further work is needed to make the innovation pipeline utilising the data broadly accepted. New value creation will not take place in an optimum way unless a holistic, systemic understanding of the process is available. Trust is a fundamental element in our monetary system. Similarly, trust is a fundamental element in an emerging datumtary () system. Models of innovation processes deriving new value from data as the critical resource are discussed.

The data age has started

Information and communication technologies (ICT) have developed over the last 40 years, driven mainly by internal innovation responding to internal needs of the ICT industries. The global telecommunication network has been designed and developed almost only for telecom-specific services. The current mainstream telecom service based on 4G technologies, specifically long-term evolution (LTE) of the radio and system architecture evolution (SAE) of core network has adopted a high-throughput packet radio and a flat architecture to better support the fast-growing internet traffic. But the overall penetration of full digital services beyond telecom is only taking its early steps. The European Union is taking advantage of ICT-enabled opportunities slower than its main global competitors such as the United States and China.

Today almost all existing information has been digitised, as Nicholas Negroponte predicted some 20 years ago [1]. He did not, however, predict that digitalisation will take place also for material things, a transition which is currently shaping all industries in several fundamental ways. The Internet of Things and the industrial internet are shining dots on the hype curve, while too little system-level thinking has been applied to understand the deep behavioural changes that impact each and every traditional sector of our society. Observing clustering of actors and stakeholders is not enough. Understanding the importance of the true common aims and the role of interdependences as the drivers and constraints in ecosystem formations is needed. The difference between a random group of companies and ecosystems is like that between correlation and causality.

Our challenge is to extend Negroponte's observation to cover not only information but also all material aspects of our life, including our gadgets, our vehicles, our homes and finally also the material aspects of ourselves. Not only atoms but even electrons will have their primary existence augmented by bits. As an example, electrical energy will carry information of its origin, price and on other aspects which can add value to plain old electricity. For material 'things', the added value can be obviously much more versatile. In casual terms, we all will have our 'web presence' in the cloud, including web pages of our wallets and pockets, as well as our livers and other organs. Digitalisation will only be complete when there is nothing left without augmenting digital data. The data age has started.

Life in general always develops towards new raw materials as they become available. The new raw material of the data age is data itself. It is not enough to think just of complementing the world we know with some additional data, but rather we need to place data at the centre. We should not just add intelligence to our products but redesign our products to be added to the vast emerging cloud of intelligence. Peter Diamandis describes the impacts of scarce resource becoming abundant by making a difference between 10 % and 10 times the growth opportunities [2]. The question today is how we should deal with data to enable the 10-time growth, rather than be happy with the limping single-digit growth that we experience in the European Union today.

Data and trust

If we look at the history of gold as a raw material, a valuable metal and later as the reference value for money, we might be able to identify some useful analogies. During the years of uncertainty, gold was used directly to bring stability to economies in each country. Only after World War Two was the Bretton Woods system created, and today the credibility and the final value of money are based on trust in the responsible organisations and processes, rather than the value of the printed paper.

Big raw data is mined, processed and packetised using deep learning and other artificial intelligence methods to provide more and more valuable knowledge, and 1 day even wisdom for society [3]. The raw material will be there but we must pay more attention to the ways it is processed. We must have complete trust in how this process works. We know the enrichment process of gold and we know we can trust it. We need to learn how to deal with the enrichment process of data. We have already seen

some small incidents where trust in data enrichment has been compromised. As a broader phenomenon this may seriously jeopardise the value creation opportunities of the data age. Data without trust has no value. Therefore further work is needed to define the relevant trust models and processes for data, regardless of whether we talk about big data, small data or any derived information based on the data. Trust is needed to make the data valuable.

Trust is not a simple concept. Just a quick look at a dictionary can give 20 or more different interpretations or aspects of trust.

'Trust is both an emotional and logical act'. 'Trust may be based on law or in some cases trust can be a much more complex construct'.

A neutral way to address the question is to look at the structures that emerge from the data itself. To get started we can use mankind as a heuristic computing machine and observe if there are any general intuitive principal components that can be observed in the way we have been dealing with data. Key words such as predictability, value exchange methods, reciprocity and vulnerability or recovery mechanisms can be used to test the hypothesis.

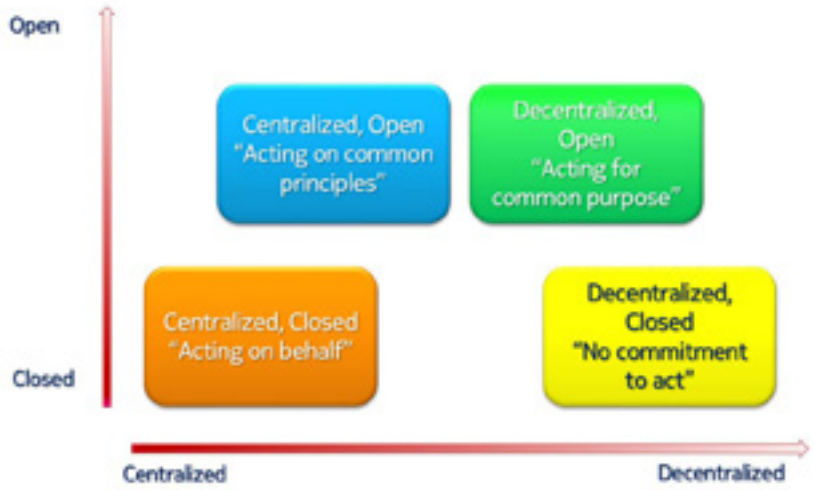
It seems that four intuitive principal ideas of trust can be identified. The first of the two strongest ideas seems to be where there is some kind of contractual trust in place. There are numerous mechanisms in our society to maintain trust this way and there are numerous ways to deal with situations where trust is not maintained. This is why we have courts of law.

The other strong idea seems to be based on social loyalty. There are numerous groups based on various ideas of common purpose and principles without any solid contractual arrangements. If trust is broken people typically just leave the group and ultimately this may lead to the decomposition of the whole group.

Both of these trust models are open based and rather transparent mechanisms. Contractual trust has a more ridged and centralised approach, while social trust is originally rather distributed, each group having its own trust asset. In the data age, digital mechanisms enable very large, even global, social systems to emerge. We may need to consider whether such large, often less transparent and rather centralised systems will maintain the expectations of the distributed and open social trust models of, for example, a local football team or a student choir.

The behaviours of these global networks lead us to look at trust models which are characteristically centralised and closed. Access to the data is limited and enrichment of the data is in the hands of the owners of the platforms. Some governments in less democratic countries drive a similar trust model towards their citizens. One common behaviour in very large social constructs seems to be the tendency towards a centralised attempt to act on behalf of their members. Trust is neither contracted nor socially fully accepted.

Figure 1: Fundamental trust models using centralisation and openness as principal dimensions



For completion of the 2 x 2 matrix using heuristic dimensions of openness and centralisation there is one corner where the trust model is also closed but not centralised. As an extreme case this is an environment where there is no trust whatsoever and the actors are working alone. One consequence of such a model is that identities are not needed and the data is fully anonymous. Data with this kind of trust model are not usable for any common activities but may still be valuable for each of those actors locally.

Innovation and trust

There are good reasons to believe that open innovation is the most competitive approach for value creation and also the best way to share the value among all the stakeholders, but at the same time we need to acknowledge the merits of closed innovation models. It is not by accident that the innovation models as defined by the Open Innovation Strategy and Policy Group (OISPG) are very similar to the trust models discussed here. The dimensions of openness and centralisation span the ecosystem space similarly independently of what the perspective is. Therefore a rational question arises: the Open Innovation 2.0 (OI2) model calls for open and active collaboration of all the possible parties, but has there been enough consideration of the prerequisites such as mutual trust between the stakeholders for a successful collaboration to really happen?

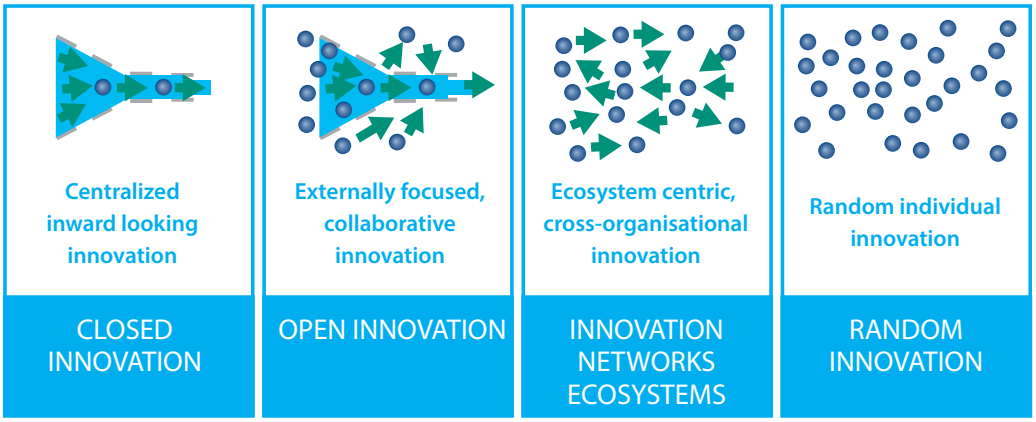
The quadruple helix (QH) used as the framework in the OI2 was introduced by Christer Asplund and Jörgen Eriksson [4] and can be seen as an evolution of the older triple helix thinking originally proposed by Henry Etzkowitz and Loet Leyderdorf [5].

The high-level innovation modelling in the OISPG follows the QH thinking by pointing out the four different segments being civil, business, academia and government. Asplund and Eriksson, however, argue that:

'The role of strong individuals who are resourceful, not in their capacity as legitimised role players in either of the three other (triple helix) organisations, but rather as resourceful individuals who are less well organised and normally not appointed by at least the classical institutions'.

This can be interpreted as an introduction of the fourth innovation model, decentralised closed innovation, in addition to the already well-defined centralised but closed innovation, (centralised) open innovation and (decentralised) innovation networks ecosystems. At least in this context we can call it random innovation. This way we will get a strong motivation to align the models of trust to the models of QH and OI2.

Figure 2: The four innovation models inspired by the QH model, completed

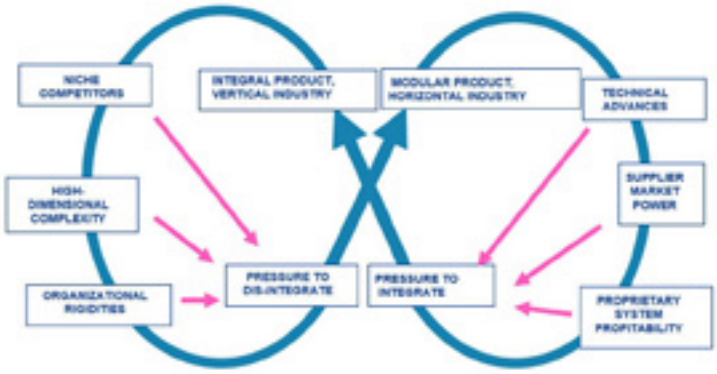


Separately from triple and quadruple helixes there is a third helix model which should not be confused with the two already mentioned. Charles Fine [6] proposed a double helix model to explain the eternal oscillation of the different value chain models between centralised and decentralised behaviours. Fine is indicating that there is no global optimum point in this oscillation but rather that the optimum point is moving forward as technologies and businesses gain maturity within their current operating point. Even if today's business thinking has developed from 'simple' supply chains to complex 'ecosystems' models, the role of openness and centralisation, periodic cycling between vertical products and horizontal platforms seems to repeat itself in a fractal way.

As a synthesis, the double helix oscillation can explain the eternal movement through the temporary leading roles of each of the four different corner points and lead actors of the quadruple helix. The double helix oscillation is driven by emerging

powers of technology and market innovations as counter measures to customers' dissatisfaction and stagnation. This is an important observation, since it raises the following question: is it possible in reality to have a fruitful collaboration between all the four stakeholder groups focusing on different innovations models all at the same time? Or, more optimistically, what are the ground rules we need to define for such a collaboration to happen? The critical testing point of that question could be the level of compatibility between the different trust models related to the data used and shared by the different QH stakeholders.

Figure 3: Double helix illustrates the oscillations in the supply chain between vertical/integral and horizontal/modular according to Charles Fine



Eternal evolution of innovations ideas

By noting the fourth innovation model as indicated by the QH, we avoid linear thinking towards any permanent end state. Random innovation may be seen as a smallest form of innovation, which normally is also the first early approach before more advanced innovation models are needed. However, recognising the fourth innovation model may help in our overall quest for seeking the viable combinations towards one fully holistic innovation framework. This approach also makes the QH and OISPG thinking fully aligned. Finally, we can also add to the discussion the different trust models of data-enrichment processes relevant for open as well as closed innovation concepts. Furthermore, we can add one more post-it note on trust to the 20 existing characteristics of OI2 as discussed in the 2015 OISPG yearbook [7].

In the context of vertical and horizontal business models, there is a need to look at the different clusters in ICT-driven industries. The double helix oscillation as defined by Fine takes place synchronously when there are strong ties and dependencies between the actors. If the ties are weaker or deliberately limited, for instance by regulation or open standards, the interrelation becomes asynchronous. There are needs to clarify the clusters for the data age especially because the role of consumers and their augmented digital presence is becoming one of the clusters on the same level as the currently, rather well-defined clusters of content, network and consumer devices. This need has been recognised but further work is needed [8]. Trust is also one of the critical factors to be considered for cross-cluster innovations. The clusters and their interaction become sustainable ecosystems only when all relevant interdependences including trust are fully understood and appreciated. Vertical bundling over regulatory borderlines is not going to be any easier issue in the future. Communications network technologies are already moving towards the 5G paradigm. This will create needs for other ICT clusters to follow, if not synchronously then at least asynchronously.

Innovation and data

The discussion on very fundamental aspects of life and business such as trust is useful when a suitable level of abstraction is chosen.

Figure 4: Innovations are needed to create value using raw material

The previous growth cycle in ICT can also be defined as an enrichment process of a raw material through extensive multiple innovations to valuable services for consumers. Value creation in telecommunications services is fundamentally an abstract enrichment process of radio spectrum. To bridge the gap between historical developments and the current topic, data-driven ecosystems can be seen more clearly if data is considered as a scarce resource like radio spectrum.

The current assumption is that there are lots and lots of data available. There are many plans to open even more, e.g. public data, to be available for anybody to create new businesses. As an example, significant publicly owned cartography databases are already open for anybody to create mobile applications in Finland. When there is such a large amount of data available and all that data can also be copied easily, how can we talk about data being a scarce resource?

In the early days of radio communication there was no scarcity of radio spectrum either, but as innovations open new opportunities, the availability of the raw material also becomes an issue, either because of the laws of physics or because of the issues within collaboration of the people. Tragedies of commons or anti-commons have been observed many times. When more and more valuable services are needed in real time, availability of the data as well as the speed of the enrichment process of the real-time data is not a trivial problem to be solved using the laws of physics. The scarcity is hiding in the first and higher derivatives of the data. What are the implications then for trust? Do we need to conceptually derivate trust too?

The scarcer a raw material is the more there are value creation opportunities through innovation. Complex value creation aims to exceed the arithmetic sum of the separate value propositions. These kinds of honeypots may be available when several innovation processes deal with several separate scarce resources at the same time. One such example is the emerging new mobility as a service (MaaS) paradigm, where scarce resources such as consumers' (mobility) data, road capacity and radio spectrum for mobile radio communications are all ingredients of the same converging innovation process. This observation easily leads to a question about the applicability of complex value generation in case the fundamentals of the separate innovation processes, for instance related to trust, are strongly misaligned. We cannot expect a guaranteed quality of service from self-driving cars if trust in the quality of data communications is best effort or the enrichment process for critical traffic data is not transparent [9]. Should this also require road capacity to be available on a commercial basis is a good question. Or even a broader question is whether the management processes of all scarce resources in the data age should be revisited. Should licences to scarce resources be aligned for a successful systemic business?

This may sound rather radical and liberal, or on the other hand even a rather old-fashioned, regulative-oriented approach. Obviously it is both. However, observations are derived from dependencies as must be done in case of ecosystems, and not only by accidental clustering where two or more assets happen to be at the same place at the same time. Causality is needed and correlation is not enough. And we might consider keeping the innovation models originally separate and invite them to converge only where appropriate.

The ubiquitous connectivity provided by different types of networking services makes all data technically available globally, but because of different ecosystem constraints, especially the trust in data and the different business models developing knowledge based on the data, value creation and innovation on data is a far more complicated matter. Following the concept for radio spectrum management, this leads to a consideration of whether there should be one international management system for data with the following four separate initial domains.

1. Data for governmental use only. Example: data for military and national security purposes.
2. Licensed data for commercial use. Example: traffic data about autonomous driving. Data is owned by the consumer but a commercial traffic

operator is licensed to manage it. Data portability between the operators.

3. Unlicensed data for social use. Example: social wellness data shared though the social wellness application within the community for the benefit of all the participants in the community.
4. Anonymous data. Example: data collected without any consent by the observed objects.

Conclusions

Four different types of innovation models are discussed in the context of four different trust levels. Mixing different innovation models can be done but it will require a careful approach to deal with the different requirements and expectations in each of the approaches. This is clearly valid for aspects of trust but should be considered in case of any other aspects of ownership and control. The challenges in making the different innovation models work together is not just a challenge for open innovation promoters. Similar challenges in different ways have been a hot potato in collaboration between different standardisation organisations for years. There are many examples of failure, but also some successes in how different approaches have been integrated into one functional setup. The recent European Telecommunications Standards Institute Summit on Standardisation and Open Source is a good example of practical work towards the OI2 environment, at least for Europe [10].

It is far too easy to assume that there is only one way of dealing with the data. Today the data age is only taking its first steps and it will take time to find broadly accepted agreements on how to deal with the data and with all the dimensions such as trust globally. We have some earlier examples where we have been able to develop working collaborative models to deal with such sensitive and abstract issues. There is no other way forward in the data age. We deserve a solid, rigid, flexible and efficient way to manage our key new raw material — data.

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Thought piece on societal innovation and futurising

Context

One of the milestones in open innovation collaborations, on the macrolevel, took place in December 2015 in Paris — COP21. A global agreement was reached among 196 parties as consensus on limiting global warming to less than 2 °C, compared to earlier escalating levels [1].

This agreement is said to be both an industrial as well as a societal challenge for planet Earth. Hopefully we will see a stream of eco-innovation, not only innovative household Tesla batteries, but also policy innovations on various organisational levels.

The further societal prototyping might take place with different impact investing models, e.g. circular economy, sharing economy, cross-disciplinary and cross-organisational, working together for the environment and the economy. As an initial outcome might we see a whole new glossary or taxonomy and metrics/key performance indicators for this emerging eco-paradigm? This will be a critical input for the innovation work of new ways of shaping and sharing the wealth creation.

Societal innovation

Societal innovation (SocInn) refers to a systemic change in the interplay of the state and civil society. It is a relative of social innovation, but differs from it by considering the state to be an important co-creator in achieving sustainable systemic change. In this sense, the term's origins lie beyond the traditional Anglo-Saxon understanding for the concept of social innovation [2]. A starting point is often the observation that the institutional systems of societies are obsolete in relation to its emerging societal and geopolitical context.

SocInn might be viewed in different perspectives, beyond social innovation:

- as a Lumification process or signal process for SocInn from knowledge navigators for sustainability navigation like in Ragusa (see later on in the article);
- as triggering reduced friction or peace innovation among citizens, by innovative harmonising of citizens' relational interaction, such as a knowledge café, the Aalto camp for societal innovation [3] or the BMW-Guggenheim Lab [4];
- as new societal rulemaking for a joint co-creative thrust, as COP21, or as civil rights innovations, like with MindLab in Denmark, pioneering specific e-lawmaking in Malaysia, the new business hybrid form the United States called Low-Profit Limited Liability company, Social Benefit Company in Australia or the legal reframing case by the Nobel Peace Prize awardees as a National Dialogue Quartet in Tunisia;
- as a usage of information and communications technology (ICT) and networking technologies for new types of democracy engagements, such as voting kiosks or distributed online community dialogues.

A learning case on a macrolevel might be the process behind and the construction of the European Union and the European Commission. It can be related to the four pillars of learning principles of its initial chairman Jacques Delors: learning to know, learning to do, learning to live together and learning to be [5].

Another pioneering case outside of Europe might be the Multimedia Super Corridor, initiated by the former prime minister to encourage the internet entrepreneurship and digitalisation of Malaysia, and the relevant rulemaking [6].

In Finland, after the collapse of the Soviet Union, there was a huge need for renewal and institutional refraining at many levels. As a critical driving force was the creation of a committee for the future, to address the societal thrust across political parties and old institutions to shape actions [7].

In Denmark some society leaders realised the need for Cabinet process renewal. Inspired by Skandia Future Centre, Rosted initiated the MindLab [8] as a collaborative thrust between the Ministry of Business and Growth, the Ministry of Education and the Ministry of Employment [8].

A recent experiment in progress is the cross-national science construct —European Spallation Lab in Lund [9] — for high acceleration research in physics. It is a cross-disciplinary lab as well as a cross-national funding together with the European Commission.

The above examples relate to the bullet points as an illustration of seeing the need for renewal (lumification) as a proactive reduction of tentative society friction by users' and citizens' involvement and usage of ICT to smartening, as well as reforming rulemaking in different contexts.

Open innovation of nations

Open innovation as a model developed by Henry Chesbrough [10] might be considered not only for enterprising, but also for nations to collaborate. The COP21 might be an illustration. We still have to explore the work model of open innovation for nations. Such macrolevel perspectives might be supported by navigational data in the work of national intellectual capital (NIC) as initiated within the New Club of Paris.

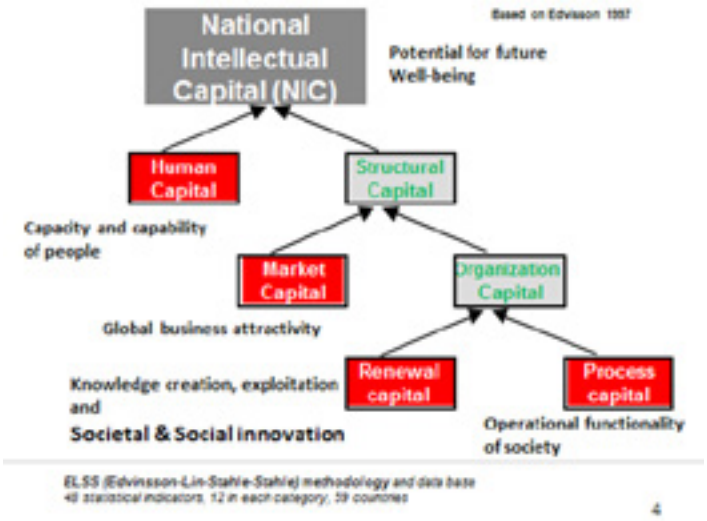
Now available through the New Club of Paris are databases for deepening the review of the progress of data of more than 50 countries, with more than 50 indicators, grouped into the NIC model. This is also referred to as the *Edvinsson, Lin, Stahle, Stahle* (ELSS) model model in *Figure 1*.

Figure 1: ELSS model of NIC

In these unique databases of the performance and development on the subject of NIC, it shows that in advanced economies, almost 75 % of growth and development can be traced back to NIC performance. NIC impact on GDP can vary from 16-72 % of GDP growth. It can also be observed that one of the critical dimensions is the renewal and innovation, not only of enterprises but of society as a whole. The fabric of society and its systems needs continuous renewal, not only maintenance.

Leading nations of NIC might be seen from maps of NIC [11]; [12]. A further look indicates the following top list: United States, Finland, Israel, Sweden, Denmark, Japan, Taiwan, Germany, Switzerland and Singapore. A more recent and detailed NIC research update on the renewal of capital of nations will be found in the continuously refined database.

Figure 2: NIC renewal



The most innovative nations reported by Bloomberg are South Korea, Germany, Sweden, Japan and Switzerland [13]. What is the implication outlook for Europe?

Historical research also indicates that national economy and well-being also go through cycles, as Dr Jay Forrester from Massachusetts Institute of Technology (MIT) documented in his book *World dynamics*. Combinatory insights also point out that the societal eroding catalyst might be in the intangibles or components of NIC. Cultural erosion and failing citizen dialogue systems might be some of them.

However, this is also a quest for more refined indicators than traditional economic perspectives. We still have to wait for such indicators from the sharing economy, circular economy, and so on. New eco-metrics for eco-mapping will emerge. Among those, trust-bridging relations capital metrics will be critical.

One of the pioneering eco-researchers is Professor Johan Rockström at Stockholm Resilience Centre [14], which was established in 2007 as part of Stockholm University. Stockholm Resilience Centre advances research on the governance of social-ecological systems with a special emphasis on resilience — the capacity to deal with change and continue to develop. Resilience has several distinctions, but the core might be in the ability to swiftly return to a previous healthy condition and to recover. Pioneering eco-metrics might be refined, such as in a SocInn index.

