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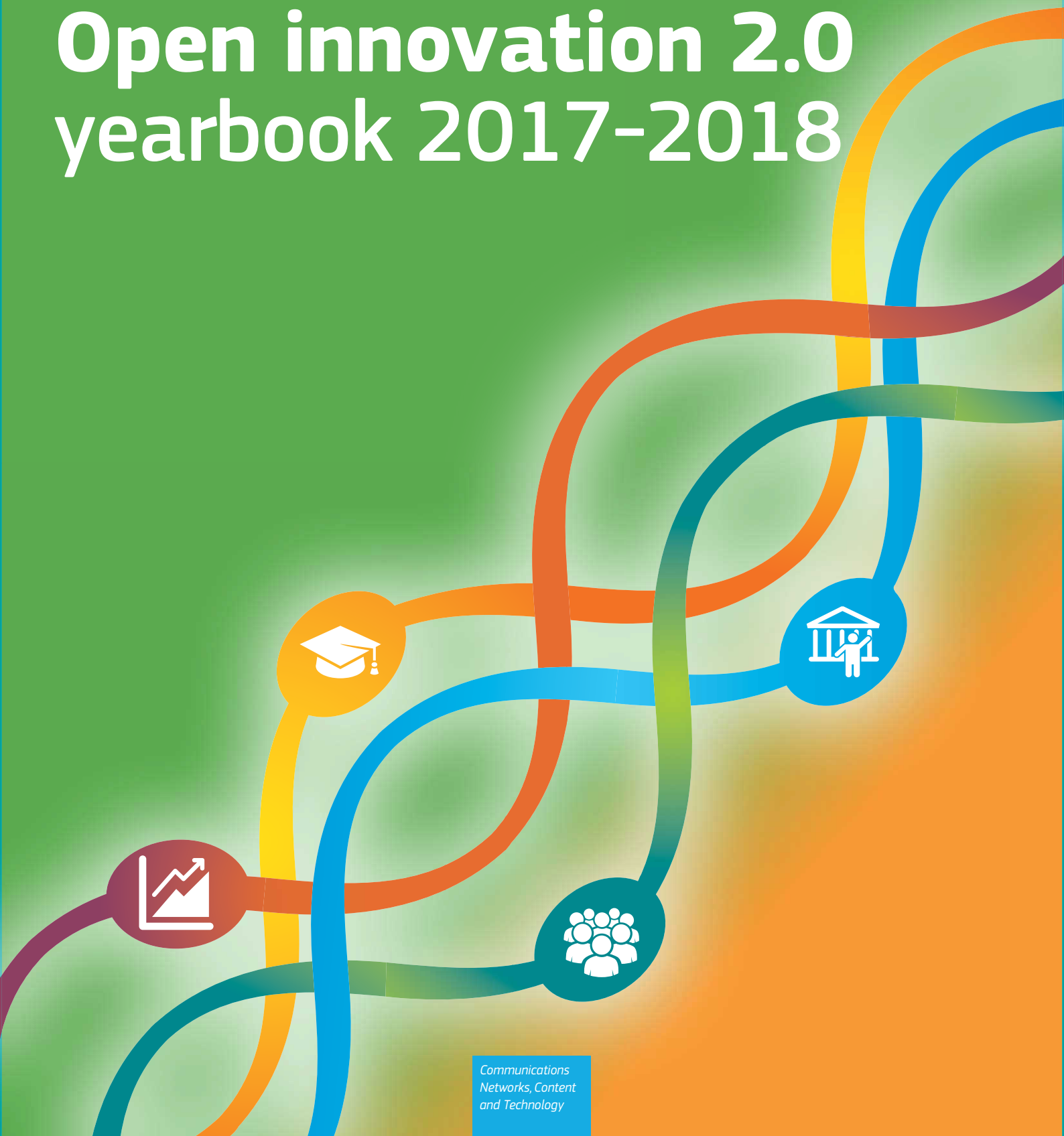

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Open innovation 2.0 yearbook 2017-2018

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Contents

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Executive summary

The *Open innovation 2.0 yearbook 2017-2018* builds on the experience of open innovation cases already introduced in the previous editions. Open innovation 2.0 (OI2) is gaining momentum and is scaling up in very many domains, as this publication will show.

We provide new perspectives on open innovation ecosystems. How to build and run them from the process and skills perspective is of great importance when scaling up open innovation 2.0.

Innovation measurement and modelling are topics we deal with as well, as it is important to understand the impact of the OI2 approach compared to traditional innovation patterns.

The yearbook is divided into four thematic chapters to help the reader to find the relevant content more easily.

In the first section on **'Making open innovation 2.0 operational'** we introduce new functional modes necessary for the creation and take-up of open innovation ecosystems. The article by **Salmelin** highlights the importance of new professions in the dynamic processes necessary at ecosystem level. These new professions integrate the various quadruple helix players and make the innovation ecosystem inclusive, along with delivering results for the commonly agreed objectives. Together with industry, academic institutions are in key positions to create the curricula for these new professions.

In his article, **Curley** brings forward the pattern language he has worked on, making the use of open innovation 2.0 easier and more systemic. The dependencies/patterns are very clear, and if brought into the canvas of open innovation 2.0 they can contribute to the definition of a holistic approach.

Cuartielles et al bring innovation, and especially innovator discovery, forward. The Innovation Radar tool can be used to identify innovators in ecosystems, in turn facilitating the composition of winning teams around selected themes. The article describes several cases, the most well-known of which may be Arduino, the company that also received the Innovation Luminary Award in 2017.

In the article by **Edvinsson et al** the concept of modern innovation and learning spaces builds on more than 20 years of thinking on future centres, a movement that has seen worldwide growth. Examples of these spaces and their development into rich, stimulating spaces are illustrated by O-spaces, where O represents both ozone and optimism. Creativity requires new thinking in designing innovation spaces as part of open innovation 2.0 ecosystems. The article highlights several critical success factors for creative spaces and the processes within.

In **'e-Platforms'** we have several interesting articles. One can see the platforms together building a foundation for common approaches, which will be set out through the work of the Open Innovation Strategy and Policy Group.

The first paper in this section, by **Kwakkel et al** describes a successful project environment which creates a strong underlying platform for sociotechnical interconnectivity. The Accomplissh project brings societal, cultural and economic aspects into innovation performance, providing clear indicators on how impactful projects need to be designed following the open innovation 2.0 approach. The article combines theoretical with practical experimental approaches and provides a better understanding of impactful ways of designing actions.

Knowledge management is an issue for open innovation application. In their article, **Berbenni-Rehm et al** explain their systemic approach to classifying knowledge for effective knowledge sharing. The approach is based on a modular structure developed in the PROMIS project. Interesting areas of take-up are identified, as the method can be used not only to find and share knowledge, but also to build teams based on competencies, very much in the spirit of open innovation 2.0.

Aarnio describes a systemic approach on how to apply open innovation in the medical field. He identifies two gaps where open innovation and the communities approach can significantly improve the success rate and take-up of innovation. The innovation gap is in finding the right competencies to bring forward solutions, and the take-up gap is to be covered by experimentation in the real world, i.e. having the right stakeholders and decision-makers involved in the process. The practical role of procurers in the health sector is obvious. The medical area is developing very interestingly to also include

devices for user communities to find out more and to co-create personalised services, which complements the strongly regulated professional aspects of this field. He introduces communities of practice as an important tool for the innovation flow.

Rubalcalba et al propose a powerful tool to describe the interrelations in functional open innovation ecosystems. Using this tool it is easy to visualise the complexity and the dynamics of such ecosystems over time. Combining this approach with others to find missing competencies can be a relevant opening for better dynamic resource management in larger innovation ecosystems.

In the section on **'Regions and cities'** there are two articles.

The paper from **Valkenburg et al** focuses on co-creating smart cities in quadruple helix settings. The case of Eindhoven moving from triple helix to quadruple helix has been described before in our series of OI2 yearbooks. In this edition we see deeper guidance, based on best practice, on how to get citizens engaged, and on what that engagement means for open innovation ecosystems, including for the public sector and industry participants.

The paper by **Cakir** addresses the regional aspect in depth. How can we expand from well-functioning innovation hubs, for example living labs scaling the activity, to regions where not all the same possibilities to operate exist?

The **'Industry and transformation'** section has interesting conceptual articles, but also very practical ones, describing key transformative factors that quadruple helix players need to take into consideration.

In the article by **Casprini et al** the transition process from open innovation to open innovation 2.0 is described in a systemic manner. The aspects to be taken into account reflecting the required new mindset for OI2 are very thoroughly described: a must-read for OI2 practitioners. The recommendations are based on Euripidis project findings and also tackle the structural and behavioural changes organisations need to face when moving to OI2.

The article by **Turkama et al** provides an interesting overview of open innovation, open innovation 2.0 and the pathways forward. It analyses and structures the drivers and added value of OI2 to all stakeholders in a very balanced and analytical manner, based on which clear recommendations on how and where to best apply open innovation can be formulated. The authors propose three dimensions where the traditional principles and processes of open innovation could provide significant contributions in the future.

The article by **Kune et al** reflects the current development of open innovation 2.0 and challenges the slow take-up. The changes in mindset from OI to OI2 seem to be a significant organisational barrier as the ecosystem practice in the spirit of OI2 is not yet fully in place. The article addresses how to engage the stakeholders in the new paradigm and what the new approach can create as added value for all of them.

The article by **Tanaka** describes the Japanese approach to things and systems (related to the Internet of Things) in the perspective of open innovation 2.0. It explains the rationale and also some very practical approaches to how the concept is implemented. The article highlights the collaborative role of industry and policymakers in the transition of Japanese industry, also leading to the use of OI2 principles in practice.

The article by **Sargsyan** tackles changes due to use of big data and opens new perspectives on how to interlink open data with new business models. Open data (stemming from both big data and little data), i.e. that kind of data which are very operational and highly context sensitive, need to be seen as complementary in the industry commons context.

The bonus article by **Hubavenska** illustrates how communication interlinked with open engagement platforms is crucial for continuous development of open innovation ecosystems. Besides new professions to build and run the ecosystems, continuous value needs to be created for all players to keep them actively contributing to the common goal.

We hope that, as the previous editions (which can be found at https://ec.europa.eu/digital-single-market/open-innovation-strategy-and-policy-group) already published, the *Open innovation 2.0 yearbook 2017-2018* can provide inspiring and useful reading on how open innovation 2.0 can be successfully taken on board and be fully integrated into strategies for open innovation ecosystems.

PART I

Making Open Innovation 2.0 operational

Article 3

New skills and attitudes at the heart of modern innovation policy

Introduction

Innovation is often used as a magic word, and it is expected to solve all problems by itself. It is very easy to only fluently use magic words without real action, because if the challenge is easy then not that many real actions or deep thoughts are hiding behind the nice words.

However, it is fair to say that we are in a period of societal, industrial and economic transition of a magnitude we have not seen before.

In her book [1], Charlota Perez refers to 'waves' when describing the successive 'technology-enabled revolutions'. We have seen how the take-up of steam (energy), railroads and cars (transport) and ICT have all had an impact upon society and upon industrial structures. Capturing the opportunities in these transformations has required creativity and courage and has led to new structures over the short and long term. Transformations do not end there, however.

Due to the very rapid development of digital technologies (e.g. robotics, artificial intelligence and high-performance computing) we are facing a transformation highlighting the role of individuals/competencies and communities in the socioeconomic context. Jobs are changing dramatically, and the structural change we face will cause some professions to disappear and other, entirely new ones to be created.

For its part, open innovation 2.0 also captures the phenomenon of creating new markets/new services. One of the leading principles is co-creation among all stakeholders (public sector, industry, academia and citizens) leading to the reverse innovation pyramid we spoke about earlier in this series of publications. In addition to that, the transformation of society must include the inclusion principle to make smooth transitions possible. We need to make the transition have less of a negative impact on both citizens and industry, as only then can the transition happen at the right pace.

Open innovation ecosystems require new skills

Open innovation ecosystems are based on common values and on common purpose-driven actions rather than organisation- or instrument-driven ones. Hence people's capabilities also contribute better to the common goal.

Innovation has always consisted of essential elements such as curiosity and courage, combined with capabilities. It is about thinking and acting beyond the ordinary, setting a new challenge to policymakers as part of the drivers in the ecosystems.

Open innovation happens when co-creation by all stakeholders, experiments and early prototypes in real-world settings lead to new products and services, and the process itself offers indications for rapid scale-up, and possible failures are hinted at in the early stages. The resources are being focused correctly for impact.