Another such societal leader who is said to be a man of extraordinary societal resilience was Nelson Mandela. In his legacy we might find a deeper dimension of collaborative and persistent models of societal cultivation and innovative policymaking for justice. A new important job function will be in the role of planet cultivators for the custody, preservation and navigational policymaking for futurising.

Societal innovation fabric and societal learning

One of the early pioneers with another perspective for its citizens is to be found in the old city of Dubrovnik, once also called Ragusa. There, for around 600 years, the citizens were living in peace, with a continuously growing economy. Its lumification intelligence was based on dragomans as knowledge navigators and diplomacy. Now, for the last 10 years, the e-students of Zagreb, together with New Club of Paris, have organised a summer school [15] to search for further insights into this unique societal construct.

Figure 3: Map of old Ragusa city with its intelligence fleet, by A. Dvir, 2015

In Ragusa, the societal fabric system was very much based on societal learning. There was a system for survival and defence based on diplomacy and societal intelligence, with special-knowledge navigators called dragomans stationed around the Mediterranean. There was also a specific educational system, amplified by the taxonomy of having the city mayor called rector/dean. This system gave the society a continuous well-being for around 600 years, up until the year 1806.

For the process of societal fabric weaving it has to be appealing, innovative, solid and continuously renewing. Unfortunately, the present situation in many leading economies seems to be characterised by what the founder of the Visa, Dee W. Hock, phrased as institutional failure.

This is a very serious alert for increasing social unrest, unemployment, financial debt burden on different levels and growing opportunity costs for future generations. SocInn might also be looked upon as a topic of justice for its citizens! Might the challenge be to find the ways to cross the chasm by new societal bridging systems?

In Tunisia this has been a process for 11 years, and with a pioneering National Dialogue Quartet of, among others, four thought leaders who were given the Nobel Peace Prize in December 2015 [16] 'for its decisive contribution to the building of a pluralistic democracy in Tunisia in the wake of the Jasmine Revolution of 2011'.

Peace Innovation Lab

In the quest for SocInn, a recently developed approach can be found in the Stanford Peace Innovation Lab [17] with several labs in Denmark as well as its spin-off into the Berlin Peace Innovation Lab. It has similarities to the early pioneering work in Skandia Future Centre, followed by MindLab in Copenhagen and now Future Centre Alliance in Japan. MindLab in Denmark has been evaluated to add to both the speed of policymaking as well as to the innovative content dimensions [18].

Soon, there will be a request for especially designed spaces for collaborative and thought leadership dialogues for fail-safe rapid prototyping. In Japan this is being pioneered by the Ministry of Economy, Trade and Industry as well as, among others, Professor Noburo Konno and his pioneering work, together with Professor Ikujiro Nonaka [19]. In their work on knowledge innovation management they are drawing upon the insights of both Asian and Western thought processing. Perhaps this would add to the resilience and peace innovation dimensions beyond the traditional management paradigm of competitive models. The peace innovation labs might be very instrumental for further prototyping of SocInn.

National open innovation and futurising steps on societal innovation

In the extension of COP21 combined with societal modelling of diplomacy and luminary intelligence, how do we take the next steps? Perhaps by looking into new digital social media models for cross-generational collaborations. Another exploration area might be a super-forecasting approach, as researched by Professor Philip E. Tetlock on the art and science of prediction from the University of California, Berkeley and the University of Pennsylvania [19]. It is about metrics for probability judgments on geopolitical predictions similar to weather predictions and improved probability scoring based on skilful/swift collective intelligence.

For societal leaders it is of the utmost urgency to address a process of reframing the institutional fabric of the knowledge economy. This will call for thought leadership, by the key work of future centres, among others, in the Netherlands. There, the innovating collaborative space was labelled LEF [20], which in English translates to courage. This is a pioneering space for the government on infrastructure challenges of The Netherlands with penta helix collaborations. This is very much highlighted in the abovementioned SocInn cases from different parts of the world. For the futurising of societal fabrics it is essential, along with institutional reframing, to address the not knowing — societal ignorance!

Pioneering steps for such an approach of SocInn 3.0 might include:

- refined and acknowledged unorthodox metrics for the societal navigation;
- cross-cultural appreciative inquiry for thought leadership and benchlearning;
- externalised innovation prototyping places, e.g. MindLab, peace innovation labs;
- leveraging the digital economy to shape new parallel hybrid parliamentary systems across generations, across institutions and across culture;
- prototyping the power of new digital currency, its implications for welfare and citizen well-being.

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Open Innovation 2.0 and higher education

A case of thesis process in social and healthcare education

Abstract

Principles regarding Open Innovation 2.0 (OI2) have been widely recognised [1]. Still, OI2 is mainly applied to areas such as industries and economics [2; 3].

Traditional models of providing education are being challenged by possibilities provided by new forms of learning. These issues relate to innovation [4] and development of work practices [5]. Innovation pedagogy serves as a wide concept bringing together different practices and ideals in pedagogy [6; 7].

Diak and the traditional thesis method

Diaconia University of Applied Sciences (Diak) is a Finnish institution of higher education. We train professionals in healthcare and social work, both domestically and globally. The Diak curriculum was reformed from January 2015 onwards. As part of that process, the thesis method was reformed as well.

Diak has bachelor's programmes in social work and healthcare, and a bachelor's programme in social services taught in English. The university also provides one master's-level programme taught in English. In Finnish, Diak has masters' programmes in both social work and healthcare.

Before these reforms, Diak's thesis procedure followed the traditional form. Students had to take a series of courses on the basics of research methodologies. These included observation, different kinds of interviews and survey methods. In fact, the thesis methods within the framework of Finnish universities of applied sciences should focus on the development of work processes and other practical development aims, rather than on 'pure' academic research. This means the research methods are applied to practical tasks such as finding out what is actually wrong in the working process of a certain clinic or finding out the views of parents and professionals on the development of preschool education in a certain community.

Despite this, the thesis followed the traditional pattern where a student or a pair of students plan, execute and evaluate a series of actions. Then, this process and the results are reported as a monograph type of the report [8; 9; 10; 11; 12].

New ideas for thesis process

During the reform of the thesis process principles of OI2 were applied, Diak wanted to form an open platform for innovation and development. This platform has to be able to serve businesses', governments' and civil societies' interests. The problem with virtual learning environments is that they are closed, where access is usually limited to the teachers and students. Representatives of businesses, governments or civil society cannot be easily integrated into these environments. They are not open for comments. This also means that they do not really serve needs of processes based on OI2. If an idea for a new project, service or business is presented on a traditional course, the only possible commentators are the teachers and students on that same course. Imagine if any expert could be invited to comment on the student's idea? What if this idea could then be developed in a direct contact with relevant business, government and civil society organisations?

It was our aim to develop an open platform to make this possible. In Diak there were earlier experiences to build upon [13]. Apart from the question of openness, there was another challenge. While Diak has a project portfolio (projects with domestic and EU funding), these projects had not been duly linked and integrated into the student's thesis processes. We needed a way to open thesis process to those outside the Diak organisation as well (projects, partners), and interlink our own project organisation into this open thesis process.

In order to serve the aforementioned aims, a technical solution had to be selected. Instead of this closed learning environment, we created a blog which inherently is an open platform. This blog creates what Salmelin [1] has called an engagement platform. It creates a possibility to publish and test ideas — with zero marginal costs.

Since Diak is an institution of higher education, the innovation process has to be articulated as syllabus. In the Diak model as shown in *Table 1*, the innovation cycle is understood as consisting of three stages: (i) innovation and planning; (ii) deployment; and (iii) evaluation and reporting.

Table 1: Stages of the Diak model

Innovation and planning	Deployment	Evaluation and reporting
Two semesters in student process	Two semesters in student process	Two semesters in student process
Students (i) get familiar with Diak partners and projects; (ii) produce ideas; (iii) plan their execution.	Students (i) work on different courses (ii) deploy ideas developed earlier; (iii) apply different methods of material gathering and development work; (iv) report on writing, statistics, videos and photographs.	Students (i) evaluate the outcome of the earlier stages; (ii) write further contributions if needed; (iii) write the summary report of the process.
Diak RDI –team integrated in the process	Ideas are deployed in co-operation with Diak partners and projects.	Reports and products are published with partners and projects.

Each stage is articulated into courses in the Diak curriculum. The process starts from the second semester and goes on through the rest of the studies.

Blog serves as an open platform

The blog for testing one's ideas is central during the first stage: innovation and planning. It consists of two courses, one focused purely on innovation and the other focused on creating a plan for executing and documenting one's idea. Students' ideas are based on the earlier Diak projects with domestic or EU funding and/or ongoing cooperation with our partners. These ideas are published in the blog. This means that ideas can be commented on by 'outsiders'; outsiders referring here to representatives of projects and organisations outside of Diak.

Apart from these comments from the outsiders, the Diak research, development and innovation (RDI) team is integrated into this stage. They comment on the ideas and connect and combine them into concepts and processes that already exist. Also, these ideas remain in the blog for the next generation of students to use. This creates a possibility for an accumulation of knowledge and understanding.

Then, during the deployment stage, students work with different organisations and deploy their plans and ideas. Despite the fact that the last stage is called evaluation and reporting, the latter takes place throughout the whole process. Students write shorter reports on each course — these reports are then evaluated at the beginning of the last stage of the process. The question is whether these reports make up a thesis that is coherent enough. Then a summary report is written and the thesis is published.

Conclusion

Since the new Diak curriculum has been active only since January 2015, one year later, in January 2016, students are only at the first stages of the process. For the blog, a beta version is employed. The deployment stage has not yet started with any of the groups. This means that a wider evaluation of the model is not yet available.

From the first experiences it is possible to conclude that students work eagerly in the process. Students produce ideas worth considering and developing further, also by professional Diak RDI staff. The model is flexible and provides possibilities to combine work and studies. As for the ecosystem, whether this kind of practice can stimulate or even create one remains an open question. Examples of online platforms used as a core for development processes do exist [5]. Discussion on innovation pedagogy [6, 7] provides conceptual tools for development.

The next step is to collect empirical data from the different points of views (students, staff, partners, etc.). Also, different practices that reach out towards our partners need to be remodelled to serve the current situation. All this will give a possibility for further development and also for more precise conceptual definitions within the model.

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CHAPTER II

Innovation ecosystems and living labs challenged by Open Innovation 2.0

When large companies build ecosystems, should small companies join? A role for open innovation

Abstract

The rise of the open innovation paradigm has encouraged the creation of innovation networks (ecosystems) involving a mix of partners: universities, research laboratories, start-up companies, small and medium-sized enterprises (SMEs), multinationals and governments. Physical proximity is an essential driver of open innovation effectiveness. It enables the exchange of ideas and inside/outside exploitation of knowledge and resources. This paper investigates how some large companies invested in key relationships with external innovation partners through the creation and the orchestration of open ecosystems (e.g. open research campuses). By contrast, small companies cannot afford to create and orchestrate their own local research ecosystem, but they do have the option to join or co-locate within existing ecosystems. This paper draws lessons from two of 13 case studies we collected, and compares and contrasts the experience of ecosystem builders and ecosystem joiners.

Introduction

Innovation ecosystem often refers to the combination of policies, ideas, institutions and regulations that shape the innovation framework of the European Union. In this paper, we specifically refer to the local physical ecosystem that surrounds innovators. One of the EU's targets is to improve competitiveness, increase employment and promote sustainable growth [1]. Innovation policies are seen as essential tools to fulfil these targets; however, to make innovation policies work effectively, an interactive system for value creation involving EU institutions, governments, firms and society at large needs to be promoted.

In this context, open innovation could help creating the optimal synergies necessary to prompt the shift from a traditional model of innovation — based on linear and vertically integrated research and development (R & D) — towards a more complex innovation system — based on interactions and knowledge flows. The innovation models that companies deploy affect the competiveness of innovation investments and, in general, the outcome.

The role of open innovation has been recently widely studied for both business and societal impact [2]. A prerogative of open innovation is the inclusion of different actors in innovation development; such as universities, industries, governments and civil societies recalling the quadruple helix innovation system [3].

Scholars generally agree that open innovation strategies (OIS) advance the exchange and integration of knowledge beyond the boundaries where it originates. The physical proximity of companies at different stages of the innovation process enables these companies to cooperate and share their scientific, technological and market knowledge to help the innovation process. Open innovation strategies encourage the improvement of technological capabilities within an ecosystem and also expand an ecosystem to reach a pareto superior outcome.

This process requires multiple players to implement OIS and requires these participants to apply mechanisms to distribute their spillovers. Only with cooperative implementation and incentive alignment can these participants reach a win-win scenario. This is particularly true in the case of interactions in open environments between large and small companies.

Open innovation in SMEs and large firms

Open innovation may encounter different obstacles and have different impacts when implemented by large firms or by SMEs. In general, large firms are thought to be more effective when implementing OIS as they are better positioned to orchestrate research partnerships and can exercise more power in (i) setting the agenda of large consortia; (ii) identifying clear benefits for partners; and (iii) boosting and spreading the OIS attitude throughout the industry [4]. Furthermore, large companies are more likely to give a central role to human resources management in order to achieve OIS goals and to adopt a long-term perspective, focusing on both the short-term benefits of technology alliances and the future objectives. Large companies may, however, face substantial managerial challenges to keep complex OIS under control and reap the benefits while ensuring business continuity.

On the opposite side, SMEs, given their structure and organisation, might lack the managerial and technical skill to successfully implement OIS. In particular, structural limitations (the so-called liability of smallness), such as the lack of financial resources, low market influence, less formalised R & D procedures, small innovation portfolio and shortness of ability in R & D planning and management with respect to large firms constituting an obstacle for the implementation of OIS. Moreover, the existence of less developed internal capabilities (e.g. the capabilities necessary to transform inventions into innovative products and processes) and the absence of a multidisciplinary competence base may lead SMEs to perform rather unstructured approaches in the organisation of the innovation processes with respect to large firms [5]. On the other hand, the lighter structure of SMEs increases their ability to fast reacting, to changing environment and to quickly adapting to new business models.

Taking into account these structural differences, the implementation of OIS in SMEs may prove to be beneficial and could help to overcome the limitation related to their size. In this perspective, the full integration of SMEs in open ecosystems set by large firms could come as an opportunity for SMEs.

In particular, innovation partnership with large firms can allow SMEs to access external knowledge to develop new technologies, explore new business ideas and commercialise new products. An open ecosystem can provide SMEs with financial support, protection from competitors through the enforcement of intellectual property (i.e. appropriation strategies), access to complementary assets such as production facilities, complementary market knowledge and new distribution channels (i.e. business model innovation).

On the other side, collaboration between large firms and SMEs could develop into the dependence of SMEs on large companies to generate value from their technologies. This strategic dependence together with SMEs' limited ability to profit from their intellectual property may raise issues of technology and value appropriability. SMEs that collaborate with large companies may become locked in. In other words, the profitability of an SME that collaborates and/or licenses its technology to a large company may depend, to a large extent, on the strategic decisions of the latter.

In light of this, for open innovation to succeed it is important to create an ecosystem able to grant benefits to both SMEs and large firms.

The following conversation rests upon case studies collected for a larger study entitled 'European innovation policies for the digital shift' [3]. The following paper discusses two of these case studies in detail: (i) Royal Philips of the Netherlands (Philips) as an example of a large company that created its own ecosystem (an open research campus) in order to evolve from a closed R & D setting to a more open one; (ii) Primo1D, an SME born within the ecosystem of a large entity. Primo1D benefited from being part of a larger ecosystem before it could develop its own. Open innovation allowed for both of these experiences to ever occur and be successful.

The case of Philips

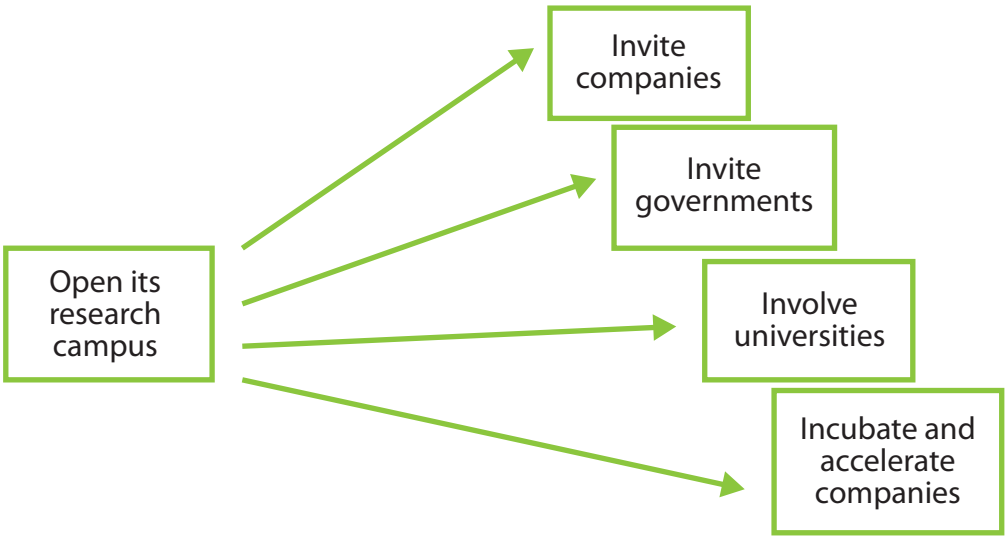
Philips epitomises the open innovation principle because of the way it fully embraced the open innovation paradigm since its inception. As such, Philips has been one of the most studied open innovation implementer [6].

Since 2003, Philips has adopted an open innovation strategy and opened its High Tech Campus Eindhoven to external companies [7]: the Philips research lab literally and figuratively tore down its walls to other technological companies, universities, research institutions and talents. Philips describes this move as part of an evolution from a closed innovation approach to the establishment of different partnerships to an open innovation model of strategic joint research programmes [8].

Companies came to use the facilities but also to be close to one of the largest Dutch multinationals. Beyond private actors, Philips attracted public actors and helped create the Holst Centre, an independent open innovation R & D centre and a Belgian–Dutch partnership on the Eindhoven campus which now encompasses over 160 employees [9].

Philips has proactively orchestrated these changes and put itself at the centre of these interactions.

Figure 1: Actions taken by Philips



A research programme manager at Philips responsible for public–private partnership and Ph.D. and European projects stated:

'Open innovation for Philips meant open innovation in the research complex, involving SMEs, spin-offs and suppliers connected to the company' [10].

While open innovation does not require a local ecosystem, the case of Philips suggests that geographic proximity plays an important role for better relationships and allows for direct communication. Having a physical campus has undeniably helped Philips in their application of open innovation and, in particular, to benefit from results of the activities shared among partners.

Open innovation is helping Philips in the present but also for the future. Specifically, Philips has opened its research campus to universities in what they see as a win-win relationship. Philips created Ph.D. programmes where students would use the facilities and learn from Philips staff, and in return Philips could train 'people with skills and abilities that Philips needs' in the hope of 'hiring [them] after the four years of the programmes.' This strategy put a strong emphasis on the attraction and retention of talented individuals.

Primo1D

Primo1D is a French start-up that was born and incubated on the Grenoble research campus of the Commissariat à l'énergie atomique et aux énergies alternatives (CEA). Central to its innovation development was the use of the CEA Laboratory for Electronics and Information Technology (CEA-Leti) [11]. CEA-Leti is one part of a larger research campus, the Minatec Technology Campus [12]. Minatec boasts 10 000 m^2 of clean rooms, initially cost close to EUR 200 million [13] and has already received additional assets upward of EUR 150 million [14].

As a CEA employee, one of the Primo1D founders created this new company as a technology spin-off of CEA in order to commercialise the technology outside the research ecosystem. Primo1D has an exclusive licence on the technology developed and patented inside CEA.

Primo1D benefited from continuous access to the R & D and management department of a larger entity. In exchange, CEA took 15 % of the spin-off share and Primo1D also pays the intellectual property licence through a mix of fixed fees and royalties on the future turnovers.

Since its inception, Primo1D partnered in an EU framework programme entitled the platform for advanced smart textile applications (PASTA) project. The PASTA project has 16 other members and extended Primo1D's network beyond CEA and Minatec [15].

On the one hand, opening up to its local ecosystem and participating in the EU framework programme allowed Primo1D to refine its technological capabilities; on the other hand, its interaction with different open ecosystems (such as Techtera Lyon cluster specialised in textiles) enabled Primo1D to refine its business model by accessing key market knowledge.

Implications

It is difficult to go past the fact that Philips's OIS evolved around the opening up of its research campus. Opening its campus allowed Philips to pull other companies — large and small — into the same physical ecosystem. A wide range of companies joined HTCE, including multinationals such as IBM and Intel. Others were born on the campus through collaborations or spin-offs.

Since this opening, Philips has decided to divest its interest in the research park and to become just 'another tenant' to further open this environment [16]. Philips, however, retains the largest presence on campus [17]. Divesting its ownership allowed the campus to become even more open and welcoming to companies sceptic about Philips's intents (e.g. was Philips inviting them to learn its trade secret?).

SMEs do not have the scale to create, manage and ultimately open their own research facilities and they usually lack the pull to attract other companies. SMEs can, however, join these types of facilities and become a node in a large open innovation hub, as was the case of Primo1D.

Becoming a node often means giving up some freedom of operation. These open innovation physical clusters often are specialised. For instance, CEA-Leti is a specialised research facility within a larger specialised research park. Picking up the correct open innovation clusters can lead to intricate path-dependency implications. It will dictate who the other nodes will be, what nodes end up interacting, and from whom they can benefit. If an SME evolves across fields, it must make a difficult decision. While Primo1D was born within a nanotech lab, it evolved across industries, through microelectronics to 'smart' textiles.

However, through other open innovation methods, these SMEs can become more than a node. Instead, these SMEs can build their own (virtual) ecosystem and become the entry to other contributors. Primo1D showed that, through its framework programme participation, it was able to join a consortium of companies and universities far and away. Open innovation goes beyond the local ecosystem.

These clusters can also be supported by governmental entities. As with the case of CEA-Leti, the public–private partnership has led to one of the largest and most modern research facilities. The extensive fixed cost to build these open innovation clusters can be led by private entities like Philips, but they can also be created by governmental entities like CEA-Leti. With larger fixed costs, the future seems that it will require further cooperation. Better understanding the intricacies of open innovation can only lead public and private participants to a win-win scenario.

Conclusion

Open ecosystems may act as a stepping stone for SMEs with growth ambitions. They may provide the necessary tools for SMEs to outgrow their size, put them on a sustainable growth path and secure new sources of competitive advantages (e.g. identify new interesting markets to apply their competences). However, at a later stage SMEs cannot rely only on the ecosystem offered by other individuals but need to start creating their own. In the case of Primo1D, the SME went outside its ecosystem. A company, whether large or small, that wants to grow needs to do the same.

Large companies have enough pull to create a physical ecosystem that resembles their networking ecosystem. SMEs cannot create this physical environment; to be close to other members of their ecosystem, they must rely on other means such as virtual meetings and consortia.

From our case studies, open innovation principles offer some guidance on how to create a valuable ecosystem. First, companies ought to focus their efforts on their ecosystem. If they develop technologies that are not central to their business model, they may benefit from licensing out the ideas; or they may develop a new business model to accommodate this new technology and identify new avenues for sustainable future growth. Having an ecosystem where a company can safely share their ideas and advances can help them decide how to exploit unused (non-core) technologies through open business models.

Second, companies ought to find ways to benefit from their ecosystem. Companies need profits to survive. Therefore, appropriability inside ecosystems is an issue both for SMEs and for large companies. Intellectual property protections allow companies to monetise some of the ideas they give away and send outside their own value chain. Selecting an ecosystem and its members becomes crucial: even with the correct protection, enforcing its right can be costly and counterproductive, which lead some companies to rely on trade secrets; having trustee ecosystem partners avoids having to wonder about these protections.

Third, companies ought to give and take. Creating an ecosystem around itself does not signify that the company must only receive information. Instead, open innovation functions better when the nodes of the ecosystem actively participate. For instance, lately the focus has been on user involvement: their involvement means that they recognise the creation

as their own and are more likely to adopt it. Key challenges for OI2 are (1) the efficient inclusion of users to ecosystems in order to exchange relevant ideas, knowledge and technologies; and (2) to identify the right appropriation mechanisms that ensure return on investments and keep users engaged.

For a full analysis of the 13 case studies, refer to the forthcoming Euripidis report.

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Open Innovation 2.0 and the digital single market

Abstract

To write this article I was inspired by the feedback to my recent blog post: 'Open Innovation 2.0 (OI2) for future cities' [1] and my professional visits to different stakeholders representing government, business, research, SMEs and citizens promoting and expanding the Open Innovation Strategy and Policy Group's (OISPG) [2] activities at a global level, in particular my visit to CGI Group, Inc. in Montreal, Canada, and meeting regional government and other stakeholders. The responses I received on the OI2 vision I saw as a timely alarm to apply the OI2 approaches into the real world.