The creation and running of the open innovation ecosystem requires new skills, however. Sadly, e-skills training and learning activities at the national and European levels have focused very strongly only on the digital user and on digital professional skills (for creating ICT systems). This also reflects the fact that

we have largely forgotten the dimension of how to make innovation ecosystems work.

Universities, management institutes and institutes of applied science have an important role in developing new innovation-enabling curricula, acting as the glue between the stakeholders and various disciplines and to be able to guide the common objectives to deliver meaningful outcomes in the new techno-socioeconomic context.

Traditionally there has been strong inside-the-box thinking, protecting narrow interests and limiting structural innovation capabilities, because both cross-disciplinary and cross-stakeholder connections are essential for the success of innovation. This old way of thinking has developed to become 'out of the box' thinking, but we need to go even further. We need to make the imaginary boxes disappear, and to allow the interactions between ideas across disciplines and stakeholders to become as fluid as possible. The collision of ideas sparks innovation, as can be seen in several cases described in this *Open innovation 2.0 yearbook 2017-2018*.

OI2 professionals

New professions and new curricula are needed to provide skills in innovation systems creation, functioning and harvesting. We have examples of new synthetic disciplines, and thus curricula, in areas such as computer science and social media. We now need curricula for open innovation ecosystems, as the approach does not fit any single academic discipline we currently have. The traditional innovation management curricula do not give enough of a basis for the new ways of thinking and acting.

The new professions can, for example, be illustrated as follows.

- **Curators** are responsible for the construction and operation of a thematic area, ensuring that the quality and transparency of the domain are fully usable in other themes and actions in the ecosystems. The theme can be seen as a collection of competencies, types of knowledge and people as a common resource.
- **Bridgers** are curious about everything, are extroverts and are able to synthesise connections between themes, competencies and people. They are thus central to creating and initiating actions in the innovation ecosystem. They do not manage the actions but help out whenever needed by ensuring the connections.
- **Orchestrators** are responsible for setting common objectives, creating an interaction and initiating a common vision for all quadruple helix players. These objectives are driven by conductors who synthesise them within the ecosystem, ensuring the fairness of operations and consistency of ecosystems and working towards the objectives that have been set. As the leader of the purpose-driven actions the orchestrator communicates with other parties in order to ensure seamless collaboration.
- **System designers** enable these connections and relationships at a systemic level. This profession requires a systemic approach to very deep knowledge management, decision-support systems, and collaborative tools and environments, including group behaviour.

Do Europeans have the proper skills and targeted training to face the digital transformation and to take up this very urgent challenge? The innovation process has changed, and we need all to co-create our future. Inclusion is an important European value, and the key is to include all the skills and ideas we have in the transition process. Compared to many other regions, in Europe we have highly skilled and demanding users, which is an important element in the co-creation processes, but it is not enough.

Moving jobs, not people

In the digital transformation we also need to look at jobs and how they are going to change. With automation, robotics and artificial intelligence the character of jobs will also change, as monotonous, repetitive and structured jobs will be done by machines, irrespective of their current level of appreciation (a lot of factory work, office work, even professions such as the law are threatened as we know them now).

Human-type jobs will be co-creative, collaborative and done in structured and unstructured environments. This will happen irrespective of whether or not the job is physical. Knowledge-intense jobs will likely lead to a greater number of workers being autonomous, and also mobile. Work is becoming location independent, and 'forced' mobility due to work, for example, is disappearing. This will have radical consequences for metropolisation and urbanisation that urban planning should already take into account. The book by Joel Garreau [2] on new structures of cities (edge cities) is truly insightful reading in this context. Before industrialisation skilled workers had their own toolboxes (as we now own computing and connecting devices) that allowed them to work wherever they were needed, quite flexibly. With industrialisation there grew the need to build industrial cities. Now again, with the dematerialisation of work, we are likely to move to similar settings as before: the knowledge worker owns the tools and can connect to any place where the skills can be used. We have thus the additional freedom to move not the worker but

the work, leading to interesting scenarios such as getting rid of work-related commuting and creating co-working spaces like modern libraries, including fab labs and maker spaces and, of course, including normal library functions too. We need to set out in this context that much of an industrial city is built on centralised large-scale manufacturing which will be reshaped in the coming decade. 3D printing is a good example of the move to widely distributed and flexible manufacturing systems.

In the future will we all be data generators for diverse service providers, justifying the 'citizen salary' that is already being tested, for example, in Finland? This experimental movement seems to be growing quickly.

Technological developments like Blockchain help us to identify data sources, and thus also create a more inclusive innovation space for all of the quadruple helix actors when innovating new products and services. Citizen science is also related to co-creativity. The main issue, however, will be how citizens are motivated to provide input and data to the research community if there is no credit beyond 'joy of participation'. Data tracking may provide a motivational factor to wider communities of co-creators. This is a possibility that should be explored further.

Conclusion

The transformation ahead of us has already begun, and the new skills base is essential. Just as important is the general change from the current mindset to a more participative one, as then we will be able to reinforce the creation of value based on knowledge and skills. The formal training institutions (universities, institutes of applied sciences and the like) play an important role in the creation of new curricula. However, it is also important to improve our understanding of best practices, hence learning by doing and peer-to-peer networking must also be reinforced.

Experiments, prototypes and real-world settings are all providing experience of what works and what does not, leading to a common understanding of best practices on the way to create something new. Open innovation ecosystems with well-defined processes in turn create a safety net for innovations. An ecosystem approach involving users as co-creators means that indicators of success, and of course of failure, are detected early. The new role of governance should also, for its part, ensure that nothing can go fundamentally wrong, even if the approach is experimental and thus not predetermined. In these experiments we must deal with sociotechnical changes, including the legal frameworks defending the interests of all quadruple helix players.

I am optimistic for the future, if our mindset is indeed developing fast enough towards co-creativity in open innovation ecosystems. The White Paper establishing open innovation 2.0 is very valid in its diversity. It is time to move from concept to action. I am very happy about the 'three Os' strategy (open innovation, open science, open to the world) that has been adopted by the European Commission as it is also directly reflected in the Horizon 2020 programme, and the future research and innovation programme. There is a lot of potential to be turned into reality.

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Article 4

Innovation for adoption

Introduction

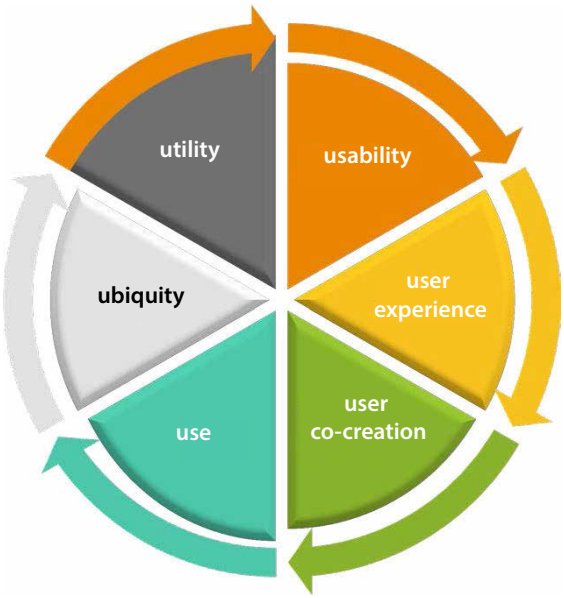
According to the Organisation for Economic Cooperation and Development 80 % of the value of innovation comes from the successful adoption of an innovation, with just 20 % of the value coming from the creation activity. We often consider the hard part of product or service innovation to be the creation phase, and this is usually where most resources are often committed. However, we need to rethink this — consider Michael Schrage of the Massachusetts Institute of Technology's statement that 'Innovation is not innovators innovating but customers adopting'. Thus in innovation we need to look first to the customer, and in OI2 a core hallmark is a 'customer- or user-first' mentality and perspective.

At the core of open innovation 2.0 (OI2) is focus on adoption, and innovation in OI2 is defined by the creation and adoption of something new, which creates value for the entities or users that adopt it. Similar to the 'design for manufacturing' movement, where engineers designing products consider how to make products more easily manufacturable, designing for adoption is critical for the successful adoption of innovations.

Users are an enormous source of innovation, and when products or services are co-created with users they are designed for adoption from the start. Erik von Hippel's research shows that the majority of significant innovations in the semiconductor industry over a 30-year period came from lead users. Co-innovation with users or direct innovation led by users is especially powerful. Designing a platform where users can innovate on a foundational set of assets with an associated set of standards can be very powerful. The Apple App Store and platform is powered by an enormous community of app developers whose imagination and energies fuel the increasing adoption and use of the Apple platform. In 2015 Apple generated over USD 20 billion in total revenue through its app store, sharing revenue of approximately USD 14 billion with app developers.

Usability in OI2 can be achieved faster by collaborating with users with real-world experiments in living labs; here we have the notion of fail fast, learn fast, scale fast. Experimentation using agile development is crucial in evolving utility, user experience and usability to meet the needs of the user community. When considering adoption in OI2 we think of the 6U adoption pattern.

Figure 1: Designing for adoption



The six components in the 6U adoption pattern are:

— utility
— usability
— user experience
— users
— ubiquity
— uniqueness.

When these attributes are found, especially with the involvement of lead users using a platform-based innovation approach, the probability of subsequent adoption is substantially higher.

Utility

By utility we mean the quality of being useful and we explore what value or usefulness the innovation provides, perhaps doing something better, faster or cheaper than before or else creating a whole new function that was not available or possible before. Innovations which are quirky but do not provide utility quickly fade from view. Products and services need to be designed for utility. A beautiful product or service that has an unacceptable mean time between failures or 'blue screen' rate may not have longevity. With the increasing emergence of the sharing economy, innovation design and operation criteria will need to be optimised for utilisation and longevity of assets as well as for utility.

Uniqueness

Uniqueness is a critical factor for adoption. With digital technology it is increasingly possible to do things that even several years ago appeared impossible. When we consider platform innovations such as Airbnb or Uber one element of the uniqueness was the scale at which they were able to bring new services to the market, making unused capacity in private homes or cars available for use and providing the capability to meet needs of people in real time. Both of these services are exemplars of the kind of innovations that make up the 'sharing economy', where the utilisation of assets is improved in everyone's interests. For a digital wallet the ability to store and automatically exchange a digital coupon at a store and to automatically accumulate loyalty points rather than having to produce paper coupons at a till will provide a unique capability that will speed up adoption.

Usability

Usability examines how usable the new innovation or service is. For example, many in the financial services industry are pushing the deployment of digital wallets but for many users the set-up effort required and the lack of merchant infrastructure currently deployed mean that credit cards may provide better usability than current-generation digital wallets. Additionally, some have contrasted the implementation effort of current-generation digital-wallet software at issuing banks to be the equivalent of an enterprise resource planning software installation, which significantly increases the barrier to the adoption of digital wallets across the broader financial system. Innovations may be unique and may bring much value, but if they are complex to use then adoption can be slowed, or can fail. One can expect significant improvements in both the capabilities and implementation effort required for digital wallets, so that at some time soon they will likely be near ubiquitous. Adoption can also be dependent on the digital readiness of a society and their ability to metabolise technology. For example, while the adoption of digital wallets in Western countries is slow, already many Chinese consumers comfortably leave their physical wallets at home and pay using their phones. Increasingly, a core basis of competition moving forward will be integration and messaging services such as WeChat, which has integrated payments services with its messaging services and is seeing high rates of usage.

User experience

User experience is increasingly considered a critical factor in the adoption and use of innovations. Analysts often refer to the experience economy, and those products and services that provide better user experiences are increasingly being adopted more quickly and can command a healthy price and margin premium. When a product or service provides both utility and a good user experience then the probability of adoption is significantly increased. There were many MP3 players on the market before Apple launched the iPod, but it was the user experience of the iPod, both in terms of touch and feel, and the back-end services provided through iTunes that drove outrageously successful adoption compared to earlier market entrants.

Ubiquity

Innovations that take advantage of the network effect, whereby the value of the innovation increases with each additional user, can have dramatically increased rates of adoption once a critical mass of users is achieved. Here innovations take advantage of network, software, information and silicon capabilities and economics. Designing carefully to create utility and incentives before an innovation is launched can have dramatic effects on adoption rates. Platforms such as Facebook, Airbnb and Google all exhibit network effects and are very hard to displace once a network effect takes hold. There are many criteria that influence adoption of innovations, of which two important ones, the innovation index and the imitation index, are described in the bass diffusion equation. However, the imitation index appears to be much more influential than the novelty index in successful consumer adoptions, and friend-to-friend referral is made much easier and faster through social media.