In this article I elaborate on the establishment of an effective OI2 ecosystem and scaling it up from a city level into a regional level and beyond. I also discuss arguments and analysis of OI2 considering the 'Think big, start small, accelerate fast' approach. Finally, I explain one of the ten EU Commission's priorities, digital single market (DSM), and how combining OI2 approaches into it can contribute in multiplying the social and economic values for all stakeholders involved.

Introduction

Recently I published a blog post 'Open Innovation 2.0 (OI2) for future cities' [1]. The text was targeted to the business readers, which is usually the most challenging participant group in the OI2 ecosystem in terms of accepting and understanding the direct business values of OI2. To my surprise, I got a lot of feedback on my blog post, most of which expressing high interest in the topic as potential value proposition to clients, asking clarifications on specific details of how it works, even making appointments with me to better understand how we can incorporate OI2 into industrial or business strategies and how the stakeholders can gain maximum value and tangible results.

I also had a professional visit to the CGI Group, Inc. head office in Canada (Montreal, Quebec) to contribute to a smart cities high-level conference organised by *Les affaires* [3] where I introduced the European Commission's digital agenda, smart cities' programmes, Horizon 2020, public–private people partnership (PPPP) and the OISPG's activities as ways of supporting the operationalisation of the concepts. Here I had opportunities to meet different stakeholders (government officials, businesses both large and small, researchers and citizens) who also quickly embraced the OI2 philosophy and shared their vision on efficient collaboration among the stakeholders in such an ecosystem.

It was energising and exciting to receive the aforesaid feedback, which I viewed as a sign that it is now time to make it happen! I have been contributing in a number of innovations, including open innovation (OI) topics, and based on my experience the time an innovative idea comes into realisation and adoption by application areas and the market might take approximately 8 to 10 years. Then I looked back and realised that it was exactly about a decade since I had been contributing to the topic. So, is now really the time to put it into practice?

Then I looked back to my publications on the topic and the activities of OISPG [4] and thought about the right timing of turning OI2 values and approaches into tangible outcomes for all the stakeholders (government, businesses, academia and citizens).

So, I started to visualise the next steps and how we can make the ecosystem even more efficient and operational.

OI2 has drawn considerable attention in the last years, recognised by some of the world leaders [5] [6] and now we see growing trends to experience it in practice. This is an opportunity which we need to take advantage of now.

Think big, start small, accelerate fast

Referring to the concluding sentence 'Think big, start small, accelerate fast!' in my paper 'Open innovation in smart cities: the rise of digital entrepreneurs' [7], I would like to apply this approach in this paper to further elaborate on OI2.

Let us start with '**think big**'. Thinking big can be considered as the core of OI2 itself laying in the quadruple helix model where government, industry, academia and civil participants work together to co-create the future and drive structural changes far beyond the scope of what any one organisation or person could do alone. We take this as our vision, big thinking, and see how we can achieve it.

Now let us see what '**start small**' means in this context. There can be several answers to this.

However, I suggest starting OI2 approaches in a city context. I perceive a city as a small environment and, therefore, a small element in the process. If we understand the challenges of OI2 in a city context and are able to identify ways to create an efficient ecosystem in a city environment, then we will be able to replicate the successful methods in a regional level and beyond.

Finally, '**accelerate fast**', which in this context I suggest understanding the following: we need to be able to rapidly scale up the effective approaches of OI2 from a city to regions, from regions to countries, from countries to the European Union and beyond. The speed is critically important nowadays because we are living a permanent digital revolution and digital transformation is happening very fast. If we are slow, we will miss considerable opportunities and we will fail in achieving our big thinking objectives.

Figure 1: Visualising the term 'accelerate fast'

What is OI2 for future cities?

During the last years several studies have suggested methods for smart, sustainable cities and citizen collaboration with the goal of social benefit. Leading companies have offered ways to implement different sustainable city or regions solutions with the aim of gaining maximum value for all stakeholders involved. Engaging citizens in this process is another challenge and, to date, there is no clear method for effectively engaging citizens in the OI process and using social capital as a key factor.

Let us try to understand what OI2 is for stakeholders, for future cities and from there we can zoom into regions and even further.

The future cities vision is about the effective integration of physical, digital and human systems to deliver a sustainable, prosperous and inclusive life for citizens. OI2 for cities is about extensive collaboration among local government, businesses, researchers and citizens — where all participants jointly create the future city vision. It is about sharing ideas, results and intellectual creativity to maximise economic and social impact.

Collaborative skills and open data, as well as shared ideas, values and processes: all of these are needed to generate a wealth of benefits for future cities and their citizens.

The future cities ecosystem is becoming more complex due to evolving factors influencing each stakeholder group. Businesses want to make more money, researchers seek new scientific advancements, citizens want inclusive society and a better life, and governments want to create a sustainable environment.

New methods are needed to empower citizen engagement through technology-intensive, user-driven services. Moving from theory to practice and creating a functional OI ecosystem requires that such methods need to be tested in practice, not just studied academically. This experimentation should take place in cities with different attributes (e.g., size, geography, climate, culture, etc.) to understand how to scale based on a common, truly effective and valuable representation of a future cities ecosystem. Involving citizens in the innovation process will allow for rapid prototyping that can foster entrepreneurship, create jobs and boost sustainable growth.

Then we move to the next challenge. Assuming that we succeeded to create an effective future city ecosystem as we defined above, then we need to be able to replicate the method in as many cities as possible to make other cities also smart and embrace the OI2 values, social and economic growth, scientific development and value (co-)creation for all.

Cities, even situated in the same country, can be very different by their nature, culture, diversity and societal capital. For instance, there is a big difference between Amsterdam and Groningen, London and Preston, Stockholm and Kiruna, Milan and

Palermo, Helsinki and Oulu, Montreal and Calgary, New York City and Los Angeles, etc. Therefore, in order to be able to replicate an effective model for all cities we need to carefully analyse the commonalities, peculiarities and eventual trends for each of the cities to create a model which will work for all.

If we look into all participants in a smart city ecosystem (government, business, academia/research and citizens) in all types of cities, there is a common trend: businesses want to make (more) money, researchers seek novel scientific breakthroughs, citizens want a better life, and governments want to support well-being and sustainability and secure a better place for all stakeholders.

I am convinced the success of future cities requires these three things:

1. an effective, open innovation ecosystem;
2. sustainability;
3. collaboration with citizens based on social capital.

Figure 2: Digital future city, citizens' collaboration

What is OI2 for future regions?

Now let us try to zoom out from cities to regions. Regions consist of cities of different characteristics. If we extend the vision of the future cities, we can conclude that the future regions are about effective integration of smart cities into a more efficient ecosystem containing the elements of future cities: physical, digital and human systems, delivering a sustainable and inclusive life for citizens. The role of the people participating in the process is again crucial.

Scaling up OI2 from cities into regions, we need to create a combined vision of an effective OI2 ecosystem in the context of future regions. If we look only into the regions of the European Union, there are about 360 regions consisting of more than 100 000 cities, each of them having different characteristics.

EU regional innovation must unite public, private and third sectors and Europe needs methodologies that mobilises PPPP and encourages people participation through user-driven OI and living labs,

argues Markku Markkula, the President of the European Committee of the Regions [8].

Agreeing with Markku Markkula and further elaborating the OI2 in the context of regions, in my view, OI2 for future regions is not only about effective integration of future cities vision, but also about collaboration, co-creation and sharing among the regional government, industry, researchers and citizens of the region, all contributing to a creation of common values.

One important aspect is 'the speed' of integration, co-creation and collaboration. We must accelerate fast to sustain a place in the current, rapidly growing digital world, and only then can we gain leadership in the global market.

OI2 for beyond the future cities and regions

To continue the line of thinking from a city to a region, let us now try to zoom further. Each Member State of the European Union consists of number of regions. From regions, if we scale up into a country level, we need to look into the meaning of OI2 from each country perspective. For example, in The Netherlands there are 12 provinces (regions) with different characteristics and socioeconomic values. We need to combine them and find the commonalities of these 12 provinces to be able to create efficient ecosystem. I believe that OI2 in each Member State is about effective integration of their own regional values and ecosystems, together with extensive collaboration, co-creation and sharing of ideas and values among them to create a better country for all stakeholders.

There are 28 states in Europe which are members of the European Union. Europe's societal capital is unique in terms of diversity. Collaboration, co-creation and sharing values of diverse countries are challenging tasks. On the other hand, the maximum value for all stakeholders in the ecosystem can be earned in the multicultural and diverse environment as there is always another or complementary point of view on the same idea/solution, which will allow enriching the horizon of understanding of complexity and seeing new added value. If all Member States extensively collaborate, co-create and share values together, then we can consider that OI2 has been successful. Some models and methods are offered within 'Socioeconomic impact of open service innovation' [9] which are useful. There is still much that needs to be done to properly establish OI2 in Europe.

OI2 and the DSM

Let us recall what OI2 means as defined by the OISPG group. OI2 is a new paradigm based on a quadruple helix model where government, industry, academia and civil participants work together to co-create the future and drive structural changes far beyond the scope of what any one organisation or person could do alone. This model also encompasses (citizen/)user-oriented innovation models to take full advantage of ideas' cross-fertilisation leading to experimentation and prototyping in real-world setting [2] [10].

In response to the global crisis of 2008, the Europe 2020 [11] strategy was created in 2010 with the aim of Europe becoming a smart, sustainable and inclusive economy by 2020. As one of the seven pillars of the Europe 2020 agenda, the digital agenda for Europe was created [12], which is the European Commission's action plan to speed up the economic recovery. The main objective of digital agenda Europe is to develop a DSM [13] as a key enabler to reach the Europe 2020 strategy.

Why DSM? As the internet and digital technologies are developing rapidly and transforming our world, there are online barriers which do not allow citizens to take maximum benefits on goods and services. Companies cannot expand their horizon of doing business, focusing only on local markets, businesses and governments are not able to fully benefit from digital tools which they need. In addition, there are 28 national markets with their own regulations which make cross-border activities very complex and inefficient. The DSM aims at tearing down regulatory walls and moving from 28 national markets to a single one. However, it is moving quite slowly and we need to act urgently.

I strongly believe that the DSM can be achieved faster and in a more efficient way if the core values of OI2 are embraced.

On the other hand, the DSM can speed up the creation of OI2 effective ecosystems, turning Europe into a powerful economy, an exclusive place to live and work and a bearer of societal excellence.

Figure 3: New illustration of the DSM with OI2

I propose a new illustration of the DSM combined with OI2 approaches as shown above in *Figure 3*.

If the framework supporting OI2 approaches is strengthened by European policymakers, I believe the DSM, combined with OI2 approaches, can contribute in multiplying the social and economic values for all stakeholders involved and can create hundreds of thousands of new jobs, which Europe desperately needs today. It is time to act urgently.

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Power of user communities affecting decision-making in innovation ecosystems

Abstract
Achieving success in a lot of businesses requires more than simply telling everyone about the new way that things are going to be done. Acceptance of change — processes, services, working relationships, policies and more — can be accelerated across the organisation through the real-time sharing of experiences. Networking and collaboration technologies are extremely effective ways of bringing experts together to perform new processes and to share experiences — both the success stories and the possible setbacks. Citizens, also business stakeholders, with common interests or related roles can form communities to learn from and support one another. Social media can also help in cases where creating a more collaborative culture is one of the major objectives of the change management. The subject is about the crowd of user communities that affects decision-making in innovation ecosystems.

Creation of strong users' community culture via social media

The online collaboration and networking platforms are empowering experts, customers and partners to be active participants in global terms. New business models should be created based on collaboration and networking platforms where all engaged stakeholders can participate in the creation of final products or services [1]. Crowdsourcing of knowledge based on Social Media Technologies (SMTs) can be the future of creating successful companies with a large share at the market due to the co-development of ideas co-creation of products/services. Collaborative culture incorporated into business is one of the basic characteristics that determine the successful positioning of the company at the market.

USTRANSCOM, a company from the United States, has launched several social media initiatives including an executive blog and a Q & A blog hosted on the command's intranet, as well as a public presence on Facebook and Twitter. The executive blog (which has been recognised by the United States Department of Defence as a best practice) enables executives to hear from staff directly, without having messages filtered through intermediate management levels. These social media tools — which quickly generated more than 5 million impressions — have flattened the organisational hierarchy and driven positive corporate culture shifts, as measured by an annual staff survey.

Figure 1: Crowd of the users' community [7]

A critical issue for ecosystems that should be addressed is trust building. All actors involved in the communication should be secured via suitable social media platforms [2]. This would require different rules for social platforms in the future. There is a need for researchers to elaborate more on the issue of providing safe ecosystems to address the needs of all participants in the communication process. Trust is the precondition to build an effective working environment that can contribute to successful business projects.

Informal communication is also one of the means for creating a successful business. Networks of professionals sharing information online should be ensured to have stable platforms that work successfully. Informal communication among experts should be supported by various online tools [2]. Cross-disciplinary communication is also very important; personal or profiled contacts from different fields sharing their knowledge and experience via SMTs could be the starting point for many new ideas that improve state-of-the-art science. At a later phase, projects in

real-term settings could develop. Such environments should be created by the SMTs. Social media tools provide an effective communications medium — for the core change programme teams and across the organisation as a whole—as a large-scale change initiative proceeds. In addition, by monitoring and participating in online discussions, managers can more readily see where any misunderstandings exist across the enterprise and take steps to address them. For example, one global resources company recently established a presence on Yammer, a secure and enterprise-strength social network that enables co-workers to communicate and share information with one another. Seventy per cent of the company's team members signed up for Yammer after its initial launch and 25 groups were created to discuss work-related issues. Today, about 2 000 messages are posted each month.

Team leaders' presence in social media-based collaboration platforms is essential. Collaboration tools can actually undermine change effectiveness if they merely cause confusion and discontent to multiply across social networking sites. Management must establish a mechanism for delivering the 'voice of truth' — an authoritative, trusted and believable source of information. The input should be easy to use, contribute to and trace if being used as part of future innovation. When there is a business idea at the beginning, team leaders should ensure that there is the encouragement in the form of a reward already at the start of the process of innovation. This idea reinforces that social media can be used by employees not only to voice ideas and concerns but also to get accurate and credible answers regarding the company's change effort.

Effective two-way communication is very important for companies to get feedback from the employees and consumers so that it can help improving business processes or end-products and services. Involvement of users from the beginning in the process of product/service development creates new market in order to satisfy users' needs. The quadruple helix open innovation model is showing the importance of engaging users in order to make the competitive advantage of companies at the market.

Improvement of community engagement via the OI2 paradigm

One of the critical success factors for managing large-scale change in the organisation is engaging employees in the change — helping them to feel ownership in the initiative and let them use their energy to resolve issues and advance the business. Collaboration solutions allow information to flow in multiple directions rather than just top-down. For example, using wikis and microblogs — applications for sharing short bursts of information in Twitter-like fashion — organisations can 'crowdsource' ideas and involve employees more directly in the change programme. Organisations can build greater internal loyalty by actively soliciting continuous feedback on issues related to the change. One United States bank initiated a major change programme to improve the customer experience as a means of gaining market share. The bank leveraged a crowdsourcing tool to tap into its workforce for ideas about how to improve customer service. Therefore, open engagement platforms are critical enablers for the OI2 paradigm, beyond the usual social media. It is evident especially in affordable prototyping and scale-up, e.g. the mobile application development. The key to success is providing such open engagement platforms that foster innovation ecosystems for creating jobs and growth. In the first use of the tool, more than 250 employees submitted 50 separate ideas resulting in seven high-quality innovations for the company — many of which resulted in programmes that have generated value for the bank. There is the strong link of users' community engagement and the success of the OI2 paradigm applied to new business models. It should be ensured that various channels of communication stay open as well as that of the OI environment that fosters creation of jobs and growth.

Creating OI culture

OI is a process designed to accelerate innovation through collaboration [3]. Traditionally companies create value by internal available resources. OI involves external partners to the process of developing new business opportunities. Products and services created in an OI environment better fit the customer's needs since they are engaged in shaping the outcome of the idea.

The OI environment represents the most suitable ecosystem for creating value at the market. It is a challenge for traditional companies to create them because moving from something already established and familiar to the new concept always represents stress to the people. The success is dependent on all engaged stakeholders and therefore the special attention should be paid to the people whose creativity, skills and knowledge create the core of every successful market realisation. Thus the OI environment has to be stimulating, easy to use, challenging and fun for the people involved. More on OI in [4], [5], [6].

Figure 2: The relation between community and budget [8]

The following are some of the issues that need to be considered carefully when creating OI environment.

- Overcoming the scepticism of the employees if new OI environment will really work. Change managers together with HR services should take care of this issue using available motivational tools. Motivation is a precondition for success.
- Engaging all stakeholders in creating value at the market through products or services that are important for all of them. Creating the win-win situation is very important as an incentive for people to really try to put the effort, knowledge and passion for success into the business.
- Being careful about intellectual property right (IPR) issues at the early stages. As seen from various innovation projects, IPR issues are nowadays more in compliance with traditional linear innovation [11]. Rules should be changed regarding IPR, especially about fair share in crowdsourcing or co-creation. Since IPRs are important in creating open engagement platforms and keeping software and data open, a new approach on IPR issues is necessary on data sharing, creative commons, etc.
- Stimulating creativity, experimentation and prototyping creating the competition environment where best ideas are realised into projects. OI competitions are highly important to show to the engaged that only the best ideas with the strongest impact to the society will be realised into the project. The same business conditions for all create the message that it is worth trying to get the optimal business position for achieving the targets.
- Networking and collaboration should be strongly present in the OI environment; thus, stimulating communication and sharing of knowledge should be one of the priorities. Nowadays success in entrepreneurship is desirable; if it is not connected with users, buyers, suppliers, competitors and others than it fades away. Long-term success without networking and collaboration is impossible.
- Stimulating people to create and use platforms where trials, experimentations and prototyping with new products and services are possible without any big loss if the attempt is unsuccessful. Courage is a crucial component that converts potential success into a real one. Keeping up the enthusiasm from the beginning to the very end of a project is important. Engagement to deliver results throughout the whole process (even when failures occur) is the key to success. The same goes for social platforms and community engagement to participatory innovation.
- Fostering result-oriented, innovative and creative thinking which creates new kinds of entrepreneurship. Traditional business ecosystems and rules of current entrepreneurship should be upgraded to more flexible, stimulating platforms where entrepreneurs should more easily change the form of organising a business or create the new form themselves.
- Taking initiatives in the area of law. Current legal economic framework is too narrow to be able to address upcoming challenges of how the EU should enhance its competitiveness. Proposing initiatives at national level and involving different think tanks and specialised groups to suggest the guidelines to the European Commission in order to make directives on new entrepreneurship. Also proposing an experimental approach for policymaking; then it could be seen when and where policy measures are necessary.

Prototyping platforms that improve decision-making in the OI environment

In the information society, information itself presents the most important resource which creates competitiveness. Knowledge society is more advanced and it combines information together with knowledge to create value. Wisdom society combines experiences of different stakeholders, intangible assets that are necessary for success, knowledge and information to make value aggregation at the market.

The new wisdom society ahead of us demands different rules and business environments that bridge the gap between the idea and its realisation at the market. Policymakers should create the business platforms where prototyping and experimentation are available and easy to use. Small and fast failures and errors should be allowed with the idea that eventually they lead to big success. Risk should be reduced to minimal, unlike the traditional approach where one of the biggest obstacles was a high level of risk to the entrepreneur property or rights. Writing the apps and putting them in the platform to see if they work in the market should create the comfortable OI environment where innovation is in the hotspot of making the entrepreneurship successful.

The collective awareness platforms (CAPS) for sustainability and social innovation are information and communications technology (ICT) systems leveraging the emerging 'network effect' by combining open online social media, distributed knowledge creation and data from real environments (Internet of Things) in order to create new forms of social innovation. They are expected to support environmentally aware grassroots processes and practices to share knowledge, to achieve changes in lifestyle, production and consumption patterns, and to set up more participatory democratic processes [9]. These kinds of platforms should be modified and upgraded to include a permissible degree of errors. Entrepreneurs should have the freedom to use easily accessible open engagement platforms as the hotspot for their applications and projects to see if it really works at the market. Social innovation leads to meeting social needs of different kinds: education, health, etc.

Entrepreneurship by user communities of the future

Young people want to actively participate in the society. They want to help in developing different perspectives of the society: culture, sport, education, environment, civil protection, etc. The outcome of involving the young in participating in societal challenges is raising their self-confidence, acquiring new and diverse skills, creating identity and a better relationship with the society. There is a big potential among the young that should be stimulated in the right direction to foster societal growth.

ICT as a significant economy driver will be even more important in the future for entrepreneurship. ICT is playing an extraordinary role in how organisations interact with their customers. It is predicted that the Europe 2020 strategy will follow the deepening trend towards personalisation in the field of business [10]. Technology will have its most positive impact on organisations enabling managers and other employees to react much faster to markets and customers. ICT will enable widening the target customers base to anywhere in the world as well as simplifying business processes. Therefore, it is essential that more attention be paid to the developing ICT skills and literature among the young in the future. ICT will have a significantly important role also among business-to-business environments. Rapid growth of smart systems and devices will play an important role in this context. Crucial ICT skills that successful entrepreneurs should master in the future are the following.

- Understanding how to market, sell and manage customers online.
- Mastering issues about data privacy.
- Building and mining open data in order to create a value in an effective way. In order to apply the OI2 paradigm, certain conditions, such as open data, should ensure that the innovation ecosystem is functioning.

It is interesting to analyse, from a psychological point of view, enterprises and businesses in the future. When we are talking about Maslow's hierarchy of needs and humans, we notice that the lower level of the pyramid is connected with physiological needs for food, water, sleeping, etc. The upper levels present more psychological needs related to self-esteem, respect and self-actualisation. The lower the level is achieved, the upper tends to be as well. It describes the well-being of humans. When Maslow's hierarchy of needs is transferred to companies we can see that the lower levels of the pyramid, such as cost revenue and customer satisfaction, are not so difficult to achieve. The real value and success of the organisation are the upper levels of the pyramid: innovation culture and organisational agility. These are the most important indicators that determine the well-being and success of the company. Each successful company should have open, experimental and sharing innovation culture on what the further progress depends. Based on

the innovation culture, a company creates organisational agility that determines the position and the respect of the company in the society.

Conclusion

In fulfilling the Europe 2020 strategy's targets, new kinds of entrepreneurship based on ICT change will have an immensely important role. Businesses are affected by technological change and new ways of entrepreneurship will require new sets of business skills. A more virtual working environment could reduce teamworking which is, traditionally, the most effective way of organising work. Business processes and structures will also need to change in order to act on the opportunities created by technology. The human side is also very important, meaning that cultural change should be appropriately managed. Human resistance is often an obstacle to the adapting new technologies and ways of doing businesses. Business leaders and entrepreneurs should pay attention to remove obstacles from creating smart, sustainable and inclusive growth in Europe.

A new approach to business will consist of a mash-up of societal drivers, value drivers and ICT enablers. Open platforms provide a user-centric and co-creative process that provides better leaps from the idea to the market value. Wisdom society, along with its societal dimension, should be in the middle of policymakers' attention, in order to create better platforms for new kinds of entrepreneurship. An OI environment with ICT-enabled drivers will foster entrepreneurship and reach Europe 2020 targets. New entrepreneurial forms are emerging based on open platforms and open data. Europe needs to foster innovation towards new business models and entrepreneurship, especially with its new instruments like Horizon 2020 and CEF research programmes. The power of users' community makes the most successful way of creating jobs and growth in innovation ecosystems.

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The role of experimentation facilities in open innovation ecosystems for the future internet

Introduction

The future internet research and experimentation (FIRE) [1] initiative is evolving towards a dynamic, sustainable and large-scale European experimental infrastructure, connecting and federating existing and next generation testbeds for future internet technologies. FIRE offers wide-scale testing and experimentation resources demanded by competitive research organisations, industry and small and medium-sized enterprises (SMEs) to speed up the time-to-market for innovative technologies, services and solutions. Gradually, FIRE's original focus on advanced networking technologies and service paradigms has expanded to new areas of technological innovation, such as the Internet of Things (IoT), and to application domains and user environments such as for networked media and smart cities. This raises the issue of how FIRE experimental facilities could further evolve as core resources of an innovation ecosystem and accelerator platform for FIRE and innovation.

The research and experimentation landscape shaping the future internet is undergoing a major transformation. Service and application developers (including SMEs) make use of advanced networking, communication and software concepts. Smart city initiatives and technology-intensive domains such as healthcare, manufacturing, e-government and financial services present new challenges to such developers. European-wide initiatives have emerged where FIRE's experimental facilities may bring added value, such as advanced networking (5G public–private partnership (PPP)), big data, the IoT and cyber-physical systems. Traditional boundaries between facility developers, researchers and experimenters, and end users in vertical application domains start blurring, giving rise to experimentation and innovation-based platform ecosystems which bring together a wide range of stakeholders to collaborate on innovation opportunities driven by future internet technologies. Correspondingly, the demands of experimenters and researchers serving those users and developers are changing, pushing for the development of new types of experimental facilities and experimentation methods and tools.