User-driven innovation

Jean-Claude Burgelman was one of the first policymakers to identify the trend of user-led and user-centred innovation. Burgelman outlined the shift from the user as a research object to the user as a research contributor, and ultimately to the user as a full research participant. According to Erik von Hippel of the Massachusetts Institute of Technology, over 70 % of the significant innovations in the semiconductor industry came from lead users or user-driven innovation. Von Hippel argues that innovation is

being democratised in that users, supported by ever-improving computers and communications, have an ever-improving ability to develop their own services and products. He also argues that these users often freely share their innovations with others, creating new intellectual commons and associated user-driven innovation communities. Von Hippel states that this trend is seen notably in information and software products, as demonstrated in the open-source software movement.

The internet is itself a great example of a user-driven phenomenon, as once it was established it continued to grow, evolve and deliver more and more utility without central governance, often driven by users.

Dell Computer encourages users to submit new product features and ideas to it, and also allows customers to vote on the top new features they would like to see in Dell products. Another standout example of user-led innovation is the powerful developer community supporting the Apple App Store and its Android equivalent.

3D Secure is a security standard that was developed to try to reduce online credit card fraud. While it had some success it led to much user frustration, often abandoned transactions and ultimately to some merchants/banks turning off the protocol and turning to risk-based authentication. A quick analysis of 3D Secure against the 6U adoption framework shows that it would not have a high probability of success, even though it shifted liability from merchants to issuers. 3D Secure 2.0 is emerging as the replacement, and it stands a far higher chance of success, as a quick analysis of it against the 6U framework shows that the protocol and implementation has been thought through much more holistically. The integration of biometrics for authentication will mean a much simpler and smoother authentication process for users and consumers, along with increased speed. The better overall robustness of the system design means that there is a significantly higher chance of achieving critical mass adoption across issues, merchants and individuals.

Conclusion

When considering the development of an innovation one should really think first about designing for adoption. Simple steps, such as involving users in the innovation process, can have dramatic impacts. Designing for adoption is one of the key patterns in the emerging pattern language of OI2. Bror Salmelin and I have documented what we call a 'minimum viable platform' version of OI2 in our soon-to-be-published book on OI2. When the innovating for adoption pattern is used in conjunction with other OI2 patterns we think the probability of digital innovation success is significantly improved.

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Article 5

Arduino — a global network for digital innovation

Introduction

Digital technologies have changed the way we store, consume and create information and knowledge. At the aggregate level, the ease of knowledge distribution and creation in the digital economy gave rise to new forms of innovation. Innovative activities are increasingly taking place in self-organising networks [1]. The outcomes of this type of innovation have been impressive. For example, at the beginning of the 1990s nobody believed that Fortune 500 companies would trust software that could not be 'owned' [2]. Today, open-source software has been crucial to the emergence of the digital economy. Linux enabled Google to build cheap servers. Such programming languages as Java, Perl and Ruby have become the language of web 2.0 applications, and the free web-server software Apache powers nearly half of all websites in the world. Increasingly, digitisation allows knowledge-intensive activities related to the development and production of any product or service to move beyond the boundaries of a single firm and to allow access by any organisation or individual to improve and develop it further. There is a growing movement of users of hardware products who are improving hardware, fuelled by ever-cheaper electronics, technical education and training material available online [2]. The internet allows communities to be built that are committed to solving particular problems and are capable of developing and designing almost any hardware or software product. This is true for a smartphone, a car, a building or a supply-and-demand algorithm organising the matchmaking between sellers and buyers of agricultural products. Today, self-organising networks are increasingly developing advanced technologies and products underpinning the digital economy.

Arduino, together with its community, is an example of how the development and production of open-source hardware takes place in a self-organising network rather than within the boundaries of a single firm. Founded in 2005 as a side research project at the Interaction Design Institute Ivrea in Ivrea, Italy, Arduino has become an innovation software and hardware network spanning the entire world. The Arduino technology platform has opened up possibilities that clearly go far beyond hobby activities and have real economic impacts. The range of products that have been launched with 'Arduino at Heart' includes synthesisers, MP3 players, amplifiers, high-end voice-over-IP phone routers, mobile phones and laptops [2]. In 2016 Arduino was also recognised by the Innovation Radar - a European Commission initiative to identify key innovations and innovators in European Union-funded research projects, as ranking first among over 1 000 organisations [3]. Together with such partners as Gorenje, one of the leading European manufacturers of home appliances, Arduino was involved in the development of a new WiFi control platform for home Internet of Things (IoT) devices. The case of Arduino shows how digital technologies changed the processes of innovation and gave rise to new ways of organising innovation activities in the field of complex, technology-based goods and services.

The current article presents Arduino as a global network for digital innovation. It starts with a discussion on how digitalisation is changing the way we handle knowledge and produce innovations, and what implications these changes have for the organisation of economic activities. Then we describe the ecosystem of Arduino. We conclude with a discussion of the implications the digitally induced changes in innovation processes have for innovation policies.

Digital innovation

Digitisation is the process of converting data or information into a digital format (see, for example, http://whatis.techtarget.com/definition/digitization). By making information and knowledge easier to preserve, access, share and modify, digitisation has led to a rapid decline in the cost of storing, computing, manipulating and transmitting data. In this way information and knowledge on the technical specifications of any software or hardware object in digital form can be rapidly copied and shared at close to zero marginal cost.

Increasingly, digitisation is moving towards knowledge, i.e. information that has been put to use. This has been quite visible in the process of the production of software code. Software code is the technology, i.e. knowledge that has been put to use, that makes the digital infrastructure run [4]. Ultimately, programmers have written these algorithms, just as engineers have designed and built the machines that carry out digitisation processes. Whether inscribed in software or burned in hardware, it is the collection of instructions that directs the functionality of

machines. These instructions determine how phones connect, the trajectory of our planes and what we are shown on the internet.

As the set of functionalities is increasing, more and more domains of our life are being directed and executed by intelligent software codes, and the digitisation of information and knowledge goes far beyond the control of the digital infrastructure. It has already made inroads into nearly all kinds of knowledge-intensive activities. In the legal services industry, for example, which is one of the most knowledge-intensive economic sectors, the digitisation of documents and information and their analysis enables law firms to analyse thousands of judgments and create data sets by analysing the outcomes of similar cases to help provide predictions for clients on the outcomes of litigation. This not only reduces the time and cost of lengthy research but also leads to higher work accuracy, at a lower cost and with more consistency than human workers would produce (see: https://themarketmogul.com/big-data-law-digitisation-legal-industry). In the online markets, pricing is shifting from humans to computers. Computer-aided design has allowed the virtual design and manufacturing of physical products such as electronics, cars and buildings. The advantage of this kind of product design is that all activities are carried out in the computer. This means that product development involves only working on, modifying and transforming digital pieces of information and knowledge concerning the design and functionalities of hardware objects.