In this context the AmpliFIRE project [2], running from 2013-2015, has developed a future vision concerning the potential of FIRE's testbed facilities and experimentally driven research for the coming decade. In this vision, FIRE's federated facilities fulfil a key role within the currently evolving innovation ecosystem for the future internet.

The evolving role of FIRE testbeds and experimentation

There have been considerable changes in FIRE throughout the 7th framework programme and now in Horizon 2020, as a consequence of the Commission's evolving FIRE vision and the needs and interests of the FIRE community. Originally established from a core of networking testbeds and aimed at investigating fundamental issues of networking infrastructure, FIRE's mission has changed to deliver widely reusable facilities for the future internet community, resulting in the current emphasis on federation. *Figure 1* provides an overview of testbeds participating in the FED4FIRE federation project.

New domains are coalescing within future networks, such as the IoT, internet of services, cyber-physical systems, big data and other areas, giving rise to new research and innovation challenges and demands to experimentation facilities. Interactions with communities such as smart cities, cloud computing and IoT already brought new perspectives into FIRE's portfolio. To some extent this is visible in the new work programme 2016-2017, in particular in relation to the IoT, where FIRE testbeds are considered to support technology validation before deployment in field trials. AmpliFIRE identifies several key trends, such as the integration of a broad range of systems (cloud services, wireless sensor networks, content platforms and mobile users) within future internet systems in large-scale, highly heterogeneous systems, to support increasingly connected and networked applications. This new emphasis calls for looser forms of federation of cross-domain resources.

Whereas FIRE has become meaningful in the context of the future internet and its research community, FIRE also increasingly addresses the demand side of experimentation, the need to engage users and to support innovation processes. This way FIRE's evolution must find a balance between coherence and fragmentation in shaping the relation between facility-building projects and research and experimentation — and increasingly innovation — projects. In this respect a specific development is how FIRE is increasingly shaped by new, flexible demand-oriented instruments such as open

Figure 1: Testbeds participating to the FED4FIRE federation project (source: FED4FIRE)

calls and open access, which demonstrates how customer 'pull' is increasingly supplementing and balancing technology 'push'.

As experimenter needs and requirements are becoming more demanding, expectations are rising as regards how FIRE should anticipate the needs and requirements from SMEs, industry, smart cities, and from other initiatives in the scope of future internet such as IoT and 5G. New types of service concepts, for example experimentation-as-a-service, aim at making experimentation more simple, efficient, reliable, repeatable and easy to use. These new concepts affect the methods and tools, the channels for offering services to new categories of users, and the collaborations to be established with infrastructure and service partners to deliver the services.

Thus it is expected that FIRE will increasingly be shaped by demand-pull factors in the period 2015-2020. These user demands will be based on the following four main trends.

- The IoT: a global, connected network of product tags, sensors, actuators and mobile devices that interact to form complex, pervasive systems that autonomously pursue shared goals without direct user input. A typical application of this trend is automated retail stock control systems.
- The internet of services: internet/scaled service-oriented computing, such as cloud software (software as a service) or platforms (platform as a service).
- The internet of information: sharing all types of media, data and content across the internet in ever-increasing amounts and combining data to generate new content.
- The internet of people: people-to-people networking, where users will become the centre of internet technology — indeed the boundaries between systems and users will become increasingly blurred.

In order to contribute to these four fast-moving areas, the FIRE ecosystem must grow in its technical capabilities. New networking protocols must be introduced and managed, both at the physical layer where every higher wireless bandwidth technologies are being offered, and in the software interfaces, which (software defined networks) is opening up. Handling data at medium (giga to tera) to large (petabyte) scale is becoming a critical part of the applications that impact people's lives. Mining such data, combining information from separated archives, filtering and transmitting efficiently are key steps in modern applications, and the internet testbeds of this decade will be used to develop and explore these tools.

Future internet systems will integrate a broad range of systems such as cloud services, sensor networks and content platforms into large-scale heterogeneous systems of systems. There is a growing need for integration, for example the integration of multipurpose, multiapplication wireless sensor networks with large-scale data processing, analysis, modelling and visualisation along with the integration of next-generation human-computer interaction methods. This will lead to complex large-scale networked systems that integrate the four pillars: things, people, content and services. Common research themes include scalability solutions,

interoperability, new software and service engineering methods, optimisation, energy awareness and security, privacy and trust solutions. To validate the research themes, federated experimented facilities are required that are large scale and highly heterogeneous. Testbeds that bridge the gap between infrastructure, applications and users and allow the exploration of the potential of large-scale systems which are built upon advanced networks, with real users and in realistic environments, will be of considerable value. This will also require the development of new methodological perspectives for FIRE, including how to experiment and innovate in a framework of collaboration among researchers, developers and users in real-life environments.

As we emphasise a focus on 'complex smart systems of networked infrastructures and applications' within the FIRE programme, the unique and most valuable contribution of FIRE should be to 'bridge' and 'accelerate': create the testing, experimenting and innovation environment which enables linking networking research to business and societal impact. FIRE's testbeds and experiments are tools to address research and innovation in 'complex smart systems', in different environments such as cities, manufacturing industry and data-intensive services sectors. In this way, FIRE widens its primary focus from testing and experimenting, building the facilities, tools and environments towards closing the gap from experiment to innovation for users and markets.

Positioning of FIRE

This leads to the issue of how to position FIRE in relation to other initiatives in the future internet landscape. FIRE is one among a number of initiatives in the future internet research and innovation ecosystem. FIRE seeks a synergetic and value-adding relationship with other initiatives and players such as GÉANT/NRENs and the FI-PPP initiatives related to IoT and smart cities, EIT Digital, the new 5G PPP and big data PPP initiatives, the evolving area of cyber-physical systems, and others. For the future, we foresee a layered future internet infrastructural and service provision model, where a diversity of actors gather together and ensure interoperability for their resources and services such as provision of connectivity, access to testbed and experimentation facilities, offering of research and experimentation services, business support services, and more. Bottom-up experimentation resources are part of this, such as crowdsourced or citizen/community-provided resources. Each layer is transparent and offers interoperability. Research networks (NRENs) and GÉANT are providing the backbone networks and connectivity to be used by FIRE facilities and facilities offered by other providers.

FIRE's core activity is to provide and maintain sustainable, common facilities for FIRE, and to provide customised experimentation and research services. In addition, given the relevance of experimentation resources for innovation, and given the potential value and synergies which FIRE offers to other initiatives, FIRE should assume a role in supporting experimentally driven research and innovation of technological systems. For this to become a reality, FIRE and other initiatives related to the future internet, such as 5G, should ensure sharing and reusing experimentation resources. FIRE should also consider opening up to (other) public and private networks, providing customised facilities and services to a wide range of users and initiatives in both public and private spheres. FIRE's core activity and longer-term orientation requires the ability to modernise and innovate the experimental infrastructure and service orientation for today's and tomorrow's innovation demands. Really innovative contributions may come from smaller, more aggressive and riskier projects. Large-scale European Commission initiatives such as the 5G PPP, big data PPP and the IoT should have an influence on their selection and justification. Early engagement and dialogue among concerned communities is essential to accomplish this goal.

Envisioning FIRE's evolution into the future

For setting out a transition path from the current FIRE facilities towards FIRE's role within a 'future internet ecosystem', AmpliFIRE has proposed four alternative future development patterns for FIRE which equally represents the spectrum of forces acting upon FIRE's evolution:

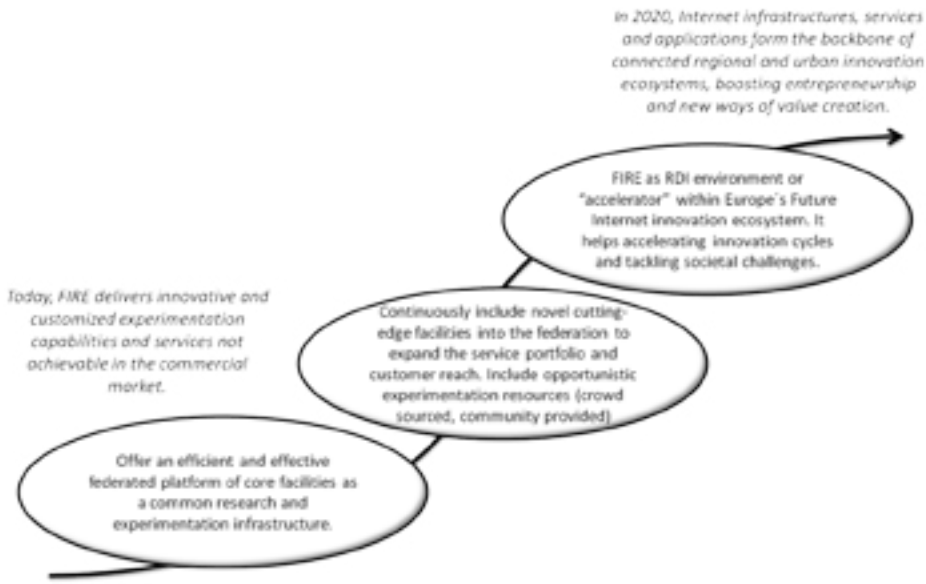
- competitive testbed as a service: FIRE as a set of individually competing testbeds offering their facilities as a pay-per-use service;
- industrial cooperative: FIRE becomes a resource where experimental infrastructures (testbeds) and future internet services are offered by cooperating commercial and non-commercial stakeholders;
- social innovation ecosystem: FIRE as a collection of heterogeneous, dynamic and flexible resources offering a broad range of facilities, e.g. service-based infrastructures, network infrastructure, smart city testbeds, support to user-centred living labs, and other;
- resource-sharing collaboration: federated infrastructures provide the next generation of testbeds, integrating different types of infrastructure within a common architecture.

These future scenarios aim at stretching our thinking about how FIRE must choose its operating points and desired evolution in relation to such forces. Simplifying the argument, FIRE evolution

proceeds along two dimensions. One dimension ranges from a coherent, integrated portfolio of FIRE activities on the one hand to individual, independent projects (the traditional situation) selected solely for their scientific and engineering excellence on the other. A second dimension reflects both the scale of the funded projects and the size of the customer or end user set that future FIRE projects will reach out to and be visible to, ranging from single entities to community initiatives.

Some broad lines of FIRE's future evolution can be sketched as follows in *Figure 2*. In the short term, FIRE's mission and unique value is to offer an efficient and effective federated platform of facilities as a common research and experimentation infrastructure related to the future internet that delivers innovative and customised experimentation capabilities and services not achievable in the commercial market. FIRE should expand its facility offers to a wider spectrum of technological innovations in European Commission programmes, e.g. in relation to smart cyber-physical systems, smart networks and internet architectures, advanced cloud infrastructure and services, 5G network infrastructure for the future internet, IoT and platforms for connected smart objects. In this role, FIRE delivers experimental testing facilities and services at low cost, based upon federation, expertise and tool sharing, and offers all necessary expertise and services for experimentation on the future internet part of Horizon 2020.

Figure 2: FIRE evolution longer-term vision 2020



For the medium term, around 2018, FIRE's mission and added value is to support the future internet ecosystem in building, expanding and continuously innovating the testing and experimenting facilities and tools for future internet technological innovation. FIRE continuously includes novel cutting-edge facilities into this federation to expand its service portfolio, targeting a range of customer needs in areas of technological innovation based on the future internet. FIRE assumes a key role in offering facilities and services for 5G. In addition, FIRE deepens its role in experimentally driven research and innovation for smart cyber-physical systems, cloud-based systems and big data. This way FIRE could also support technological innovation in key sectors such as smart manufacturing and smart cities. FIRE will also include 'opportunistic' experimentation resources, e.g. crowdsourced or citizen-/community-provided resources.

In this time frame, FIRE establishes cutting-edge networked media and possibly big data facilities relevant to research and technology demands to support industry and the solving of societal challenges. Federation activities to support the operation of cross-facility experimentation are continued. A follow-up activity of Fed4FIRE is needed which also facilitates coordinated open calls for cross-FIRE experimentation using multiple testbeds. Additionally, a broker service is provided to attract new experimenters and support SMEs. This period ensures that openly accessible FIRE federations are aligned with 5G architectures that simplify cross-domain experimentation. Second, via the increased amount of resources dedicated to Open Calls, FIRE will create an accelerator functionality to support product and service innovation of startups and SMEs. For this, FIRE will establish cooperation models with regional players and other initiatives. FIRE continues to implement

professional practices and establishes a legal entity which can engage in contracts with other players and supports pay-per-use usage of testbeds.

For the longer term, by 2020, our expectation is that internet infrastructures, services and applications form the backbone of connected regional and urban innovation ecosystems. People, SMEs and organisations collaborate seamlessly across borders to experiment on novel technologies, services and business models to boost entrepreneurship and new ways of value creation. In this context, FIRE's mission is to become the research, development and innovation environment, or 'accelerator', within Europe's future internet innovation ecosystem, providing the facilities for research, early testing and experimentation for technological innovation based on the future internet. FIRE, in cooperation with other initiatives, drives research and innovation cycles for advanced internet technologies that enable business and societal innovations and the creation of new business-helping entrepreneurs to take novel ideas closer to market.

In this timeframe it is envisaged that FIRE continues to add new resources that match advanced experimenter demands (5G, large-scale data-oriented testbeds, large-scale IoT testbeds, cyber-physical systems) and offers services based on experimentation-as-a-service. The services evolve towards experiment-driven innovation. More and more FIRE focuses on the application domain of innovative, large-scale smart systems. Implementing secure and trustworthy services becomes a key priority, also to attract industrial users. Responsive SME-tailored open calls are implemented to attract SMEs. FIRE continues the accelerator activity by providing dedicated start-up accelerator funding. FIRE also takes new steps towards (partial) sustainability by experimenting with new funding models. Sustainable facilities are supported with continued minimum funding after the project's lifetime. FIRE community has achieved a high level of professional operation. FIRE contributes to establishing a network of future internet initiatives which works towards sharing resources, services, tools and knowledge and which is supported by the involved Commission units.

Around 2020, FIRE thus may have evolved towards a core infrastructure for Europe's open lab for future internet research, development and innovation and FIRE has evolved into a technology accelerator within Europe's innovation ecosystem for the future internet. Clearly this implies that FIRE should achieve a considerable level of sustainability, possibly as (part of) the core infrastructure of a thriving platform ecosystem which creates technological innovations addressing business and societal challenges.

In summary, some of the key strategic objectives for FIRE proposed by AmpliFIRE are the following.

- For 2016: to increase its relevance and impact primarily for European-wide technology research, but also to increase its global relevance.
- For 2018: to create substantial business and societal impact through addressing technological innovations related to societal challenges. To become a sustainable and open federation that allows experimentation on highly integrated future internet technologies; supporting networking and cloud pillars of the net futures community.
- For 2020: to become a research, development and innovation space that is attractive to both academic researchers, SME technology developers and industrial research and development (R & D) companies, with emphasis on key European initiatives such as 5G, big data, IoT and cyber-physical systems domains.

Conclusions and recommendations

FIRE has evolved into a diverse portfolio of experimental facilities, increasingly federated and supported by tools, and responding to the needs and demands of a large scientific experimenter community. Issues that require attention include the sustainability of facilities after the project's termination, the engagement of industry and SMEs, and the continued development of FIRE's ecosystem to remain relevant to changing research demands. A more strategic issue is to develop a full service approach addressing the gaps between ecosystem layers as well as integration issues that are only now coming up in other future internet-funded projects. A related challenge is to expand the nature of FIRE's ecosystem from an offering of experimental facilities towards the creation of an ecosystem platform capable of attracting market parties from different sides that benefit from mutual and complementary interests. Additionally, FIRE should anticipate the shifting focus of future internet innovation areas towards connecting users, sensor networks and heterogeneous systems, where data, heterogeneity and scale will determine future research and innovation in areas such as big data, 5G and IoT. Such demands lead to the need for FIRE to focus on testbeds, experimentation and innovation support in the area of 'smart systems of networked infrastructures and applications'.

To address the viewpoints identified by the FIRE community, the FIRE initiative should support actions that keep pace with the changing state of the art in terms of technologies and services, able to deal with current and evolving experimenter demands. Such actions must be based upon

a co-creation strategy, interacting directly with the experimenters, collecting their requirements and uncovering potential for extensions. FIRE must also collaborate globally with other experimental testbed initiatives to align with trends and share expertise and new facilities. Where major new technologies emerge, these should be funded as early as possible as new experimental facilities in the FIRE ecosystem.

This analysis leads to some recommendations regarding the future direction of FIRE, concisely summarised below.

- FIRE's strategic vision for 2020 is to be the research, development and innovation environment for the future internet, creating business and societal impact and addressing societal challenges. Adding to FIRE's traditional core in networking technologies is the shift of focus in moving upwards to experimenting and innovating on connected smart systems which are enabled by advanced networking technologies.
- FIRE must forcefully position the concept of experimental testbeds driving innovation at the core of the experimental large-scale trials of other future internet initiatives and of selected thematic domains of Horizon 2020. Relevant initiatives suitable for co-developing and exploiting testbed resources include the 5G PPP, IoT large-scale pilots and e-infrastructures.
- FIRE should help establish a network of open, shared experimental facilities and platforms in cooperation with other future internet initiatives. Experimental facilities should become easily accessible for any party or initiative developing innovative technologies, products and services building on future internet technologies. For this to happen, actions include the continuing federation of facilities to facilitate the sharing of tools and methods, and providing single access points and support cross-domain experimentation. Facilities should also employ recognised global standards. At the level of facilities, open access structures should be implemented as a fundamental requirement for any FIRE facility. To extend open facilities beyond FIRE, for example with 5G PPP or GÉANT and NRENs, cooperation opportunities can be grounded in clear value propositions, for example based on sharing technologies and experiment resources.
- FIRE should establish 'technology accelerator' functionality, by itself or in cooperation with other future internet initiatives, to boost SME research and product innovation and facilitate start-up creation. The long-term goal of FIRE is to realise a sustainable, connected network of internet experimentation facilities providing easy access for experimenters and innovators across Europe and globally, offering advanced experimentation and proof-of-concept testing. The number of SMEs and startups leveraging FIRE can be increased by offering professional highly supported facilities and services such as experimentation-as-a service, shortening learning time and decreasing time-to-market for experimentation. A brokering initiative should provide broker services across the FIRE portfolio or via exploitation partnerships. Additionally, community application programming interfaces should be offered to make FIRE resources more widely available.
- FIRE's core expertise and know-how must evolve: from offering facilities for testing networking technologies to offering and co-developing the methodologies, tools and processes for research, experimentation and proof-of-concept testing of complex systems. FIRE should establish a lively knowledge community to create innovative methodologies and learn from practice.
- FIRE should ensure longer-term sustainability building upon diversification, federation and professionalisation. FIRE should support the transition from research and experimentation to innovation and adoption, and evolve from single area research and experiment facilities towards cross-technology, cross-area facilities which can support the combined effects and benefits of novel infrastructure technologies used together with emerging new service platforms enabling new classes of applications.
- FIRE should develop and implement a service provisioning approach aimed at customised fulfilment of a diverse range of user needs. Moving from offering tools and technologies, FIRE should offer a portfolio of customised services to address industry needs. FIRE should establish clear channels enabling interaction among providers, users and service exploitation by collaboration partners.

FIRE should become part of a broader future internet value network, by pursuing cooperation strategies at multiple levels. Cooperation covers different levels: federation and sharing of testbed facilities, access to and interconnection of resources, joint provision of service offerings, and partnering with actors in specific sectoral domains. In this FIRE should target both strong and loose ties of opportunistic collaboration. Based on specific cases in joint projects, cooperation with 5G and IoT domains could be strengthened.

Finally, FIRE should evolve towards an open access platform ecosystem. Platform ecosystem building is now seen as critical to many networked industries as parties are brought together who establish mutually

beneficial relations. Platforms bring together and enable direct interactions within a value network of customers, technology suppliers, developers, facility providers and others. Developer communities may use the FIRE facilities to directly work with business customers and facility providers. Orchestration of the FIRE platform ecosystem is an essential condition. Steps towards forming a platform ecosystem include the encouragement of federation, the setting up of open access and open call structures, and the stimulation of developer activities.

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Trends in the innovation ecosystem, startups and the industrial renaissance

A look into innovation and startups in Turkey

Introduction

The world is going through the fourth industrial revolution which is about to be as and even more disruptive as the previous ones. It is proposed that the fourth revolution will not only affect the systems governing global production, transportation and consumption of goods, but it will have consequences reaching far into every aspect of our lives. The message that echoes around the globe is clear: 'You have not seen anything yet!' If you will allow me to point out the obvious, I will just say that the aftermath of this wave — no, tsunami — will be an industrial and culture renaissance, and we will be one step closer to being a global civilisation.

The fourth industrial revolution is different from the previous ones in three ways: first, it is evolving at a far greater pace than anything previously experienced. Second, it affects an incredibly broad range of technologies — 3D printing, sensors, nanotech, brain research, etc. Consequently, it opens the possibility for large leaps in knowledge. Third, it allows for holistic optimisations of complex services as opposed to the fine-tuning of individual products.

Opportunities of the fourth industrial revolution

Digitalisation: software and cloud-based services are multiplying. This leads to the possibility of commercialisation with low capital costs and this is considerably empowering.

Ownership: the concept of ownership is changing; collaborative consumption is becoming more and more prominent.

Talent: talent and 'the team' are becoming more valuable. Microentrepreneurship is gaining importance, and entrepreneurial quotient (EQ) is already a taking-shape term. Large companies are progressively competing for the privilege of breathing life into pioneering projects. Consequently, the global competition among 'ecosystem players' is growing to be more acute. The 'million-dollar laboratory' of the old now stands in stark contrast to research and development (R & D) making its way into the primary and secondary school curricula. Therefore, finding metrics for innovative talent is something to ponder on.

Transformations in the marketplace: as the marketplace defines the investment strategy, changes in demographics have to be tracked. On a local level, if we look from a vantage point in Turkey, for instance, we differentiate two growing markets on which to focus innovation: one which caters to the large proportion of the younger generation, and one that focuses on creating services that are sensitive to social conservatism (the latter trend is not only limited within the confines of Turkey).

Transformations in market segments: as market segments are further subdividing, large companies are afforded a chance to go more local, and small companies are able to thrive.

Entrepreneurial spirit: Turkish startups are entering a new and promising period in 2016 which will positively affect European startups.

Where does Turkey stand?

Turkey, with its population of 82 million, is the second largest country in Europe after Germany, and half of its population is below the age 25. Out of the 82 cities in Turkey, 29 have a status of 'metropolitan municipalities'. In those cities, regional municipalities are also active alongside the larger metropolitan municipality. Istanbul is, of course, the largest city in Europe being situated on two continents. Istanbul can be surely considered as a country; having 16 million people, a population number bigger than in 131 countries in the world.

Turkey is one of the world's leading countries in terms of urban growth. Consequently, the municipalities are in competition with one another towards making cities 'smarter'. Başakşehir is one of the regional municipalities of Istanbul and its population is projected to reach one million by 2020. Başakşehir has successfully established a living lab and innovation centre which focuses on information and communications technology. The living lab is creating a new ecosystem for 30 000 SMEs located in Başakşehir and affects 400 000 citizens. The living lab's focal areas are industrial design area, user experience centre, startups space, smart home prototype, healthcare and education rooms. In the municipality region of Başakşehir every business and apartment building has 1 GB internet connection.

Cities as open living labs

Once, cities were the centres of imperial empires where local governance was usually undertaken by members of the conquering nation who would be placed over the local elite. In the industrial era cities became factories; they became the engines of national economies. Now, we witness them becoming innovation hubs. In the digital era, step by step, cities are transforming into living labs, as a living lab provides an innovation ecosystem model that best fits the complexity of a city organisation.

The European Network of Living Labs (ENoLL) offers local governments and municipalities a clear message:

'Every city needs an open living lab strategy because this citizen-based approach is the ultimate innovation model' [1].

Of course, cities need to digitalise urban infrastructures by installing sensors and making data available. This will lead to advanced services for citizens. And yet, this is only a small detail of the transformation of the city. If a city is to lead other cities in a certain area, it should embrace open living lab strategies, based on the Open Innovation 2.0 'quadruple helix' paradigm: cities to be transformed into citizen-driven living labs, where local governments and municipalities will partner with thousands of companies, hundreds of research centres and millions of citizens in order to build a real innovation ecosystem that is much more comprehensible than any smart city strategy.

As Artur Serra Hurtado (the director of İ2Cat Living Lab/ Barcelona) said:

'Cities are becoming too complex to be managed like factories of the industrial era. We need to manage them like we manage the internet; putting our trust on the network, in the citizens, in the entrepreneurs and in the neighbourhoods, thus relying on the peer-to-peer model. The key issue: increase talent and desire of the citizen to innovate. Open living labs are the new 'school of innovation'. They are the places where the new generations feel free to develop their own dreams, projects and jobs in cooperation with their peers. Leaders of the regional governments and municipalities who believe that they have the ability to make change are limited without the help of citizens. Therefore, their ultimate role should be to empower everyone to be innovative' [2].

Table 1: Components of the entrepreneurial ecosystem

Administrative Framework	Market Conditions	Access to Finance
Administrative Liability (Business Creation / Building)	Risk of Competition	Loanable Markets
Execution and Bankruptcy Legislation	Access to Outside Market	Private Capital
Health and Environment Legislation	Access to Internal Market	Venture Capital
Product and Business Markets Legislation	Public Procurements	Angel Investors
Justice System	Role of the Public	Capital Markets
Tax System	Quality of the Market	
Social Security System		
The Creation and Spreading of Knowledge	**Talents of Entrepreneurs**	**Culture**
R&D Investments	Education and Experience	Risk Perception
College-Industry Cooperation	Framework of Entrepreneurship	Entrepreneurial Perception
Inter-sectoral Cooperation	Consultancy/Education Fees	Willingness to Own a Business
Technology and Internet	Taskforce Mobility	Social Capital and Trust Relationships

Source: OECD 2012

The regional innovation ecosystem

The innovative entrepreneurial ecosystem is a broad field that is fed by a varied policy landscape. In the past the innovative entrepreneurial ecosystem was considered an appendage to the policies governing SMEs, which were a product of industrialisation. But today, it is acknowledged that the favourable conditions for the growth of SMEs and innovative entrepreneurship are quite different, so the innovative entrepreneurial ecosystem is increasingly becoming an independent policy field. Reports and documents such as the *Global entrepreneurship monitor* (GEM), the EU *Progress report*, the European SME law and the entrepreneurship 2020 action plan make a strong emphasis on new strategies for innovation.

In parallel to these developments, Turkey has decided to author a plan that is separate from the SME strategy and action plan. Thus a new plan called the Turkish innovation ecosystem action plan (GISEP), which covers the time span of 2015-2018, has been prepared. The general purpose of GISEP is to make the innovative culture in Turkey more widespread, and to create an ecosystem which will support entrepreneurship. The six goals that make up the plan are the following:

1. to develop an entrepreneur-friendly regulatory framework;
2. to support innovative entrepreneurship;
3. develop sustainable thematic frameworks such as woman entrepreneurs, eco-entrepreneurship,

young entrepreneurship, social entrepreneurship and global entrepreneurship;
4. to develop a culture that embraces the entrepreneur and entrepreneurship;
5. to extend formal and informal innovation education, and to develop consulting services for entrepreneurs;
6. to facilitate the entrepreneur's access to financial instruments.

Table 2: Policies of SMEs and entrepreneurial ecosystems

Policies of SMEs	Policies of Entrepreneurial Ecosystem
Decreasing bureaucractic burdens	Decreasing bureaucractic burdens
Access to capital	Access to micro loans and seed capital
Presantation of information services	Briefing about business creation
Presentation of export and marketing services	Presentation of entrepreneurs as role models
Presentation of education and consulting services	Entrepreneurship training
Technology transfer	Networking services

Source: Ministery of Science, Industry and Technology

The strengths and weaknesses of the innovation ecosystem and risks in Turkey

The strengths

- Market advantage: Turkey's demographics, its geographic location and its proximity to different types of markets; Istanbul's attractiveness and consumerist tendencies.
- The young population: the strong numbers of the Y generation that wants to work in the fields of technology, science and media and the positive view of entrepreneurship among university students.
- Skilled workforce: the fact that the people who will be the architects, builders and leaders of the future are currently being educated.
- Incentives: the fact that investors receive incentives for R & D, patenting, design, marketing and investing.
- Trendy: the fact that innovation and startups are openly supported by the public and that they are the order of the day; collaborations are visibly strengthening, as are the pools of funding; the government, endowed universities, technoparks, chambers of industry and some large municipalities are offering space and funds to startups.
- World brands and the diaspora: the fact that a will to create world brands through collaboration between the industry and startups exists; the strategy to access the global halal market with the help of the diaspora.

The weaknesses

- The lack of early-stage funds: investors are inclined to support startups in the growth stage as opposed to in the beginning; the missing links in the investment chain.
- The level of R & D capacity: the small market share of R & D in Turkey; the difficulty in offering incentives for patenting and copyrighting; the lack of industrial experience, and the lack of industry-university collaboration.
- Non-supportive education: the shortcomings of the education system in teaching analytic skills and teamwork. Lack of English-language competency, which is crucial to entrepreneurship; the lack of computer programming education before university level is an indicator of how the education system does not support innovation in Turkey.
- The weakness of the entrepreneurial culture and mindset: original and commercially viable ideas are not produced at a redundant rate; ideas that come out do not get the support that they need; income inequality, and the lack of an honour system.
- Metrics: the lack of reliable statistical reports on a lot of important phenomena.
- The lack of interest in the public and private sectors: public companies have a hard time managing even public projects; the reputation-based leadership model and lack of synergetic collaboration between corporations; positive discrimination of foreign companies.
- Role models: the small number of serial entrepreneurs, the difficulty of finding employees for startups because there are not enough success stories.
- The shallow talent pool.

Risks

- Contradictions in understanding: the lack of a startup handbook, the dangers of bureaucratic confusion about the differences of particular entrepreneurship models.

- Falling behind: the middle income trap makes it difficult to catch the crests of the waves of technological change.
- Attraction of talent: brain drain is a familiar problem in many countries.
- Education: the enormous task of educational reform in a country with 25 million students.
- Cultural obstacles: the social and psychological pressures that startups face; the risk of falling behind because of slow cultural transformation.

Table 3: 10th development plan: developments and targets in entrepreneurship and SMEs

	2006	2012	2013	2018
Number of Newly Established Companies	53	39	50	75
Ratio of SMEs over All Enterprises (%) (1)	1.7	2,4 (2)	3,0	4,0
Export Amount of SMEs (billion dollar)	50 (3)	90	100	150
Number of Exporting SMEs (thousand)	44	50	52	60
Share of SMEs in R&D Expenditures (%)	10,0 (3)	14,9 (2)	17,0	20,0
Number of Initiatives Operating in Technology Development Zones	604	2174	2500	4000

Source: Tenth Development Plan

(1) Includes enterprises that has 20-249 employers amongst SMEs

(2) Data of 2010

(3) Projection of Ministry of Development

Table 4: Statistics of incorporated and terminated companies (between 2010-2014)

Number of Incorporated and Terminated Companies (except enterprises of real commercial personalities and cooperatives)					
Year	2010	2011	2012	2013	2014
Incorporated	50423	53409	38887	49943	58715
Terminated	11400	13095	14168	17400	15822
Difference (Incorporated-Terminated)	39023	40314	24719	32543	42893
Incorporated/Terminated	4,42	4,08	2,75	2,87	3,71

Source: TOBB Statistics of Incorporated/Terminated Companies

Turkey's innovation and entrepreneurship goals for 2023

The Organisation for Economic Cooperation and Development defines the entrepreneur as somebody who can shape new business opportunities and use sources efficiently. It is somebody who can identify new products, processes and markets and creates value by establishing new commercial processes or improving on current ones. Accordingly, the entrepreneur is not evaluated by his actions, but by the outcomes of these actions. The entrepreneur invests his time, creativity, network and other resources to begin processes working within an environment that contains uncertainty and risk.

Figure 1: ENoLL open living lab days 2015, Istanbul

As these processes mature, they should lead to economic and social value as well as to dissolving values that were in place before.

Vision and goals

In order to become one of the 'regional hubs' in Europe and the Middle East for an innovation and entrepreneurship ecosystem, Turkey needs to have an overarching vision as well as specific goals, to suggest legislative steps, to have a clear idea of marketplace, define financial initiatives, understand human capital, networking opportunities and desirable cultural transformations.

Vision

- Be located in Istanbul.
- Be protected by law that is integrated with global regulations.
- Be completely independent.

Goals

On the path that this vision guides Turkey, the country envisages:

- to give rise to multiple Unicorn companies by 2023;
- to reach two-digit percentages of the national export produced by startups;
- to attract foreign and global entrepreneurs;
- to be instrumental in establishing a ministry of enterprise and innovation;
- in order to boost the exit performance of entrepreneurs:
- to lower the cost of entry to the market,
- to connect various kinds of reachable markets for easy reach;
- to create special incentives for 'born global' ventures;
- to influence entrepreneur-friendly legislation.

Figure 2: Social innovation atelier in Başakşehir Living Lab

Legislative steps

- Startups should be allowed to receive benefits from a credit guarantee fund trust; they should benefit from breaks in sales, withholding and dividend tax as well as receive temporary social insurance tax exemption.
- Revisions should be made in incentives for angel investors.
- Intellectual property rights of startups should be protected.

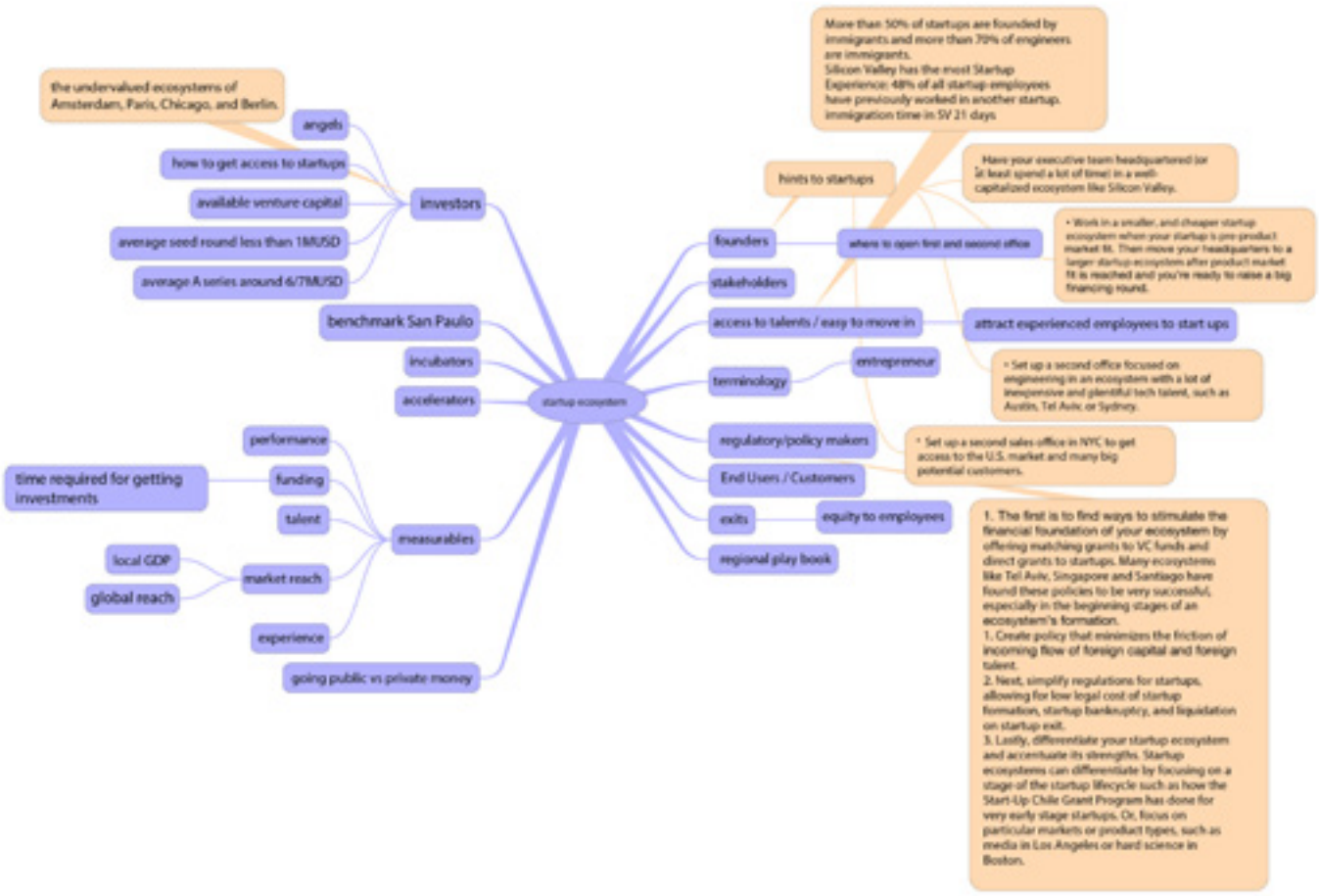
Finance

- Local investment should be facilitated.
- Local banks and companies should be allowed a fair opportunity to support and purchase startups.
- Crowdfunding and co-investment platforms should be established.
- Cooperation between venture capital and accelerators/incubators should be facilitated.
- Early-stage and corporate enterprise-funding projects should be established.
- Legislative steps to draw foreign investment should be made.

Human capital

- Coding and computer-aided design (CAD) should be included in early education. Design thinking should be emphasised, and maker labs should be established.
- Gender equality in employment should be in the forefront.
- The causes of brain drain should be probed and radical steps be taken to prevent it.

Figure 3: Global startup ecosystem



Networking

- National and international 'mentoring ecosystem' should be incentivised.
- Clustering should be encouraged in cities other than Istanbul.
- Technoparks and incubators should receive well-defined benefits.
- Amateur interest groups should be rewarded to provide cooperative outreach.

Culture and communication

- Hands-on project-based education should be organised.
- A culture of 'do it yourself' should be embraced.
- Financial literacy should be boosted.
- Experienced role models should appear on the media.

To understand what is happening and what is going to happen in Turkey, we need to look at the world. The two horses that pull this carriage forward are enterprise and venture capital. Some of this belongs to early-stage seed funds, and others to growth stages. It is also crucial to spread the risk in the investments that are made. Invested funds should be collected in a pool and invested at multiple stages of startups.

According to the global innovation index that is published through collaboration by Cornell University, Insead and the World Intellectual Property Organisation, Turkey ranks 68th among 142 countries. The global creativity index that is published by Martin Prosperity Institute under the University of Toronto defines three pillars of economic growth: technology, talent and startups. In this index, Turkey ranks as 37th among 82 countries in R & D investments,

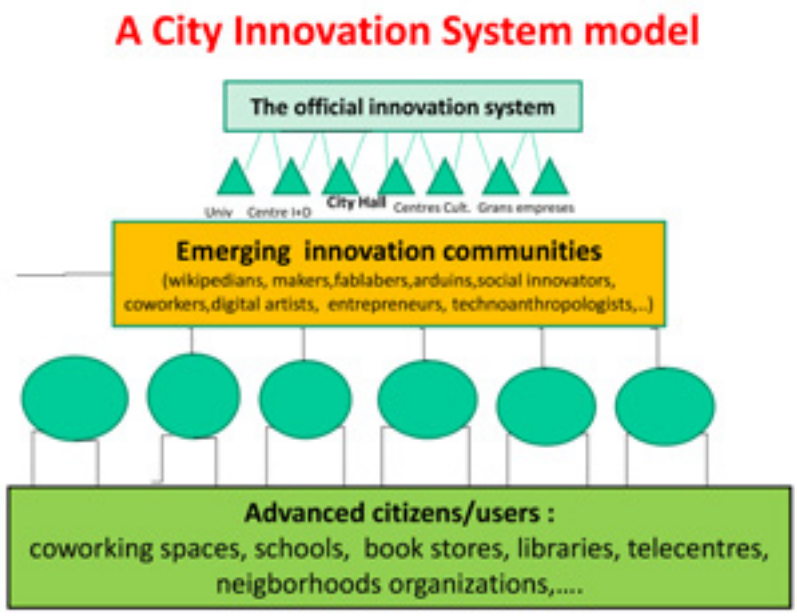
44th in research, 54th in innovation and 51st in technology.

To combine the two wings of the startup machine — technology and business — under one body is uncommon but not impossible. For this reason, the symbiotic interaction between technocrats and startups is very important. Therefore, it is paramount to establish innovation ecosystems that bring together finance and mentorship structures. Technocrats came into existence as a logical continuation of an occupational group of the industrial society. The same thing is not valid yet for startups. The industrial society has turned professional management into an occupation, but not startups. Now the information society is trying to achieve this, and it will probably take another five years.

The World Economic Forum asked 800 professionals in the information technologies sector for their predictions about the near future. Their responses are documented in the report titled 'Technology tipping points and social impact' [3]. What sorts of transformations are possible until 2025? 86 % agrees that we will see a drugstore that is entirely operated by robots, 84 % agree that we will see 3D-printed cars, 91 % agree that our clothes will be connected online, 78 % agree that the number of cars will reach 10 % of today's numbers, 76 % agree that we will see the first 3D-printed kidney, 69 % agree that half of internet traffic will be between devices and 45 % agree that we will see some form of artificial intelligence in managerial boards. The last one of these, and the least likely one to become reality, was implemented by a start-up in Hong Kong by the name of Deep Knowledge. They officially assigned an algorithm to help the board make better decisions about investment strategies. The algorithm is a product of a biotechnology firm called Aging Analytics. This software is called Vital, and it is designed to detect early investment opportunities in biotechnology. This will make it possible for the algorithm to analyse advances in subjects like renewable medicine, cancer treatment, bioinformatics, drug development and personalised medicine, and will have a vote in the administrative body.

These innovations fall under the umbrella of 'Thingalytics'. The article titled 'Here's how managers can be replaced by software' by Devin Fidler and published in the *Harvard business review* is neither the first or last place where such ideas are explored [4]. Thus, the i-CEO concept is emerging.

Figure 4: A city innovation system model (i2Cat Catalonia Digital Lab)



How should startups be?

The startups in Turkey follow the news in the world and have parallels to examples in Europe. Following their path is undeniably good, but to reach Silicon Valley levels requires efforts far beyond the current ones.

Startups in Turkey need to be on top of their field, follow the advances in their domains closely, fulfil the basic requirement of 10 000 man hours, be sharp and have faith. They need real muscles, mental and physical fitness. They need to be good with the books, and if they are not, they should team up with such people. In fact, this is nothing but the definition of a modern-day gladiator. Turkey has the potential to enter the global arena among European and American startups in as much as it is able to produce gladiators.

The Slush event organised in Helsinki every November that cringed together 17 000 people in 2015 is planned to be organised in Istanbul during June 2016 by the most important local start-up ecosystem, StartersHub. 3 000 participants from five continents are expected to attend the event. With this event, Turkey is taking a big step towards establishing its position in the global start-up environment.

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CHAPTER III

Future cities and regions in the context of Open Innovation 2.0

Smarter cities in the cognitive era

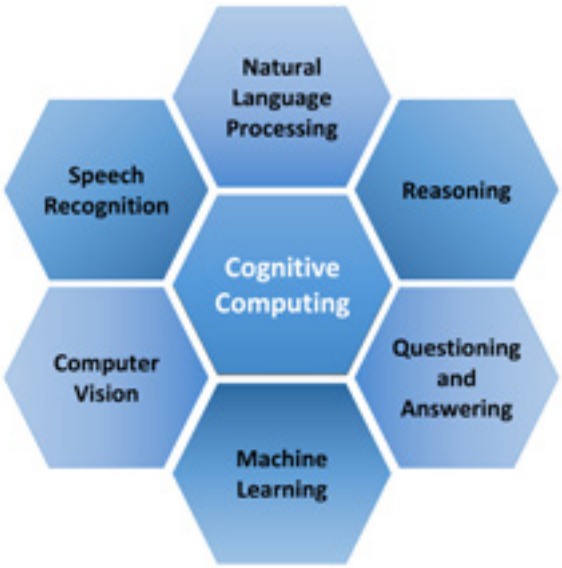
Introduction

A new technological age is upon us — the cognitive era. Cognitive technology brings new capabilities that offer the potential to transform the way work is done, the way services are provided, the way products are made, and the way businesses and organisations of all sizes and in all sectors are run. It offers a real and tangible opportunity to fundamentally improve every aspect of how cities function, from the core public services provided by cities or private sector entities to the products and services produced by private sector businesses for citizens and businesses. Existing challenges can be addressed in entirely new ways and new opportunities can be seized. Organisations can enable and accelerate innovation and growth as part of open innovation activities by pulling in capabilities from outside the organisation, and by active participation and engagement in cognitive ecosystems and collaborative networks.

What is cognitive computing?

The history of information technology can be broken down into two distinct eras [1]. The first, the tabulating era, covered the period from 1900 to the 1940s. This technology comprised of machines designed to perform a specific job, such as counting, and they enabled large-scale data inputting and calculations. Applications of this technology included population censuses in the United States as well as the control of industrial machines. The programmable era emerged in the 1940s and still forms the basis of much of the technology in use today. This instruction-led computing involves programming computers with logical sequences of instructions coded in software to conduct specific tasks such as analysing, processing and performing

Figure 1: Cognitive computing capabilities



calculations on structured data — that is, data organised, entered and stored in a record or file [2].

The dawn of the cognitive era began in 2011, although the potential for surpassing the limitations of programming were raised many decades before this, and some of the key capabilities of cognitive emerged from work undertaken in earlier decades, such as that on artificial intelligence [3]. Yet this era is distinct due to the combination of the capabilities that cognitive brings. Some of these capabilities are outlined below [4].

- **Natural language processing** is the ability to interpret and process language in the same way as humans [5]. This includes analysing and understanding the tone and context of language to derive meaning from it as well as being able to generate natural language. This means that anything written in natural language, such as in books, articles, newspapers, websites and social media, can be analysed and understood.
- **Reasoning** relates to the probabilistic nature of cognitive systems. While programmed systems were based on predetermined processes and rules applied to structured data, cognitive systems do not offer definitive answers. Instead, they analyse, weigh and interpret large amounts of information from structured and unstructured sources, and generate hypotheses and answers with supporting evidence and confidence levels assigned to answers [6].
- **Questioning and answering** is the ability for users or systems to use questions or inquiries in natural language [7]. It goes beyond a search on Google, for example, that produces a list of results. Instead it can go through large sets of documents or data and pick out a person, place or thing that answers a question and thus reduces the time between answering a question and getting an answer [8].
- **Machine learning** enables computer systems to learn, discover and predict automatically without having to be explicitly programmed [9]. This means that systems have the ability to improve their own performance [10]. Machine learning also covers data-analysis capabilities including predictive analytics and data mining that can make connections, discover trends, patterns and relationships between datasets, with cognitive analytics bringing faster processing and better algorithms.
- **Computer vision** is the ability to analyse and understand the content of an image and return the objects, people and text found within the image [11]. This can help with analysing online photos and videos to extract insights, for example, related to customer interests, hobbies or life events.
- **Speech recognition** converts speech into text [12]. It can be used wherever voice interactivity is needed, for example transcribing media files or converting sound to text to then make data searchable.

All of these capabilities help support and extend human expertise in decision-making. The cognitive era is not about replacing humans with machines but offers the chance to augment human decision-making to produce better outcomes and results. The cognitive era will thus provide new ways for information technology to continue its role as a critical enabler of economic growth and development [13]. The next section outlines some of the key drivers for why these capabilities are increasingly needed.

Why we need cognitive

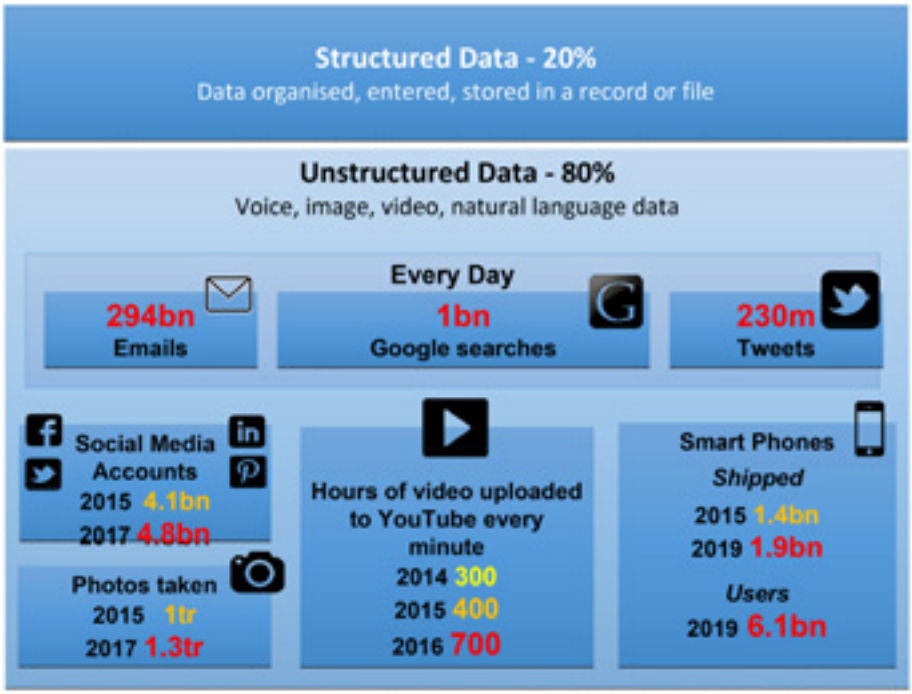
The growth in big data

The volume of data being created is exploding; 90 % of all data has been created in the past 2 years [14], with 294 billion emails sent every day, 1 billion Google searches performed and more than 230 million tweets made [15]. In 2015, there were almost 4.1 billion social media accounts [16]. Facebook users send on average over 31 million messages and view 2.8 million videos every minute [17].