The digitisation of information and knowledge not only means easier copying and sharing, it also allows for seamless sampling (see: http://culturedigitally.org/2014/09/digitalization-and-digitization). Sampling information and knowledge means breaking them down into pieces and combining them with other pieces to create new structures. These new structures represent new pieces of information, knowledge and technologies, i.e. innovations. Because of the universality of digitised information, i.e. 'bits are bits', they have the ability to be effortlessly combined with other bits, as any bit can interact with any other bit. These pieces of information can also be easily modified, rearranged and used in other designs, and furthermore can be distributed at no cost. In this way, digitalised information and knowledge provide those who can access them with the opportunity to control the information and knowledge. By allowing this, digitisation permits an extreme level of interactivity between the user and information and knowledge [5].

Along with digitisation, the digitalisation process takes place. Digitalisation is the creation of a media and communications system that increasingly links all parts of social and economic life. The digital communication infrastructure has more numerous transmission channels and allows information delays to be reduced. More channels increase the likelihood that more nodes contribute to information and knowledge creations. By the quick dissemination and processing of information, network arrangements allow new interpretations, i.e. innovations, to be produced faster. In addition, they allow for the quick (re-)formation of linkages. This development of the digital infrastructure links current and potential contributors to the process of recombining the digitised knowledge.

In conclusion, the digitisation of information and knowledge, together with the diffusion of computation and telecommunication networks, is taking us into a world where anyone who can read and use the information can also copy it at no cost [4] and write and make changes to software codes, algorithms and digital manufacturing blueprints. In this way, anyone with sufficient capabilities and skills in programming and other domains, for example manufacturing products or architecture, can modify the code behind a new piece of software, a new model of a car or a building.

Networks as a form of organisation for digital innovation

Technology is one of the main determinants of the organisation of economic activity [6,7]. It determines the number and size of actors in an industry, along with their conduct and performance [8,9]. The rapid proliferation of digital technologies triggered a discussion on how they would reshape the economy. In general, a move to the market was expected [10]. However, as relationship-specific investments and asset specificity prohibit companies from engaging in pure market transactions, a new organisational form combining the elements of markets and hierarchies was expected to emerge [11]. By reducing transaction costs and information asymmetries, digitisation facilitated the creation of hybrid forms of organisation [12,13]. As a result, not only did the number of contributors increase, but also economic agents that were previously not actively involved in economic activity entered the process of innovation and production. This development is of such a scale that user-based innovation, peer-to-peer production and innovation [14,15] led to the emergence of large self-organising networks.

These new opportunities in technology development and innovation can be compared to the internet. The distributed architecture of the internet, together with the possibility to break up data into small packets travelling independently of one another, allowed the creation of an infrastructure that permits distant pieces of information to be connected, recombined and sent across the network [16]. To give an example of innovation activities performed in a self-organising

network it is not enough to study a single company. Wikipedia is a foundation, but it does not produce its content. The Linux operating system is a software system, but not a corporate entity. Similarly, rather than individual entities, Wikipedia and Linux are large and complex networks of heterogeneous actors including firms, non-profit organisations and individuals. The concept of a network can be expanded, if studied from a sociology-of-technology perspective, to include not only human actors but also machine-based ones [17-19]. In this way, when talking about an online platform like the ones above, we can understand them as the assembly of the users, the developers, the servers, their operating systems and the content, i.e. everything that makes the platform what it is. The complexity of such networks makes it hard to replicate the success of one of them. Why did Wikipedia succeed, for example? When working with past facts it is relatively easy to understand what has made it work, but is such a situation replicable? Actor-network theory, the field within sociology trying to make sense of these networks, looks at the description or, in the technical jargon of the field, attempts to trace the network for others to build their own understanding of how it works [20].

Actors in self-organised networks behave differently from and follow different economic strategies compared to players in traditional industries. For example, the technology-enabled decrease in transaction costs increases the incentives to add new products and increase product variety [21-23]. It also allows for interactions with a larger number of actors and access to a larger pool of capabilities and resources. A network's flexibility allows it to provide more customised goods and, as a result, to provide constant quality improvements [12,24,25]. Product diversity in the digital economy can be illustrated by, for example, the supply of smartphone applications. Since the introduction of smartphones, the number and diversity of apps has increased continuously. The ease of development and low entry barriers invite a large number of contributors to develop their apps, which address various market niches.

Regarding pricing of goods, the conduct of actors is likely to be dependent on the scarcity of the goods. If the supply is limited, buyers and sellers spend considerable resources bargaining over the price at which the exchange is to take place [11]. This clearly implies that for public goods, which are not exclusive and do not wear out through consumption, for example information and knowledge, the pricing outcome is likely to be driven towards the marginal cost. For a number of digital goods it will be zero. Again, the case of smartphone apps is quite illustrative. Built using few resources, often based on software modules that are available at zero cost once produced, new apps are further distributed at no cost. Similar developments have been observed not only in the software industry, with Linux being the most successful open-source project, but also in the supply of information goods such as encyclopaedias (e.g. Wikipedia) or mapping services (e.g. Open Street Map). With respect to pricing open-source hardware, one of the differences between free software and open-source hardware is that 'electrons are cheap but bits are expensive' [26]. By this Ackermann means that sharing electronic circuit designs is not as cheap as sharing software, not because of the designs but because of the manufacturing cost of prototypes.

With respect to interactions between the actors, networks are dominated by non-market types of interactions [27]. This is related to the fact that this type of organisation is optimal for knowledge-based activities, which require know-how and detailed, often tacit knowledge. These kinds of resource do not lend themselves to market-based exchanges, as they are subject to high transaction costs. Instead, partners involved in exchanging intangible capabilities or complementary activities, such as pooling research staff, are likely to share critical information and, hence, create spillovers available to others. Mutual trust and collaboration are necessary to facilitate these types of exchange.