The rate at which data volumes are growing is also increasing faster than ever before. By the year 2020, about 1.7 megabytes of new information will be created every second for every person [18]. To put that amount into perspective, data creation will be 44 times greater in 2020 than it was in 2009 [19]. Social media accounts will reach 4.8 billion by 2017 — a 50 % rise on 2013 levels [20].

The variety of data is also growing, with increasing amounts of video and photo data being created. In 2014, 300 hours of video are uploaded to YouTube alone every minute, increasing to 400 hours in 2015 and is expected to grow to 700 hours by the beginning of 2016 [21]. In 2015, 1 trillion photos will be taken and billions of them will be shared online — by 2017, this will increase by 30 % to 1.3 trillion [22]. This year, over 1.4 billion smartphones will be shipped — up from just 173 million in 2009 — and this is expected to rise to almost 1.9 billion in 2019 [23]. By 2020 there will be over 6.1 billion smartphone users globally [24]. These phones are packed with sensors that can collect all kinds of data and result in the creation of data by their users. While sensors are not new, the declining size and cost means that they are being put into more types of devices than ever before [25]. This growth in data is creating an Internet of Things (IoT) and 6.4 billion 'things' will be connected to the internet in 2016, up 30 % from 2015 [26].

Figure 2: Why we need cognitive: the growth in big data



Extracting meaningful insight in a timely manner from this data offers a huge challenge for organisations. But it also offers a huge opportunity — what IBM's chief executive officer Ginny Rometty called the world's new natural resource [27]. It holds tremendous potential to generate insights that result in huge improvements and transformations in the way services are delivered and how work is done, and to drive innovation and foster growth. Yet, despite the rapid growth in the amount of data that organisations have available to them and the potential it holds, it is estimated that businesses use just 20 % of it — the remaining 80 % being 'dark data'. This 'dark data' is unstructured data, such as complex human voice, image, video and natural-language data, but it is wasted as existing systems cannot process it. And, while more than 70 % of data is generated by individuals, enterprises have responsibility for the storage, protection and management of 80 % of it [28].

These are some of the key reasons why organisations are starting to leverage the capabilities of cognitive computing and this is driving rapid spending growth in this market from an estimated USD 2.5 billion in 2014 to almost USD 12.6 billion by 2019 representing a compound annual growth rate of 38 % from 2014 to 2019 [29]. With many of these capabilities available through internet-based services via the cloud, this enables organisations to take advantage of cognitive as well as all the benefits that cloud brings, such as greater flexibility, shifting from capital expenditure to operational expenditure, and the ability to work from anywhere.

Cognitive capabilities are needed by businesses and organisations to make sense of the large and rapidly growing amounts of unstructured data and to shine a light on 'dark' data. Cognitive systems will generate new and improved insights from existing data sources and new sources of information, such as sensors [30].

Scale of challenges in Europe

The scale and magnitude of the economic, social and environmental challenges facing Europe is another key reason why public and private sector organisations should take advantage and make greater use of cognitive capabilities as part of open innovation. This can help to find new approaches to utilising the data within and between systems to help solve the challenges and issues in these systems.

In health, for example, Europe's aging population will result in increasing demands being put on already strained services. Between 2014 and 2020 the number of people over 65 will increase by 10 million from 94 million to 104 million people, and growing by a further 20 million to 124 million by 2030. [31]. Over one third of those above the age of 15 in Europe have a chronic disease and two thirds of those reaching 65 will have at least two chronic conditions. [32]. This will increase the burden chronic diseases place on already strained budgets given chronic diseases currently account for 70-80 % of healthcare spending in the European Union [33]. New ways are needed to more rapidly and cost-effectively prevent, correctly diagnose and treat patients to improve the health of citizens.

In education, the Europe 2020 strategy set a target for 40 % of 30- to 34-year-olds to have a higher education qualification by 2020 [34]. While there has been substantial progress towards this target, there is still a need to help improve student engagement and performance to reduce dropouts and improve completion rates. This need also exists at second level where over 11 % of 18- to 24-year-olds were early leavers from education and training with at most a lower secondary education [35]. There were more than 22 million people unemployed in the European Union in November 2015 and the youth unemployment rate was at 20 %. Improving educational attainment using cognitive technologies offers a new way to help improve employment opportunities for citizens, reduce the economic and social costs of unemployment, and support growth as the educational system provides graduates that are suited to the needs of growing businesses [36].

In terms of innovation, in 2014 R & D investment was 2 % of GDP, up from 1.85 % of GDP in 2008 but still below the 3 % target set in the Europe 2020 strategy [37]. The latest figures available show that almost half of all enterprises in the EU-28 reported some type of innovation activity between 2010 and 2012, but this actually declined by almost 4 % compared with 2008-2010 [38]. 27.5 % reported organisational innovation, 24 % implemented some form of marketing innovation, the same proportion were engaged in some form of innovation related to developing new products or services, and 21 % of enterprises implemented process innovations [39]. With Europe's strong focus on innovation, there is substantial scope to leverage cognitive as part of these existing innovation activities and to help increase the scale and magnitude of innovation within enterprises. Capabilities, such as rapidly and accurately analysing large bodies of information to generate insights, can accelerate all kinds of research discoveries and support innovation. For example, IBM's Watson cognitive system can analyse over 800 million pages per second. There is also scope to leverage cognitive to help drive improvements in the efficiency of all kinds of agricultural, industrial and service activities to foster labour productivity growth in the European Union, which is currently growing at about 0.5 % annually, well down from the 2 % growth in the 1980s [40].

Good examples of those who are already leveraging it

This section outlines some examples where these capabilities are already being used and applied to a range of economic activities to provide better services for citizens and businesses, accelerate the pace of innovation and discoveries, and support revenue and other aspects of business growth.

Health

- Memorial Sloan Kettering, a cancer centre in New York, uses natural language-reading tools and machine learning to manage and rapidly analyse the massive amount of data collected. This results in a decrease in time for the latest research and evidence to influence clinical practice for the oncology community and deliver evidence-based medicines and therapies to patients [41].
- Bumrungrad Hospital in Bangkok, Thailand, analyses patients' data against thousands of cases, medical journals, textbooks and 12 million pages of text to reduce the time to develop treatment plans for cancer patients from weeks or months to just minutes [42].
- The Mayo Clinic in the United States uses natural-language processing and powerful data-analytics capabilities to help its clinicians sift through millions of pages of clinical trial and patient data and build a clinical trial-matching solution to increase the speed of new discoveries while offering patients more treatment possibilities [43].
- GenieMD, an application developer based in California, developed a predictive analytics tool to provide users with a holistic view of their health while collecting their medical records. GenieMD gives answers to personal health questions, offers periodic and highly targeted health recommendations, reduces medical errors, increases patients engagement and satisfaction, improves patient outcomes and reduces the cost of healthcare [44].

Education

- Deakin University in Australia is using a 24/7, always on, personalised student advisor to improve student engagement. Using natural language and machine-learning capabilities, the solution provides students with tailored answers to their specific questions to help improve engagement and student satisfaction by 20 % and boost the ability to attract new students [45].
- Gwinnett County Public Schools in the United States uses machine learning, predictive modelling, deep content analytics and advanced case management to identify learning needs of students and recommend personalised learning pathways to move from a 'one size fits all' model to a personalised approach that motivates and engages learners, reduces dropout rates, improves academic performance and college readiness, increases student engagement and enhances teacher effectiveness [46].
- More than 100 Kenyan schools are leveraging cognitive, mobile and analytics technologies to capture data to track and reduce students'

underperformance and have a complete overview on the resources available as well as the school conditions. This helps to create an early warning system that can help identify school needs and students who are at particular risk of failing [47].

Services

- DBS bank in Singapore is using cognitive computing solutions to transform customer experience and shape the future of banking. Large volumes of complex unstructured and structured data can be analysed, including research reports, product information and customer profiles, to help identify connections between customers' needs. This helps advisors weigh various financial options available to customers and gives DBS data-driven insights that can personalise the client experience [48].
- Thomson Reuters, the world's leading source of intelligent information for businesses and professionals, is leveraging deep content analytics, natural language processing, decision support and evidence-based learning to enable Thomson Reuters' customers to derive greater insight and workflow efficiency. Applying cognitive capabilities to the company's vast trove of data on science, law, tax and finance helps accelerate discoveries and brings new levels of speed and precision to important decisions [49].
- Alpha Modus Corp., a financial services technology company in the United States, uses a cloud-based platform and ecosystem for developing next-generation investment tools, reducing deployment cycles by 80 % [50].
- Trisept Solutions is a travel company in the United States that leverages cognitive capabilities to generate personalised travel recommendations from natural language queries to enable travel agents to make better decisions more quickly and provide highly personalised holiday recommendations to their clients [51].

Manufacturing

- Sanofi, the French pharmaceutical company, is using cognitive capabilities to speed up the discovery of alternate uses for existing drugs by analysing and extracting key information from millions of pages of scientific literature and visualising relationships between drugs and other potential diseases. It is also being used to understand, extract and organise toxicological information to enable researchers to make better decisions on candidate progression to improve drug safety and toxicity in clinical development and trials, and to improve the success rate of drug R & D [52].
- PhotonStar LED Group, a designer and manufacturer of smart LED lighting solutions in the United Kingdom, is using cognitive capabilities to enable the company to build new innovations. This is helping the company to uncover opportunities, find new avenues of growth and be better positioned to fulfil client requirements for innovative, end-to-end solutions for the commercially built environment [53].
- Media Control Gmbh, a media and entertainment company in Germany, uses sophisticated algorithms to continuously sift through reviews, blogs and other content on over 100 000 websites to create a sentiment index and a first-of-a-kind social media analysis service. This has helped the company strengthen relationships with existing customers and attract new customers, improving the company's competitive position and increasing its market share [54].
- Inno360 is an enterprise research and innovation management company in the United States. It uses sentiment tracking and machine learning to provide advanced analysis to clients for their R & D data to resolve product issues quickly and bring new products to the market more rapidly, thereby enhancing client return on investment, and increasing Inno360's revenue [55].

Conclusion

The cognitive era and cognitive technology clearly offer an opportunity to radically improve how cities operate and function, how services are delivered, how products are made, how new services and products are developed, and how to accelerate the discovery of solutions and answers to our most pressing challenges and problems. This applies not just to the public sector or local government organisations in cities, but also to any private sector business providing goods or services to citizens and businesses in cities. And, of course, there is considerable scope for central and national governments to take advantage of these capabilities in driving innovation in any of the services they deliver for citizens and businesses — internal and back-office government processes can be transformed, and governments can make more informed and better policy decisions and better predict the impact of their decisions.

Open innovation will play a critical role in this process. Cognitive capabilities go beyond the capabilities of most companies relying on their internal resources and activities, as in a closed innovation model. Integrating cognitive ideas, solutions, resources and capabilities into internal innovation activities and processes enables improvements that are simply not possible for many firms to do themselves. While organisations can start now to take full advantage of these capabilities, as time goes on, cognitive will become essential for

organisations to stay competitive and grow as existing systems hit the limits of their abilities due to the ever-expanding sea of unstructured data. It is time for smarter cities to become cognitive cities.

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Designing a smart society

From smart cities to smart societies

The awareness that cities need to react to new, disruptive transformations and become smart and sustainable is being put into practice. More and more cities are applying the Open Innovation 2.0 (OI2) principles as a new approach to today's innovation challenges [1]. These are caused by the digitisation of society and the associated disruptive technology solutions, forcing us to reconsider how technology can best be applied to create a better quality of life. Redesigning the city for the digital era means redesigning society at large, engaging citizens and other stakeholders in innovation, and actively seeking new connections between sectors [2]. In brief, this means redesigning in co-creation, going far beyond technical solutions alone.

Redefining 'smart'

'Smart' is not just about technology. Although technological development enables new facilities that were not available before, smart solutions also improve liveability and contribute to a vibrant and sustainable city for citizens. But most of all, smart solutions enable citizens themselves to actively produce societal value, instead of simply being passive consumers of services provided by the government. Redefining smart cities with a focus on creating quality of life for and by citizens implies creating a smart society. This transformation poses a new design challenge: how to engage all citizens so they use the new facilities and actively take part in creating a higher quality of life for themselves and others?

Resilience is an important factor in the smart city philosophy. Instead of believing that everything can be engineered and controlled, we have to accept uncertainty. This affects the (new) solutions and systems that we design, but it also affects the citizens themselves. Future city residents have to be prepared to deal with unexpected, disruptive events; they must be able to consciously adapt their behaviour, and they must value personal development. The challenge lies in giving *participating citizens* the space and opportunities to become enthusiastic, and to be involved. This requires smart systems, offering and co-creating human-centred, personalised services. These should meet people's needs, using a shared platform that contributes to economic resilience. But it also requires rethinking the participation process, to ensure the support and active involvement of all citizens in the transformation process.

Redesigning the 'rules of the game'

To make sure the new technology solutions are people centric and technology enabled, and not just technology driven, we need to define the 'rules of the game'. When the digital and real world are blended, with the aim of improving the quality of life for citizens, we need to reconsider issues like standardisation, handling of data, privacy and openness in the public space from the perspective of societal value and ethics. We will need new instruments and frameworks to link the digital and physical spaces. In the same way as municipalities are responsible for safety in the public space, the new virtual layer on the public space also has to be designed with the principles of inclusiveness, openness, safety and accessibility in mind, to ensure the public interest, and at the same time as a prerequisite for active citizen participation.

In brief, the aim is a future scenario in which citizens live together well and unwanted developments are avoided. But how can we achieve this? How can we safeguard public interests? How can we deal with resistance to new technology, and protect people from undesirable commercial interests? How can we drive innovation and build an attractive economic climate in smart cities? And how can we achieve shared, efficient use of resources in the public domain to create higher societal value?

Redesign the approach

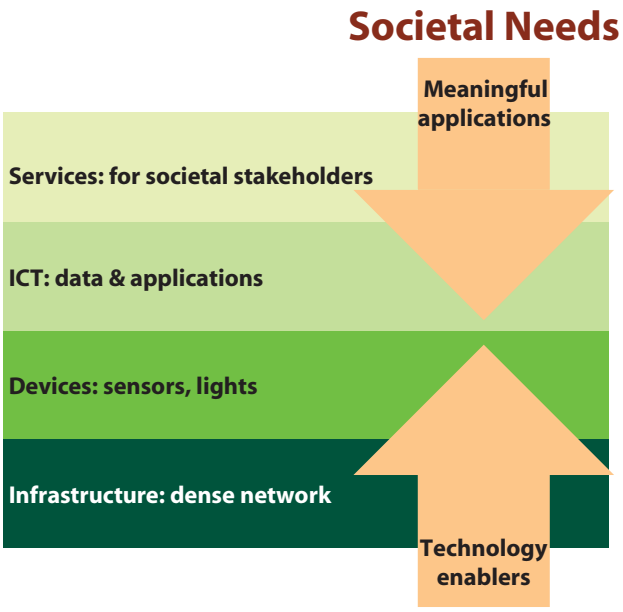
Nobody knows what the future will look like, but it will most probably be disruptively different. We are going through a change process in which the traditional control changes from leadership to orchestration [3]. It may be tempting to wait until we have more clarity on the new solutions and the required approaches. In the city of Eindhoven we do not want to wait until things are clear, because by then, consciously or unconsciously, the rules of the game will have been set. This is urgent, because experiments have already started. So we have decided for collaborative experimentation. We believe that the path to the desired future can be reached by mixing innovative technology with creative design. So we adopt a design approach; starting from a basic vision, experimenting in different settings and collaborating with a number of stakeholders. This is what we mean by iterative co-design of the smart society.

In the *Open Innovation 2.0 — Yearbook 2015* we describe the practical challenges in the paradigm shift to OI2 based on experience gained in real smart city projects [4]. This year our contribution — again in a cooperation between Eindhoven University of Technology (TU/e) and the Municipality of Eindhoven — continues along the bumpy path of innovation towards a smart and resilient society.

The transition: from hardware to services via data

In earlier contributions we emphasised that smart solutions use technology to create new applications. These then become meaningful only if they address relevant societal needs. To explain the architecture of such smart systems, we introduced a four-layered model (*Figure 1*) [5; 6].

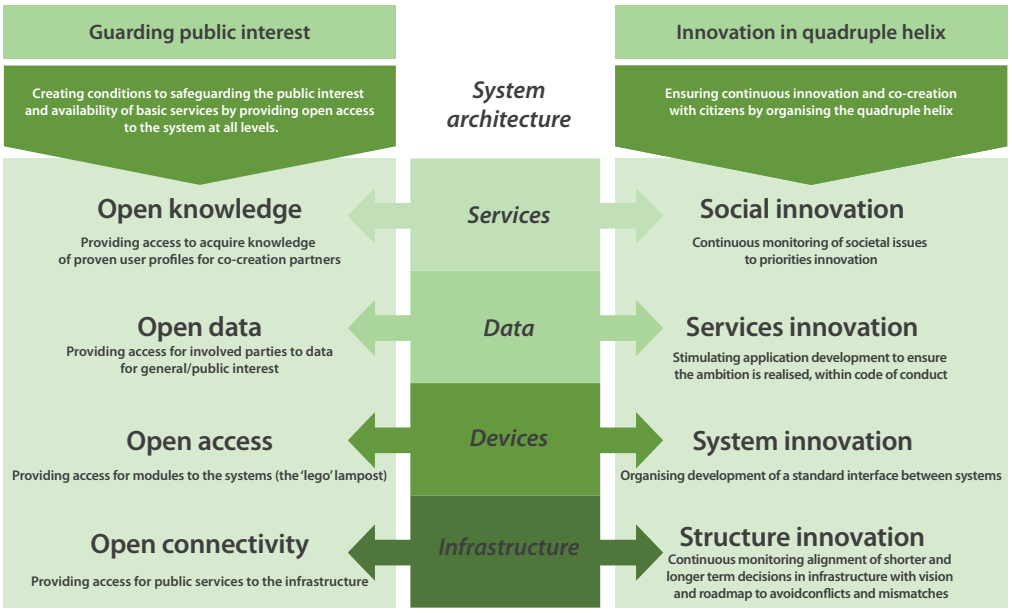
Figure 1: A four-layered model of smart systems [6]



We argued that in the coming years innovation will take place at all four levels of this model (see *Figure 2*). Innovation can take place in the separate layers, but each layer also enables innovation in the levels above. To ensure innovation through the entire system, two aspects need to be addressed.

- The openness of the system (the left column in *Figure 2*) to ensure transparency and safeguard public interest at all levels of the system. This requires innovation beyond contemporary business models, which in many cases are based on ownership of (parts of) the system.
- The orchestration of innovation (the right column in Figure 2) by organising the collaboration in the quadruple helix structure (consisting of citizens, industry, knowledge institutions and municipalities).

Figure 2: Prerequisites of innovation [5]



In the context of smart society innovation, municipalities have an important role in establishing the preconditions for innovation. By setting the right criteria in tenders for solutions to be implemented in the public space, they can safeguard public interest, cyber-safety and the availability of the basic services by providing open system access at all levels: connectivity to the public services infrastructure and access to the devices, to the data for public interest and to acquired knowledge. Municipalities can also decide not to invite tenders based on available solutions, but instead to use innovations or even a continuous innovation process in co-creation with citizens. By using the quadruple helix structure, innovation can be ensured at all levels of the system, together with the development of solutions for societal challenges that citizens regard as important.

In last year's contribution [4], we described several smart city projects and indicated the challenges in the transition to open innovation starting from societal needs. During 2015 we continued these projects and identified the crucial role of data. Measuring and monitoring systems in public spaces or social contexts generate data in the public space, which is not in itself a new phenomenon; traffic counts have been used for years. What is new is that intelligent technology enables applications beyond the specific goal for which the data is gathered. Secondly, until now data collection was limited to actions taken for public purposes, whereas nowadays public parties initiate sensoring in public space. And yet, this data plays a vital role in the transition to a smart society. So far, there has been little regulation of data collected in the public space. As a result, many companies design their business models around the collection and ownership of data, just as they do in other domains. But the public space is a different context in which people do not have an 'opt out', and privacy is a major concern. New business models are needed that respect privacy and give users of public spaces control of their own data.

Several studies of the future of smart and sustainable cities of 2050 [7; 8] indicate a desired future scenario in which ambient networks provide connectivity for (wireless) access to data and energy. These studies emphasise that citizens should be able to choose freely from a range of available options. The system ensures the privacy and security of users, who are always in control. Those systems are user focused: that means users can understand how the systems work, and there is a range of available solutions that plug in directly to the city's open platform. Cities offer a good balance in the quality of neighbourhoods and infrastructure, with affordable services for all income levels. Experts interviewed in these studies indicate the need for democratised systems based on open data. Democratised means that the systems are open, bidirectional, multipurpose platforms on which (renewable) energy and energy management services are available to all.

Smart cities need a smart infrastructure. This 'Internet of Things'-like infrastructure serves a range of functions and aims. It enables the development of new services and empowers people as owners of data. But unfortunately we encounter challenges in current projects. These mean the roles and responsibilities of all the innovation partners are changing, so we have to redefine the rules of the game together while we are playing it. We recognise the need for a shared framework, and especially for data to ensure open, multipurpose, democratised platforms.

Creating new frameworks: open data principles

Because developments in (open) data are still very new, regulations at national or European level are not yet available or are still insufficiently detailed. Most commercial companies now focus primarily on gaining ownership of data as a new business model. Most people are not yet aware of how this strategy will affect their privacy, and how it will limit the availability of services in their daily lives. Achieving Eindhoven's ambition of co-designing an open, multipurpose, democratised platform requires a clear position in relation to the ownership, openness and use of data gathered in the public domain. The aim is to safeguard public interest and to maximise value for society as a whole, rather than for individuals or companies.

The Municipality of Eindhoven has developed a set of open data principles, which serve as a first attempt to deal sensibly with data in the public space (see *Table 1*) [9]. These principles follow the policy that all data collected (unconsiously from the people), generated or monitored in the public space remains public property, and they prevent that data from being monopolised by any party or parties. Clear agreements about how data is managed benefit trust, transparency and acceptance of new technologies by citizens and businesses in the city. In this way, citizens are assured that their data will not be misused, and that the public interest is safeguarded.

Opening up data aims to promote innovation and to help create an attractive economic climate in the new smart society. The essence is that everyone can make money by using data from the public domain, but the data itself remain in public ownership, so that other parties (both public and private)

can use and re-use it. The open data of the City of Eindhoven is freely available [10]. Innovative applications of data and healthy competition should ensure a sustainable and self-sustaining ecosystem. The sharing of data aims at more efficient use of the city infrastructure, for example in terms of network capacity and sensors. The (literal) physical space is limited, and opening it encourages shared use of the facilities that are already there. By keeping data as public property, the city aims to secure the (yet unknown) added value of data for the public interest.

The city is currently working on embedding the principles in legislation to create a legal structure, in which undesired developments in the use of (open) data can be prevented. Defining the principles is a step in the iterative design process; we expect that by applying the principles in practice we will be confronted by new and unexpected situations, and that we will gain progressive insights that will require us to review the principles. These principles provide a start for constructive dialogue with the quadruple helix partners, and they will be adjusted as and when necessary in the course of the design process.

Table 1: Open data principles by the city of Eindhoven [9]

a.	Data residing in the public space (further on: data) belong to everyone. These data are an asset of the public. Data that are collected, generated or measured (for example by sensors that are placed in the public space) should be opened up such that everyone can make use of it for commercial and non-commercial purposes. While doing so, privacy and security aspects should be taken into consideration.
b.	Data may contain personal information. These data can therefore impact the private life of individuals. The rules specified in the Personal Data Protection Act are applicable here. These data may only be opened up after they have been processed (for example, by anonymization or aggregation) such that there are no privacy threats anymore.
c.	Data which do bring privacy or security risks along may only be used according to the privacy legislation. Storage and processing of these data should be performed according to the existing legislation.
d.	Data that do not contain personal information (anymore) should be placed such that everyone can access these data in an equal manner (for example, through an Open Data portal). We call this "opening up" the data. There should be no technical or juridical obstacles that limit, discriminate or block access to data.
e.	Data are always opened up free of charge, without unnecessary processing (as much as possible in a raw form) and according to the functional and technical requirements that are yet to be defined.
f.	A distinction is made with regard to personal data (such as an e-mail address or payment information) that are collected with full awareness and after an explicit consent of the individuals. Use of these data is defined by an agreement between the parties involved according to the rules of privacy legislation (such as an end user agreement).
g.	The city authorities always have an insight into which data is collected in the public space, independently of whether these data can or cannot be opened up.
h.	The city authorities keep an ongoing dialogue with the parties that contribute to the development of data infrastructure in the city and strive to create earning opportunities and a fruitful economic climate.