Summing up, innovation activities in the digital economy increasingly take place in a self-organising network. Setting the direction of activity is imposed neither by a hierarchy nor by profit maximisation. Instead, decentralisation sets up expertise as a source of power. Power and influence are not derived from rank or exclusive access to specific resources, but from convincing others to accept a particular direction and objectives. As participation and the motivation to contribute to the development of the technology are not driven by profit maximisation, the price of goods is close to the marginal cost of their production, which for many goods is close to zero. Rather than financial profit, the objective of the product development is to create solutions to problems. This is also the main source of value.

Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. It is an example of product development that takes place within a self-organising network of users rather than within the boundaries of a single firm. Arduino was born in 2005 at the Ivrea Interaction Design Institute as an easy tool for fast prototyping [28]. The goal was to create low-cost, simple tools for non-engineers to create digital projects. The initial platform consisted of a microcontroller and library functions to easily programme the microcontroller. Released under the Creative Commons licence, Arduino's open-source hardware design

and policy encouraged modification and reuse of its product. Soon afterwards, a community of developers and users embraced it and grew up around Arduino [29]. In addition, a new crop of projects and devices emerged that can be traced back to Arduino's roots and that have in return contributed to the development of various aspects of the entire Arduino ecosystem. Today there is already a range of open-source hardware products, including synthesisers, MP3 players, amplifiers, high-end voice-over-IP phone routers, mobile phones and laptops [2]. They were built by the Arduino community using Arduino-based technology.

The key element of the Arduino ecosystem is the community around it [29]. The community of makers has contributed to the Arduino ecosystem by developing code and libraries, designing new hardware, teaching workshops and classes and sharing what they have made. Arduino is now being taught in high schools, colleges and universities all around the world. It is assumed that the number of Arduino members increases by 100 000 per month [30]. A large share of the users and developers come from developing countries. In China, for example, a large part of the community is made of teachers. They play a critical role in the development of the Arduino ecosystem. They create documentation for projects and experiments that can be used to teach using Arduino technology in schools and educate future generations of Arduino community members.

When we look at the Arduino case we see that the networks include not only increasingly more organisations and individuals, but also hardware designs, software and community-supported documentation. Moreover, the Arduino concept opens up possibilities that clearly go far beyond hobby activities and have real economic impacts. The Arduino ecosystem allows infrastructure to be created for large technological projects such as smart homes, IoT applications and small satellites (like the Ardusat project). According to the Innovation Radar, Arduino ranks first among over 1 000 organisations participating in the seventh framework programme for research and technological development and Horizon 2020 projects that were assessed between October 2014 and January 2016 [3]. In this ranking Arduino was ahead of such technology and science giants as Siemens or the University of Cambridge. Together with such partners as Gorenje, one of the leading European manufacturers of home appliances, Arduino was involved in the development of a new WiFi controlling platform for home IoT devices. As a result, Gorenje's advanced fridge has been enhanced with a WiFi-enabled solution, and it is expected that the product will be put on the market within the next 2 years. Thus, we can expect that participation in the Arduino community does not only take place pro bono. There are already a number of companies that have built their business models around the Arduino ecosystem. For example, of the 13 largest open-source hardware companies that, in 2010, together had a total of approximately USD 50 million in revenues, most operate within the Arduino community [31]. By 2010, all of them had at least USD 1 million in revenues, and most of them were approaching USD 5 million and were involved in hundreds of projects.

As in the case of open-source software, money in the open-source hardware domain is not made through manufacturing and selling products. Instead, companies rely on providing services [2]. As every innovator knows their own solution best, knowledge and expertise about improvements or innovative uses become the most valuable assets, and are not easily replicable. Other ways of making money are to sell innovative devices and to create new ones faster than the competitors.

Arduino's model

Arduino's way to approach a sustainable economic model is based in a series of actions taking place in parallel. First and foremost, it is important to understand that Arduino is not a hardware company, it is easy to get such a misleading idea from the fact that Arduino does currently manufacture its own printed circuit boards. If one looks back in time this has not always been the case, and even when Arduino is the main manufacturer of some designs there are occasions when Arduino collaborates with other corporations such as Intel, Adafruit Industries, Seeedstudio or Sparkfun in order to simplify the amount of work to be put into controlling such a large series of physical assets. Money in these cases comes from the profit from selling goods; when manufactured by others it consists in a royalty fee per unit. On the other hand, hardware is distributed through a dense network of distributors worldwide and through the official Arduino store, which always tries to feature not only Arduino products but also those from its partners.

Second, Arduino produces a very successful piece of software, the Arduino Integrated Development Environment (IDE), that is massively used in education and development. There are two versions of this software: a Java-based IDE, also known as the classic IDE; and a newly developed HTML5 version. The older version is community maintained and offers two different ways to contribute to its maintenance: through an in-kind mechanism, whereby developers can make contributions to its open-source codebase; and through donations (it is not mandatory but is possible to donate money to Arduino prior to downloading the software). The amount of money obtained this way is significant enough to help finance some of the development costs of the software. It should be mentioned that, at the time of writing, the Arduino classic IDE was

being downloaded once every 2.6 seconds. One can imagine the kind of server needed to provide users with the software (which is about 100 MB in size) and how much it costs. The HTML5 IDE is still in the making, but it is expected to generate revenues through the creation of a subscription model attached to some premium features that can only be obtained by taking advantage of the cloud.

Third, it is in Arduino's interest to promote success stories relating to projects and products that use some parts of the technology developed by the Arduino community. In order to exploit the possibilities offered by having a server (the Arduino server) that counts over 110 million unique visitors per year, Arduino has created a programme called Arduino at Heart that helps small businesses that are willing to produce open-source products using the Arduino technology not to have to incur expenses in supporting their own IDE. This programme encourages these SMEs to provide Arduino with a percentage of their profits in exchange for maintaining their product's compatibility with the Arduino IDE. While this programme is still new (it has just finished its first year) it has proved to be a great vehicle for small and medium-sized enterprises (SMEs) not just to save money on developers, but also to get some marketing by being listed on the Arduino website and being promoted through Arduino's social media channels. This programme will most likely evolve, since currently it only makes sense if products are up to a certain price and if the participants only sell up to a certain amount of money. It is now being iterated in order to offer a broader set of options to collect even more projects within it.

Fourth, Arduino collaborates with larger companies like Microsoft, Intel, Telefonica and Samsung. These collaborations are a mixture of shared services co-created through cooperation between actors and products. Most of the time such collaborations are listed as certifications. A certification programme includes putting a series of developers from Arduino at the service of one of the abovementioned companies to help them make some of their products or services compliant with the Arduino philosophy. Certification programmes are typically a flat fee applied on a yearly basis to the companies on top of a series of services that will be billed by Arduino.