Next steps for Eindhoven in becoming a smart society

The challenge on the path to a smart society is to (re-)design the game and the rules of the game. The open data principles are a first effort to do this. These principles should be reviewed in use to see if they actually lead to more innovation and have the ability to prevent undesired business models in public spaces.

At the same time this is a huge opportunity to develop local solutions that answer questions with a global impact. The municipalities, the companies and the knowledge institutions have the ambition to not only regard solutions as a 'local pilot project', but also to seek ways to increase their scale. This is needed to enable companies to develop sustainable businesses, but also to speed up the development of the platform and smart society services. Given its size, Eindhoven would not be an attractive market on its own, but can serve as a front-runner. Solutions that work for Eindhoven cannot simply be transferred to other contexts: they need to be tuned to meet the new and specific local needs. But a smart platform will enable added-value services in different contexts, using similar hardware modules but with different services, settings and usage scenarios. This also makes it possible to adjust the services and solutions over time.

In Eindhoven, stakeholders are already used to working together in 'living labs', which allow innovative solutions to be designed and tested. To actively seek entirely new connections and solutions, and to scale solutions across sectors, all parties are willing to look beyond the pilot stage. Living labs are the ideal context in which to jointly practice design: to prototype, to test, to learn and

to discover step by step which elements work. The next challenge for living labs will also be to learn about the concepts and requirements that facilitate success (the rules of the game) and to facilitate the adjustment and enrolment in new contexts, in a continuing iterative process. This aims at eventually up-scaling the solutions, creating a larger market and speeding the development of the platform and services.

Redesigning the city to become sustainable for the digital era indeed requires a shift from leadership to orchestration. In a quadruple helix collaboration, innovation is turned into a process of participation. This aims to create shared value by making the lives of citizens more enjoyable, with sustainable business propositions by existing and new companies. The municipality takes responsibility not only to promote and facilitate living labs, but also to ensure that this happens safely and inclusively, in the same way that security in public spaces is ensured. The virtual layer on the public space — the public data layer — has to be considered in the same way: dealing with openness, accessibility and security.

Conclusion

The transition to smart cities is in full swing. To really become a smart society, we need to put citizens at centre stage. To really become a city with resilient citizens, we need to truly empower people. And to really get there, we need a different approach: a design approach.

Data play a vital role in the transition towards a smart society. We believe that if an open, multipurpose democratised platform is applied in the public domain, data can empower people to become active producers of societal value. And to ensure a strong foundation on which to built the smart society, we need to regulate at different levels.

Locally, the rules of the game need to be designed to facilitate innovation to the maximum possible extent. We need to avoid data monopoly and lock-in business models in the (virtual) public space, as well as safeguard the public interest and maximise social value over individual or commercial profit. Issues of ownership and privacy must be safeguarded, and cities must be aware of their public responsibility to facilitate and orchestrate the basic, local infrastructure to enable these processes in the best possible way. Eindhoven has developed open data principles as a first attempt to sensibly deal with data in the public domain. But this is still only a first step. How this will enable new business development and economic prosperity at the same time will also need to become clear in the following steps.

Collaboration with other European cities is necessary to ensure a market that enables sustainable development of the platform, the smart society services and the necessary frameworks and regulations. Dealing with open data in particular is still very new, and regulations at national or European level are not yet available or are still insufficiently detailed. A lot of progress has been made with the living labs in Eindhoven, but it is only through cooperation that we can learn which way is best and achieve the scale needed to guide the transformation process in the right direction. In the EU frameworks, regulations can be designed to promote a vibrant society and at the same time build a thriving economy.

In Europe we value human rights and have firmly secured a number of issues, such as openness, privacy and security. It is only through cooperation that Europe can compete with other international economic power blocs. The views, concepts and activities in Eindhoven as described in this chapter depend greatly on good contextual frameworks. EU citizens as well as local and national authorities have to be alert to maintain and promote their values.

For instance, the currently negotiated Transatlantic Trade and Investment Partnership (TTIP) [11] may underpin some of our European rights. TTIP does not cover data, although this will form the main basis for new business models. Critics have expressed concerns about a number of issues, including data protection and privacy [12]. In the current proposal, for instance, personal data of EU citizens could be transferred to any country trumping the EU data protection framework. There are also negotiations dealing with issues like mass surveillance and encryption. In its current form, this may subvert the democracy of actions and consequently directly limit potential local opportunities and solutions. We should prevent any provisions on data protection, any lock-in of existing data transfer agreements, and any form of standardisation of encryption or interoperability of encryption standards that could lead to a possible lock-in of those standards [12]. Although the protection of personal data now seems to be covered, the collection of other data in public space still seems to be poorly regulated.

Finally, we also recognise that we are exploring new territory on the path to the desired future, and we will have to constantly adapt to new and changing insights. The smart society will not happen by itself. Municipalities, institutions, companies and engaged citizens need to be involved and inspired to participate. In Eindhoven, we will continue with new forms of collaboration in our

current and future living labs. By integrating our visions and strategies, all the actors and stakeholders in the cities will contribute in some way (through regulation, knowledge, funding and feedback) to the city's power to innovate.

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World cities that need transformation

Intellectual capital of 36 cities

Abstract

Today half the world's population lives in cities. Cities have been recognised as centres for the production of knowledge, culture, information and innovation. Thus, metropolitan areas, rather than nation states, will shape the world's social, cultural, technological and economic agendas in this century. National governments are aware of the significant impact of city competitiveness, resulting in increasing investments in building unique city characteristics to boost city as well as national economic development.

In the past, cities generally set their visions and goals by considering tangible assets as the main driver of a city's prosperity. In the knowledge economy, the role of intangible assets has become fundamental to wealth creation. As a result, an intangible assets framework that allows navigation from the present reality to the future vision has become an urgent need for all cities [3].

Although there is an awareness of the role a city plays in sustaining a country's competitiveness, a well-accepted city-level intangible asset model and ranking is still lacking. This paper introduces a city-level intellectual capital (CIC) covering human capital, market capital, process capital, renewal capital and financial capital. The top six CIC cities are Paris, London, New York, Stockholm, Copenhagen and Helsinki.

Introduction

After the dawning of the knowledge economy, how intangible assets affects competitiveness has increasingly caught worldwide attention. The concept of intellectual capital was the product of such a trend. Intellectual capital originated at the organisational level and was gradually applied to regional and national level, ever since Edvinsson and Malone [6] proposed the Skandia model. Intellectual capital (IC) includes not only knowledge, competence, skills, culture, employee motivation, working methods and systems, but also customer relationships, partner relationships and other processes to leverage these assets. Although hard to grasp, IC could mainly be represented by three distinct components, namely human capital, structural (organisational) capital and relational (social, customer) capital [6]; [15]; [37].

Over the past 15 years, some researchers have extended the concept and its application to the national level, such as Bontis [1], Pasher and Shachar [33], and Lin and Edvinsson [18]. Among various national-level IC researchers, the author of this article continuously conducted a large-scale national intellectual capital (NIC) study and published a series of 12 booklets for 48 countries [19]-[29]. This paper attempts to extend my past national-level research to the city level, mainly because of the rising of the borderless global economy.

Since the 'city' is gradually becoming the source of future competitiveness in any country, this CIC research reports the relative position of 36 world cities. Hopefully, city governments and relevant policymakers can learn from examples of globally competitive cities to gather essential resources to build facilitating environments for future city development.

Background

Nowadays, cities and regions all over the world devote a large amount of resources, encouraging and cultivating the collective knowledge or IC to shape future competitiveness [3]. Since half the world's population lives in cities [35], cities have been recognised as centres for the production of knowledge, culture, information and innovation [32]. In addition, the increasing growth of mega-cities, particularly in the emerging economies, adds further importance to this perspective [38].

City Mayors (an international think tank for urban affairs) believes that metropolitan areas, rather than nation states, will shape the world's social, cultural, technological and economic agendas in this century [38]. The Lisbon strategy on sustainable European cities also recognises that cities are the centres of knowledge and sources of growth and innovation. The strategy promotes a process to make the European Union the most competitive and dynamic economy in the world, leading to more and better jobs with greater social cohesion [32]. For example, Amsterdam becomes the hub of city networks in Europe; Barcelona is known as the 'city of knowledge' and the best place for knowledge workers [10]; and Rotterdam has retained its role as a transit hub in Europe by providing new transportation knowledge and capability [39]. In addition, Poitiers in France utilised information and communications technology, multimedia and a high-tech work team to transform itself from a barren rural location to a learning city with research and development (R & D), education and a recreation

future scope theme park. Such transformation has attracted global tourists as well as 70 companies, thus creating 1 500 jobs inside the park and 12 000 job opportunities in the vicinity [17].

In the United States, New York is the global economic centre and Silicon Valley is the base of emerging industries. Similarly, Austin, Texas is another city known for its so-called wired for talent strategy that is designed to attract talent from around the country [38]. In Canada, Edmonton, Alberta is pursuing a vision for an international smart city through 'smart research, smart workforce and a smart culture'. These cases clearly explain the value of creating an environment in which people and businesses can succeed and thrive in cities.

Literature review reveals that urban planning is currently the main stream in this field of study. A small percentage of city studies include liveable cities, sustainable cities, knowledge cities, intelligent cities, smart cities and creative cities. Yet few studies particularly focus on CIC [29]; [12]; [35]; [32], and most of CIC publications are conceptual papers. For the studies that have real city data, generally they report status of a limited number of cities or one city only. For example, Rodrigues and Tomé [35] studied three cities — Braga, Luxembourg and Ruse; Hyrkas, Kianto and Rings [12] studied four municipalities located in southeastern Finland — Lappeenranta, Joutseno, Lemi and Taipalsaari; and Maria and Marti [30] used one city, Mataro in Spain, to illustrate their model. The book *Intellectual capital for communities: nations, regions, and cities*, published by Bounfour and Edvinsson [2], only described a small portion of CIC.

For non-academic literature, world organisations, governments and private organisations showed interest in evaluating cities from different perspectives. For example, the European Union regularly ranks European cities based on six defining characteristics, namely smart economy, smart mobility, smart governance, smart environment, smart living and smart people (www.smart-cities.eu) [38].

Based on 39 indicators, every year Mercer reports the results of Mercer quality of living survey for 221 cities and the world's 'greenest' cities. *The Economist* retrieved some of Mercer's results and published 'The world's most 'liveable' cities'. From 2010, a private company in Australia named 2thinknow started to collect data of 162 indicators and reports an 'innovative cities' ranking for around 300 cities, covering architecture, art, business, economy, education, environment, food and health.

In addition to the above efforts, *Table 1* summarises eight city-level models for assessing IC, smart cities or cities with quality of life.

CIC — Navarro and associates

Navarro and associates [32] propose that CIC should cover human capital, process capital, commercial capital, communication capital, R & D and innovation capital, and environmental capital. They advocate that IC is essential for the economic growth of cities and local IC provides a measure of hidden wealth of the city.

CIC — Viedma

Hyrkas, Kianto and Rings [12] regard municipalities as non-profit organisations with the main task to produce services to their citizens' needs. And services are essentially intangible. To meet this challenge most effectively and professionally, IC is the foundation [12]. Although it is difficult to quantify IC, especially in the public sector, they proposed to use Viedma's [40] model consisting of human capital, market capital, process capital and renewal and development capital to define and measure CIC.

CIC — Maria and Marti

Maria and Marti [30] proposed a CIC benchmarking system based on the IC navigator model (Skandia model). According to the model, there are four areas of focus with regard to IC: human capital, customer and market capital, process capital, and renewal and development capital.

CIC — Hsu

As a master thesis from National Chengchi University, Taiwan, my student Ms. Hsu and myself worked together to come up with 29 CIC indicators, covering human capital, market capital, process capital, renewal capital and financial capital, comparing four major cities in Taiwan.

PricewaterhouseCoopers city of opportunity indicators

PricewaterhouseCoopers, together with New York City, has been researching cities of opportunity for five consecutive years and particularly highlighted the importance of IC in city development. The 2010 results include that Stockholm was named the 'green capital' of Europe, Chicago was the best business city with a high quality of living, and Sydney was renowned for its landscape with visionary city policies. In its most recent 2011 version, 60 indicators were used to rank cities of opportunity.

Features of smart cities

Rodrigues and Tomé [34] studied smart or knowledge cities and reported the need for a radical reformulation when entering the knowledge-based economy. Based on these two researchers, smart cities score high in smart economy, smart mobility, smart living, smart governance, smart environment and smart people.

Features of cities with quality of life

Donald [5] identifies eight features of cities with quality of life, including social cohesion, human services, learning, community safety, affordable housing, public transportation, environmental quality and culture.

Features of creative cities

According to Cabrita and Cabrita [3], there is a high demand for new approaches to IC assessment and valuation, including services, information, technology and intellectual property. Generally speaking, the quantity and quality of human capital and derived creativity will determine the parameters for success. These two scholars provide four dimensions to explain and develop creative cities, including scientific creativity, economic creativity, cultural creativity and technological creativity.

As mentioned earlier, the nexus of competitive advantage has shifted from nation states to those cities and regions that can generate, retain and attract the best talent. Accordingly, future competitive cities should have a high degree of knowledge and innovation; that is, intangible assets. This trend will lead to increased competition for human, intellectual and material resources but will also force cities to cooperate with and learn from one another [38].

The CIC ranking reported in this paper enables a city to locate its relative position for benchmarking and coping strategies. Measuring CIC enables cities to determine what they must take into account to make them a source of wealth, prosperity, welfare and future growth. Given that the measurement and management of the IC of cities has great similarities to that of countries, the advances made in the management of the IC of nations can be extrapolated to the case of cities [30]. In what follows, the definition and components of CIC are briefly introduced.

Table 1: Eight studies about CIC, cities with quality of life and creative cities

Viedma (2004)	Maria and Marti (2003)	HSU (2008)	PwC - Cities of Opportunity	Rodrigues and Tomé (2011)	Donald (2001) Cities with quality of life	Cabrita and Cabrita (2010) Creative cities
Human capital	Human capital	Human capital	60 indicators	smart economy	Social cohesion	Scientific creativity
Market capital	Customer & Market capital	Market capital		smart mobility	Human services	Economic creativity
Process capital	Process capital	Process capital		smart living	Learning	Cultural creativity
Renewal and development capital	Renewal and development capital	Renewal capital		smart Governance	Community safety	technological creativity
		Financial capital		smart Environment	Affordable housing	
				smart people	Public transportation	
					Environmental quality	
					Culture	

CIC

City competitiveness is the reflection of CIC. CIC development can also be based on the Skandia model [6] and national IC model [18]. The component capitals may include city human capital, market capital, process capital, renewal capital and financial capital, briefly explained hereunder.

City human capital

City human capital consists of knowledge about facts, laws and principles relating to city interactions and other specialised and communication skills. It may include knowledge, wisdom, expertise, vision and individual capability to accomplish city goals. Relevant indicators include population with higher education, internet subscribers and percentage of knowledge workers.

City market capital

City market capital is similar to external relational networking and social capital in a microsetting in that it represents a city's capabilities and successes in providing an attractive and competitive incentive in order to meet the needs of its partners, while also sharing knowledge with other cities. It includes a relationship with other local as well as international cities, such as strategic partners, city loyalty, city satisfaction, city branding and city export and import.

City process capital

City process capital comprises the non-human sources of knowledge in a city. Embedded in a city's infrastructure, these sources facilitate the creation, accessibility and dissemination of information, and infrastructures needed for collaboration, knowledge

flow and better outputs, such as information technology system, hardware, software, database, laboratories and organisational structure.

City renewal capital

City renewal capital is a city's future intellectual wealth and the capability to utilise city resources for innovation and renewal, such as investment in R & D, patent and trademark development, and a number of new companies that sustain a city's competitive advantage.

City financial capital

City financial capital is the wealth of a city and reflects the 'outcomes' of city governance, such as disposable household income and city GDP. In this study, city financial capital is the city's GDP per capita (ppp) in US dollars transformed to a score between 1 and 10.

Methods

For city-level analysis, it is very hard to get longitudinal data for world cities. Eurostat has quite a comprehensive database; however, it is for cities in Europe only. Different databases have different focus, such as PricewaterhouseCoopers on cities of opportunities, Rodrigues and Tomé [34] on smart cities, Donald [5] on cities with quality of life and Cabrita and Cabrita [3] on creative cities. Based on the literature review, we first select relevant indicators in Eurostat, PricewaterhouseCoopers and the Global Urban Competitiveness Research Centre for City and Competitiveness in China. The greatest number of cities with the largest amount of required data is 36. They cover 15 cities in Europe, 11 in North America, seven in Asia, two in Australia and one in the Middle East. Due to a large amount of missing values, we have to supplement data in 'search global city data,' 'Numbeo' and 'international city indicators database from Taipei City Government'.

After several rounds of model validation, *Table 2* shows the best possible CIC model with limited data. Due to a large amount of city-level missing values, some indicators in human capital and renewal capital use national-level indicators from the IMD database. The assumption is that some national systems apply to all cities in the nation, such as public education investment, gender equality, human development index, years of education and intellectual rights protection. In this model, there are six indicators for each of the component capitals, except process capital which has seven and financial capital which is a single indicator of city ppp. This paper describes intellectual capital of 36 cities over a period of six years, from 2007 to 2012.

The model consists of two different types of data: data with an absolute value, such as 'years of education', and data with a qualitative rating based on a scale of 1 to 10, such as 'attracting foreign direct investment (FDI)'. Although subjective, qualitative rating on the degree or magnitude of certain variables is unavoidable, as evaluating intangible assets cannot be fully represented by merely adding up absolute numbers. For a meaningful integration of the quantitative score and qualitative rating, the ratio of the absolute value relative to the highest value of each quantitative variable was calculated and multiplied by 10 to transform the number into a 1-to-10 score. The data transformation procedures have been repeated for all numerical indicators of human capital, market capital, process capital, renewal capital and financial capital. The overall city intellectual capital ranking, as shown in *Table 3*, includes the mean scores of the five types of capital and the total score of city intellectual capital for each city.

Table 2: Indicators of human capital, market capital, process capital and renewal capital

Human Capital	H1	X1	R&D personnel researchers
	H2	X2	*Public Education Investment
	H3	X3	*Gender equality
	H4	X4	*Human Development Index
	H5	X5	*Years of education
	H6	X6	*Overall productivity
Market Capital	M1	X7	number of laboratory and research center
	M2	X8	Number of Global 500 headquarters
	M3	X9	international tourists
	M4	X10	attracting FDI
	M5	X11	cost of business occupancy (reverse)
	M6	X12	city population
Process Capital	P1	X13	living quality
	P2	X14	air quality
	P3	X15	number of cultural and arts organizations
	P4	X16	public transportation single ride price (reverse)
	P5	X17	households broadband access

	P6	X18	CPI plus Rent index (reverse)
	P7	X19	Green spaces (%)
Renewal Capital	R1	X20	number of international papers
	R2	X21	industry promoting power
	R3	X22	patent applications
	R4	X23	*Business R&D spending
	R5	X24	*Intellectual rights protection
	R6	X25	*Cooperation between universities and enterprises

Table 3: Intellectual capital score and ranking of 36 world cities

2007-2012	Human capital		Market capital		Process capital		Renewal capital		Financial capital		Overall CIC	
Mean	7.45		5.15		6.43		5.45		5.46		29.83	
SD	0.99		0.94		1.31		0.93		1.42		4	
city	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking
Amsterdam	7.59	23	4.96	20	7.2	9	5.24	22	5.39	21	30.37	20
Barcelona	7.13	28	5.09	13	5.68	30	4.04	33	4.21	32	26.15	32
Beijing	4.44	35	5.58	7	2.95	36	3.56	35	1.88	36	18.4	36
Berlin	7.44	26	4.99	17	7.14	11	5.74	17	3.56	33	28.87	27
Boston	7.91	6	5.2	10	6.7	17	6.32	7	5.22	28	31.35	10
Chicago	7.91	6	3.03	36	7.17	10	6.15	10	5.46	12	29.72	26
Copenhagen	8.49	4	4.76	26	6.78	15	6.64	3	6.23	7	32.9	5
Dubai	5.02	34	5.19	11	4.11	34	4.18	31	5.46	13	23.95	34
Frankfurt	7.46	25	4.43	34	7.33	7	5.96	13	5.18	29	30.35	21
Hamburg	7.39	27	5.05	15	6	26	5.59	19	6.89	4	27.4	28
Helsinki	8.73	1	5.23	9	6.7	18	6.27	9	5.29	25	32.21	6
Hong Kong	6.61	33	5.87	5	4.99	31	4.05	32	5.9	9	27.4	28
Houston	7.91	6	4.5	31	6.8	12	6.31	8	5.03	30	30.55	19
Indianapolis	7.91	6	4.92	22	6.46	23	6.11	11	5.46	13	30.86	16
London	7.71	20	7.85	2	8.01	4	4.95	26	7.57	3	36.1	2
Lyon	7.78	18	4.96	19	6.69	19	4.93	27	5.46	13	29.8	24
Melbourne	7.83	16	4.81	25	6.8	12	5.13	24	5.23	27	29.8	25
Milan	6.73	32	4.95	21	5.91	29	3.85	34	5.25	26	26.69	30
Minneapolis	7.91	6	4.69	29	6.57	22	6.46	6	5.46	13	31.07	12
Munich	7.59	22	5.16	12	6.76	16	5.85	15	5.46	13	30.82	17
New York	7.91	6	6.18	4	8.12	3	6.47	5	6.3	6	34.97	3
Paris	7.91	5	8.56	1	8.58	1	4.57	30	9.5	1	39.11	1
Philadelphia	7.91	6	4.97	18	5.94	28	6.02	12	4.99	31	29.83	23
Pittsburgh	7.91	6	5.03	16	6.59	21	5.93	14	5.46	13	30.91	14
San Francisco	7.91	6	4.45	32	7.25	8	6.69	2	5.51	11	31.8	9
Seattle	7.91	6	4.73	28	6.65	20	6.48	4	5.46	13	31.22	11
Seoul	7	30	5.23	8	4.95	32	4.74	29	3.42	34	25.33	33
Shanghai	4.44	35	5.68	6	3.18	35	3.54	36	2.06	35	18.89	35
Singapore	7.02	29	5.07	14	5.98	27	5.37	21	8.68	2	32.12	7
Stockholm	8.5	3	4.61	30	7.69	6	6.87	1	5.97	8	33.64	4
Sydney	7.83	16	4.24	35	8.48	2	5.01	25	5.34	23	30.9	15
Taipei	7.59	23	4.45	33	4.37	33	4.85	28	5.42	20	26.68	31
Tel Aviv	8.61	2	4.92	22	6.01	25	5.72	18	5.39	22	30.65	18
Tokyo	6.86	31	6.35	3	6.38	24	5.77	16	6.47	5	31.83	8
Toronto	7.71	19	4.88	24	7.93	5	5.21	23	5.34	24	31.06	13
Vienna	7.64	21	4.76	27	6.79	14	5.55	20	5.58	10	30.31	22

Findings

With respect to the 6-year data for 36 cities, the top 10 cities in the overall ranking list are, in order, Paris, London, New York, Stockholm, Copenhagen, Helsinki, Singapore, Tokyo, San Francisco and Boston. Among the top 10, five are in Europe, three are in North America and two are in Asia. Interestingly, the five European cities and Tokyo are all capitals of their country, whereas none of the three cities in North America is a capital. Singapore is a city nation. The overall results of this CIC confirm the general perception that the three super-large cities, Paris, New York and London, are the top three CIC cities. The capital of the three Nordic countries also has a high degree of CIC.

Cities ranked 11th-20th are, in order, Seattle, Minneapolis, Toronto, Pittsburgh, Sydney, Indianapolis,

Munich, Tel Aviv, Houston and Amsterdam. Among these 10 cities, five are in the United States, one is in Canada, three are in Europe and one is in Australia. Tel Aviv ranked 2nd in human capital as it has very high R & D researcher and overall productivity.

Cities ranked 21st-30th are, in order, Frankfurt, Vienna, Philadelphia, Lyon, Melbourne, Chicago, Berlin, Hamburg and Hong Kong (tied) and Milan. Among the 10 cities, six are in Europe, two are in the United States, one is in Australia and one is in Asia. Chicago is particularly weak in market capital; raw data shows that Chicago is low in 'number of laboratory and research centres' and 'attracting FDI'. Hong Kong ranked fifth in market capital but is relatively weak in human capital, process capital and renewal capital.

Cities ranked 31st-36th are, in order, Taipei, Barcelona, Seoul, Dubai, Shanghai and Beijing. Shanghai and Beijing are relatively strong in market capital, ranked sixth and seventh, respectively. However, these two cities are relatively weak in human capital, process capital and renewal capital.

In order to see the relationship between CIC and ppp of the 36 cities, we prepared several graphs. *Figure 1* shows a relatively high correlation between overall CIC and ppp. That is, generally speaking, the higher the CIC the higher its ppp. *Figure 2* shows a majority of cities cluster in the middle right of the graphs, indicating the competition of acquiring good human capital among the cities. The correlation between human capital and ppp is not as high as that in *Figure 1*.

Figure 1: Scatterplot of overall CIC vs. ppp

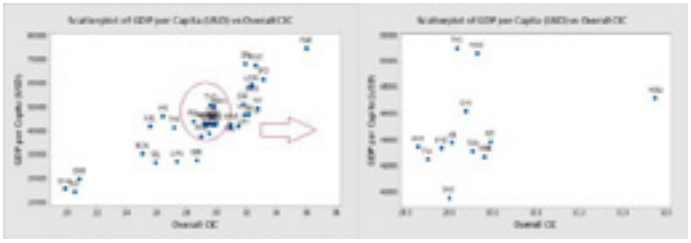


Figure 2: Scatterplot of human capital vs. ppp

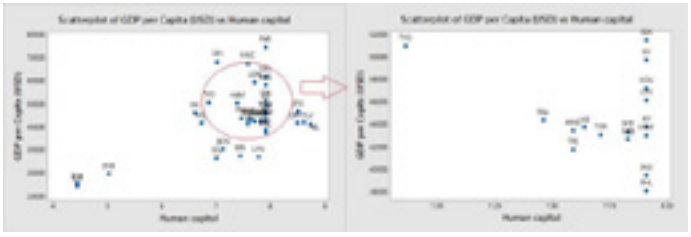


Figure 3 shows a spreading graph with low correlation between market capital and ppp. *Figure 4* shows two parallel lines. London and Singapore are on the upper left side. A majority of the cities fall in the middle part of the graph. The two lines indicate a positive correlation between process capital and ppp, yet with different degrees. *Figure 5* shows two clusters. The large cluster indicates a positive correlation between renewal capital and ppp, whereas the small cluster shows limited correlation between the two.

Figure 3: Scatterplot of market capital vs. ppp

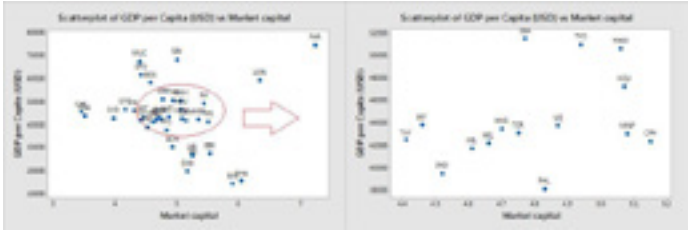


Figure 4: Scatterplot of process capital vs. ppp

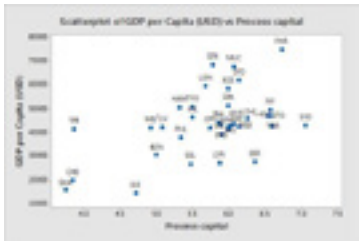


Figure 5: Scatterplot of renewal capital vs. ppp

In order to see the progression of the top six CIC cities, scatterplots of human capital vs. renewal capital and market capital vs. process capital are presented in *Figure 6* and *Figure 7*. Human capital and renewal capital together are long-term intangible assets that cities need to possess. *Figure 6* shows that even though the specified six cities are ranked as the top six CIC, New York had some progress in human capital and renewal capital over the years. Paris, London, Helsinki and Stockholm regressed in renewal capital. Copenhagen progressed more in human capital than in renewal capital.

Figure 7 shows that, over the years, Paris increased a little in process capital with relatively stable market capital. London regressed quite a bit in process capital, however with a little increase in market capital. New York had great improvement in market capital and a little increase in process capital. Stockholm regressed in both market and process capital. Copenhagen increased market capital, however regressed in process capital. Helsinki increased more in market capital than in process capital.

Figure 6: Human capital vs. renewal capital of the top six cities from 2007-2012

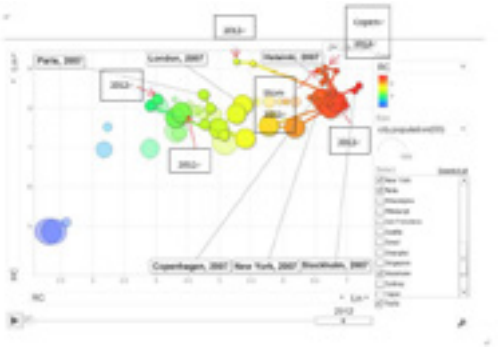
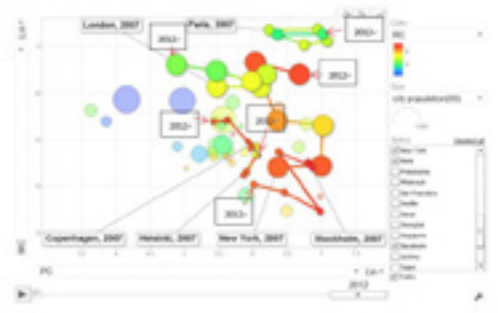


Figure 7: Market capital vs. process capital of the top six cities from 2007-2012



It is understandable that market capital is more short-term oriented and depends on the regional or global economic situation. As the world economy is still stagnant, declines in market capital after the 2008-2009 global financial crisis can be anticipated. However, city governments can continuously build on better process capital, such as air quality and living quality.

From *Figure 6* and *Figure 7*, Paris and London need to be aware of losing future competitiveness in long-term intangible assets — human capital and renewal capital. From the raw data, Paris declined in R & D researchers, public education investment, patent applications, business R & D spending and cooperation between universities and enterprises. London declined in R & D researchers, gender equality, number of international papers and patent applications. Both Paris and London are cities with long histories that attract tourists. Some Nordic cities, such as Stockholm, Helsinki and Copenhagen, are becoming more and more attractive to tourists. In addition, they provide a social environment with high degrees of freedom and equality, which is important to the young generation. City transformation advice for Paris and London is to create an environment that attracts and nurtures young talent to stay and develop their career. R & D is also an area worthy of further pursuit, as renewal and innovation may be future determinants of city competitiveness.

Due to space constraint, we only plotted the top six CIC cities for the development paths of human capital vs. renewal capital and market capital vs. process capital over the years 2007-2012. Other cities can refer to *Figures 1-5* and *Table 3* for their relative position, and then compare and contrast with their benchmarking cities for future intangible assets development. For example, Shanghai and Beijing are at the bottom-left corner of the graphs, except for market capital. Human capital requires time to develop over the years. These two cities in China need to start a journey of accumulating human capital in order to reach the level of human capital in European cities and United States cities. The same situation applies to renewal capital. Although China is increasing its R & D investment, for a higher degree of renewal capital, business R & D spending and intellectual rights protection are also very important.

Conclusion

The selected 36 cities are all well known in each country. However, when comparing their CIC on a global arena, some of their rankings are not as good as expected. The main reason is that when there is fierce competition, some good cities will be competing down as others are stronger. The main goal of reporting CIC ranking is for each city to find its relative position for guiding future development. It is also important to note that the scores are relative. Even though Paris declined in R & D researchers, it does not necessarily mean a reduction in the number of R & D researchers. It could be that other cities increased their R & D researchers and pushed Paris's score of this particular indicator down.

For long-term intangible assets — human capital and renewal capital — for the top six cities, New York had a little progress in human capital and renewal capital over the years. Copenhagen progressed more in human capital than in renewal capital. Paris, London, Helsinki and Stockholm regressed in renewal capital. For the short-term intangible assets — market capital and process capital — Paris increased a little in process capital with relatively stable market capital. London regressed quite a bit in process capital, however with a little increase in market capital. New York has made great improvement in market capital and a little increase in process capital. Stockholm regressed in both market capital and process capital. Copenhagen increased market capital, however regressed in process capital. Helsinki increased more in market capital than in process capital.

Although these six cities are already at the top of CIC, there are still signs of warning. From their path of development, New York is the best without decline in both long-term and short-term intangible assets over the six years. Copenhagen is mainly improving its intangible assets, except some decline in process capital. Helsinki has relatively large scale decline in renewal capital. Stockholm needs to worry about its decline in market capital, process capital and renewal capital.

In addition to the six top CIC cities, two more cities (7th and 8th CIC) are particularly weak in human capital. Singapore's ranking is 29th with low scores in public education investment and gender equality. Tokyo lags behind in R & D researchers, public education investment and gender equality. These low-degree indicators explain why Tokyo ranked only 31st in human capital.

City transformation suggestions especially go to Stockholm, Singapore and Tokyo. Sweden used to be high in intangible assets [18]; [19]; [27]. Stockholm's decline in three out of four CIC capitals sent a signal for city transformation. Two Asian cities, Singapore and Tokyo, are low in human capital. Although history and culture may play a role in explaining this outcome, higher education investment and enhancing gender equality should be the right direction for future development.

As mentioned previously, cities will become the unit of competition rather than nation states in the future. Attending to the intangible assets development may decide the future talent hubs of the world. There are abundant clues from the figures and tables presented in this paper. City transformation suggestions are provided using the example of Paris, London, Shanghai and Beijing.

This paper presents a preliminary model of CIC, with limited data from various sources. We are only able to have an almost complete dataset of 36 global cities. Future studies may refine the model when more data becomes available.

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Smart city network boosting open innovation

An open innovation platform provided by Finland's six largest cities

Introduction

The six city strategy — open and smart services — is a strategy for sustainable urban development carried out by the six largest cities in Finland: Helsinki, Espoo, Vantaa, Tampere, Turku and Oulu (*Figure 1*). The main objective of the strategy, which will be carried out in 2014-2020, is to create new know-how, business and jobs in Finland. The strategy is a part of the implementation of Finland's structural fund programme for sustainable growth and jobs 2014-2020, forming its integrated territorial investment (ITI) component [1].

The additional objectives of the six city strategy is to improve the services offered by cities, increase the competitiveness of businesses and enable more widespread participation in development work. City services are developed based on three focus areas: open innovation platforms, open data and interfaces, and open participation. The central idea is to view cities as platforms, whose operations and services should be developed in ways that also allow easier participation by third parties. Cooperation becomes easier as cities open up their processes and data, and produce tools and operating models that facilitate joint development.

Figure 1: The six cities network

Cities as basis for innovation platforms

In the six cities collaboration, open innovation platforms are regarded as functional elements in a city community that create a basis for new solution creation and from there enable new business creation [2]. Open innovation platforms consist of infrastructure, physical and virtual elements, productised processes and members of communities to form a strong value-added environment.

The national open innovation platform network supports the new business development in a modern, international, competitive digitalised world. The environment also supports the development of the new devices, service solutions and institutional research. The target is to offer a 'one door' solution for focus groups. The other main objective is to offer a structured platform for digitalisation of the municipality services and to involve the companies to create new innovative ways to implement services and thus utilise all available local resources. With this model the role of the city will evolve from service provider to service creation enabler.

Open innovation platform collaboration

The six cities open innovation platforms collaboration is aiming to build a strong network of the open innovation platforms by the six biggest cities in Finland [3]. By building the national network of open innovation platforms, driving new competence development, business and jobs creation will become more efficient. Utilising the wide variety of knowledge and specialisation in different cities, the best practices and concepts will be collected to form an excellent basis for a new type of city business modelling (smart market creation).

The open innovation platform network will provide companies with a possibility to access several cities at the same time, instead of single cities. Besides the critical mass, the collaboration offers a possibility to share best practices in between the cities on how to develop new smart city innovations.

Six cities and their innovation platforms together are more competitive and attractive than separate platforms for six cities.

The piloting phase of the six-city open innovation platform collaboration consists of platforms from the respective six cities (*Figure 2*). The platforms are developed and tested together. The open innovation platform also links together the platforms working with the same topic, such as district development activities. All the platforms are going to be presented as a smart city portfolio to make it easier for companies and others interested to find and get access to relevant innovation platforms for any specific need.

Figure 2: Six cities open innovation platform

Finnish smart city open innovation tool for Europe

The smart city sector is a growing global business. The market for smart cities will reach a value of EUR 1.5 trillion globally by 2020 [4]. As part of the European Union-funded integrated territorial investment activity, the six city strategy (6Aika) collaboration will provide a model for an open innovation platform network which can be used to support European businesses to exploit this remarkable opportunity.

Conclusion

It is essential for European developments to create new tools and environments that support companies to match the demand from growing, global smart city and digitalisation market. An important part of the support is to provide sufficient scale open innovation platforms for product and service development. When being able to show references from the world's most advanced smart city markets, global success is guaranteed.

The six city strategy open innovation platform links Finland's six largest cities and their innovation platforms under one network. The network is now in its pilot phase. Defined innovation platforms are tested in real circumstances with real users and real market circumstances. The experiences from the piloting will be available at the end of 2017, witnessing the power of smart city cooperation.

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The Smart Countries and Cities Congress

Abstract

Information and communication technologies have a great impact on city and territory management, which is quickly evolving. New interrelations between territories and knowledge have appeared, reshaping our environments and restructuring competency domain interactions.

A smart city has become a territory open for experimentation by startups and innovators of any kinds, including living labs, fab labs, media labs, making and co-working spaces. A few examples are Chicago (United States) with its chief data officer, Nantes (France) with its all-integrated services, Helsinki (Finland) with its smart Kalasatama project, and Barcelona (Spain) with its Poblenou district ecosystem.

In this context, the following elements have been underlined.

- the importance of the economical stakes linked to technologies for cities and territories;
- the position of large French enterprises in delivering services to local communities: Veolia, Suez and Vinci are world leaders;
- the strength of the French innovation ecosystem: many innovation startups are offering solutions at the forefront in these domains;
- the strong wishes from French economical partners: 'francophonie' and more generally French-friendly countries are expecting support from French operators on these sensitive technologies;
- the Paris situation as the 'city of light': a city which was at the birth of human rights, which is at the crossroads of Europe, and which, through its involvement in the European smart city project of the Horizon 2020 EU programme, is the obvious capital city of the debate related to this major transformation of cities.

Smart Countries and Cities Congress objectives

Ensuing from these findings, the Smart Countries and Cities Congress (S3C Paris) was created as a global event dedicated to technologies related to connected cities and territories and open to all stakeholders in these areas. Initiated in 2014 by the Sikiwis company as a regional conference, S3C Paris changed its format and location in 2015 and has now taken on an international dimension with the support of Smart-C European hub of reflection on smart city and of the Territories of Tomorrow Foundation [1] dedicated to the development of technologies in cities and territories.

The S3C objectives are as follows:

- to increase economic development and productivity;
- to protect the environment and climate;
- to accelerate social development and improve quality of life in order to boost 'productive, green and happy cities'.

Figure 1: S3C Paris

The actors

The congress allows officials in charge of cities and territories to meet all innovation actors. Among them were the following.

Accenture, Alcatel, Alstom, ARM, BlaBlaCar, Bolloré, Bosch, CapGemini, CGI Group, Inc., Citrix, Congo Telecom, Deutsche Bank, EDF, ERDF, General Electrics, IBM, Intel, JCDecaux, L&T Infotech, McKinsey&Company, MERCK, Oracle, Renault, Siemens, Sikiwis, Shell, Sistra, Transdev, Vedecom, Veolia, etc.

Figure 2: Participants in the congress

The S3C Paris in 2015

For its first edition, the S3C Paris 2015, located in the Paris Congress Centre on September 1, 2 and 3, run under the patronage of Mr Laurent Fabius, Minister for Foreign Affairs and International Development, and of Mrs Axelle Lemaire, Secretary of State for Digital Affairs from the Ministry of the Economy, Industry and Digital Sector. It enabled stakeholders of intelligent territories and cities from around the world to discuss the issues and discover the experiments underway in the city of tomorrow.

Articulated as a centre of expertise, the congress was organised around 250 practical and educational conferences, complemented with an area where exhibitors presented immediately applicable solutions to increase the intelligence of cities and territories.

The event brought together 1 650 people coming out of 65 countries, one third being mayors and elected representatives. Attendees studied together in situ how to speed up economic development and the human development index of their country through new technologies.

S3C Paris welcomed 200 international senior government representatives (ministers, secretaries of state, governors) who were engaged in workshops to develop a joint statement.

250 lecturers, all international experts in their fields, have joined forces to present the different facets of the city of tomorrow around subjects as diverse as economics and trade, open government, security, healthcare, smart telecommunications, environment and COP21, intelligent buildings, smart energy management, connected home, smart transportation, education and future employment, the Internet of Things, innovations in cloud and mobile technologies, and big data.

Along with the speakers, more than 150 experts presented solutions and innovations created by their companies. 17 startups demonstrated innovations which enable territories and cities to better

interact with their citizens and to safeguard their welfare as well as that of future generations.

Congress programme

Themes were centred on digital technologies and equipment for countries and cities and on how they could contribute to economic, social and environmental development.

Day 1: Ministers day — Smart government and augmented territories: economic, social and environmental stakes — Ministerial declaration

- Smart economy
- Smart security
- Smart jobs
- Smart education
- Smart health

Day 2: Smart devices — Technologies for growth, for competitiveness and for quality of life

- Smart equipment
- Smart services
- Smart arts and culture
- Smart commerce
- Smart operations and maintenance

Day 3: Environment technologies and COP21

- Smart buildings
- Smart telecommunications
- Smart transportation
- Smart services
- Smart grids

Running in parallel all along the 3 days there were three additional topics: innovating cities in France/living and microlabs/mobility

Congress results

The congress was a great success and some of the highlights were:

- the opening of the congress by Mr Michel Valache, from the Paris Chambre de commerce et d'industries, who illustrated the stakes identified by the Chamber in this technological area;
- the keynote speech of Mrs Axelle Lemaire, Secretary of State in charge of digital affairs, demonstrating a strong position of the French government on all technologies related to territories;
- the interview Mrs Lemaire gave France 24 from the 'government area';
- keynote speeches of Mr Janaillac, Transdev CEO;
- the number of media covering the whole spectrum ranging from traditional media, web and professional newspapers to large audience means;
- the unanimously positive welcome of the event by all media;
- the announcement of the creation of the Smart City Consortium, a grouping of more than 10 innovating European enterprises (France, United Kingdom, Spain), several of them being part of the S3C Paris Scientific Committee (Actility, ITB, Sikiwis);
- the speech of Mr Stéphane Beaudet, Mayor of Courcouronnes, vice-president of the Association of the Mayors of the Île de France region, appointed at the Conseil national des villes by the French Prime Minister, and administrator of the Syndicat des transports d'Île de France, presenting the results of a study on territory responsibilities and showing smart city experimentations, undergoing or under preparation, in more than half of the Île de France districts;
- the startups competition with its Jury des maires, chaired by Mr Beaudet and incorporating the general directors of System-X, Efficacity and BeAngels, and the VCs jury, which includes large French and foreign businesses, in particular Innovacom, Elaia and Alven Capital;
- competition winners have received good visibility — diffusion of the three winner names to 6 000 AFIC (Association Française des Investisseurs pour la Croissance) members — which reinforces the probability for them to raise funds even outside the S3C Paris attendees;
- the visit paid by former ministers Mrs Valérie Pécresse and Mrs Chantal Jouanno and by Mr Beaudet to the main exhibition actors like Veolia Environnement and to the startups in the 'Start-up alley';
- the attendance of a large number of high-level speakers from both public and private sectors, originating from many countries;
- the declaration of ministers and government representatives which has been a recognised success due to the significance of its recommendations and the extremely large consensus that came out;
- the 'Government — SVIP (Super Very Important Person) evening which gathered chairpersons and high-level representatives of large companies together with government officials;
- the quality of speeches;
- the fact that conferences went smoothly and on time, a great challenge due to the starting of four new conferences every half hour during 3 days;
- the ERDF (Electricité Réseau Distribution France) demonstrator visit has also been very appreciated by attendees.

The Living labs y espacios de innovación de America Latina y el Caribe (LEILAC) network, created in 2010 by the Territories of Tomorrow Foundation [2] at the occasion of the 'Innovation and Prospective' seminar at the Unesco headquarters in Paris, was represented by most of its 25 members from Europe and Latin America.

The number of industrialists who mentioned major contracts under negotiations should also be noted, confirming the relevance of having such an event in Paris.

Ministerial declaration

Government representatives (from ministries, regions and cities) from 50 nations met together in S3C Paris to elaborate statements on the citizens' rights to smart technologies. This led to the following statements:

- cities, territories and countries should investigate innovative technologies to improve lifestyle, economic development and environmental protection;
- innovative technologies in cities, territories and countries should be investigated with the perspective of services to citizens, not as a means to reduce freedom or other basic human rights;
- cities and territories are to implement one or more initiatives to reduce carbon emissions;
- cities should include energy-efficiency criteria for further new infrastructure development;
- cities and territories should promote energy-efficient behaviours among its citizens and its economic players;
- cities and territories should promote environmental protection behaviours among their citizens;
- cities and territories should investigate means of easy access to general interest data.

NB: apart from the second statement with 79 % of support, all statements were endorsed by more than 92 % of the workshop voters.

Paris becoming the world capital city for innovation

In 2016, and following the lessons learnt from previous smart cities conferences like the S3C Paris of 2015, Paris will feature a number of important events related to smart cities, smart territories and innovation labs, having in mind that a smart territory is first — whether related to local projects or to European and international programmes — a place of experimentation.

Creation of a lab of labs

A wide variety of physical spaces dealing with innovation exists: living labs, fab labs, hackerspaces, digital factories, microfactories, co-working spaces, TechShop, makerspaces, etc. Their common objective is to promote innovation and entrepreneurship by leveraging collective intelligence and collaborative dynamics in the territories.

Initiated by the Conservatoire national des arts et métiers (CNAM) [3] located in Paris and by the Territories of Tomorrow Foundation, the lab of labs (LDL) will identify and characterise existing labs as well as new emerging labs, through contacts with initiatives of territories.

Some of the elements to be studied by the LDL cover innovation management practices, mapping of the labs, business models related to the functioning of the labs, current and future economic impact of the labs on the territories, success factors of innovation projects, future 'dominant design' and foreseeable developments to be expected for labs. In addition, the LDL may carry out ad hoc studies on request.

It should be noted that the CNAM is becoming one of the major actors in the French living labs arena through the creation of a living lab related to cultural heritage, with its first implementation in Lyon where the Maison du Chamarier, a Middle Ages historical monument, will be the pole of a Lyon district rehabilitation.

A collaborative social network on innovation

Currently innovation actors act within ecosystems that are dynamic but fragmented. Following some meetings and discussions during the S3C Paris 2015, the Centre Michel Serres on Innovation and the Territories of Tomorrow Foundation are jointly creating a new innovation project on the theme of a collaborative social network for innovation actors.

The objective of this project is to remove barriers between these ecosystems, thus facilitating the creation and diffusion of innovations.

Viva Technology Paris

A large forum named Viva Technology Paris is currently launched in France aiming at bringing together about 5 000 startups, and putting them in a relationship with industrialists, investors and opinion leaders of the world.

Its first edition will take place at the exhibition park located near Porte de Versailles in the south of Paris from June 30 till July 2 2016. The last day will be open to the public.

Over 30 000 m^2, Viva Technology Paris will feature a place named 'Hack' for exchange and collaboration between startups and visitors, a conference

area called 'Imagine', and an 'Experience' area devoted to demonstrating new technology contributions to everyday life.

Startups interested in participating are already entitled to register through the event website [4]. The most suitable candidates will then be selected from March 2016 on.

The Parisian innovation arc

Labs of any kind are booming in the eastern part of Paris thanks to this innovation arc which is a cooperative project of the greater Paris. The project mobilises local authorities who cooperate with all potential actors of city innovation in order to develop the city of the future, smart, sustainable, inclusive, connected and open to citizens.

The S3C Paris in 2016

Organisation

A few days after the Viva Technology event, the S3C Paris [5] will take place from July 12 till 17. These dates will conveniently allow welcoming high-level attendees considering the euro 2016 finale which will happen on July 10, and the French national celebrations on July 14.

The 2016 congress intends to construct in 10 days a short-lived demonstrator having a real size. This demonstrator will first be presented to government representatives, then open to the public. Several high-rank industrialists have already confirmed their willingness to contribute to this operation, of which technical conditions for realisation are under scrutiny.

Figure 3: S3C Paris 2016

Programme

On the first day, the 'Ministers' day', smart and open governments as well as augmented territories will be addressed.

The second day will focus on technology for transportation and energy: COP21 and the sustainable city.

On the third day, Internet of Things, big data and smart services will be discussed.

Conclusion

The city of Paris has become an important place in the area of innovation, the S3C Paris being one of its main players. The latter will continue promoting concrete solutions as well as demonstrating their potentialities and their effectiveness.

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