Fifth, in the field of education, which suffers from an endemic lack of economic resources, Arduino has developed a different strategy that consists in financing the R & D processes by having third parties such as non-governmental organisations or foundations of any kind support certain projects economically. In that way Arduino develops custom-made projects that are run all over the world. Once they work they can be repurposed into products that will be sold through the Arduino store.

While one could think that such a model is very profitable, it should be mentioned that this is not always the case. Arduino is a medium-sized company with employees in at least three countries, and needs to maintain a series of inventory items to be able to supply the demand for hardware all over the world.

Arduino in the EU-funded research projects

In order to maintain a reasonable amount of ongoing research Arduino needs to look at external funding coming from external actors such as EU H2020 grants, grants from the Swedish Vinnova innovation foundation and the like. Arduino only applies for grants when there is somehow a clear possibility for those projects to turn into products that could be served from the traditional distribution channels. For a company of the size of Arduino it is, at this moment in time, not possible to invest in basic research, only applied research. It does not rule out the possibility of entering other kinds of projects, but first the company needs to figure out ways to benefit directly or indirectly from more basic research activities.

Up to this point Arduino has been or is part of four EU-funded projects. One of them is the 'Social&Smart' (SandS) project that aimed at building up a physical and computational networked infrastructure allowing household appliances to better meet the needs of their owners. One of the results of the SandS project was the creation of the Arduino Yun board, a substantial innovation in the world of prototyping boards with internet capabilities. Launched in 2014, this product offered a full Linux computer with a full microcontroller board, both fitting onto a single printed circuit board of 50 × 60 mm. This hybrid product was applauded by both the higher education community and the industrial community, both completely immersed in the IoT boom of the mid 2010s. A later research project, 'Practice-based experiential learning analytics research and support' (Pelars), focusing on learning and making, has given rise to a hot-plugging protocol for low-level microcontrollers, the so-called Eslov protocol, which will be embedded in the Arduino product roadmap from 2018 onwards. The still-running Decode project, exploring and piloting new technologies that give people more control over how they store, manage and use personal data generated online, will assist with the creation of an IoT motherboard for a gateway with the ability of signing Blockchain information packages. Finally, Arduino has a residual participation in the eCraft2Learn project. The objective of this project is to research, design, pilot and validate an ecosystem based on digital fabrication and making technologies for creating computer-supported artefacts. Its outcome will be the creation of a portal for educators to find technical resources to help their teaching.

Arduino's community

The Arduino community is currently quantified as the number of users actively participating in the Arduino forum. This forum has over 425 000 participants who have posted almost 3.3 million posts. On an average day there are 10 to 20 times more visitors to the forum than registered users (e.g. if there are 100 registered users reading the forum, the statistics software registers 1 000 to 2 000 visitors on it at that same time). This forum is open for discussing all sorts of topics on the use of digital technology in hobby projects, education, industrial cases, etc. There have been cases when users have associated with one another and have created Arduino-derivative products, using the Arduino forum as a space to discuss development and as a marketing tool. The forum is maintained by a mixture of community moderators and some of the Arduino core developers and founders.

There are other mechanisms for participating in the Arduino community. It is possible to be part of the active development of the classic IDE by joining the corresponding GitHub page or the developers' email list. It is also possible to join an email list dedicated only to teachers, and to exchange emails with others also concerned with creating educational materials using microcontroller technology.

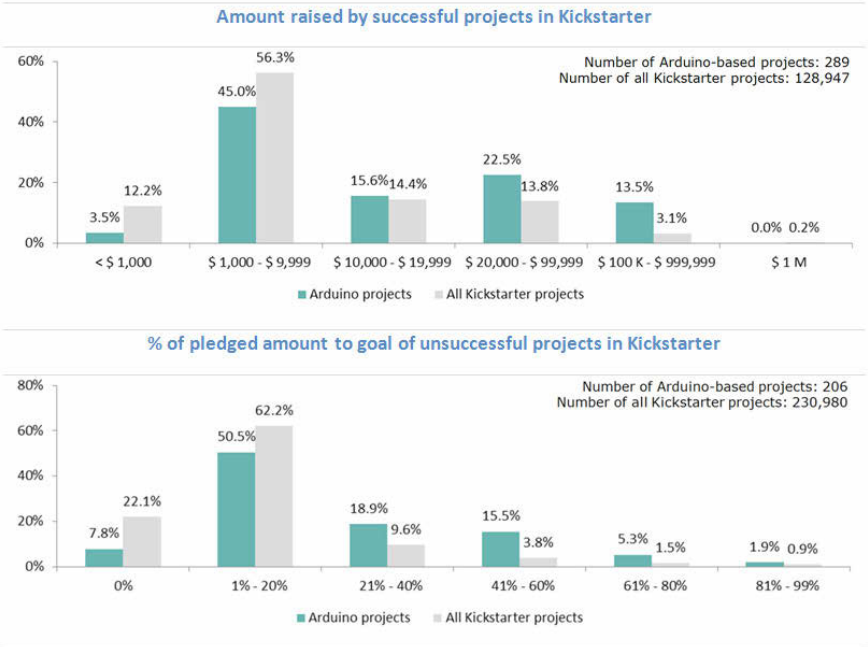
The Arduino website also has two different documentation mechanisms: the Arduino Project Hub; and the Playground wiki. The latter is how projects have been documented in a traditional fashion. Registered users can post articles on the wiki, rearrange links and contents, etc. There have been massive group efforts accomplished through the Arduino wiki, such as the translation into Spanish of the whole Arduino website. Back then, in 2010, the site had over 700 documents translated by volunteers in less than 10 days. The Project Hub is a contemporary way of producing content where users post their projects using a form, adding information about their projects, pictures and videos. Projects are then listed in an easy-to-search way. There is a full-time Arduino employee dedicated to filtering these projects and adding tags to them in order to make the information easy to search by visitors.

Crowdfunding of Arduino–based projects

With its flexible and easy-to-use hardware and software, Arduino created an electronics prototyping platform making programming and embedded applications using Arduino boards more accessible to a wider public. Being open source and royalty free, Arduino allows anyone to get involved easily in electronics and programming. The real power of Arduino is not in the hardware but is a result of the enormous network of users, resources, discussion boards and published projects that have spread through the internet. As the cost of entry is minimal, the Arduino platform unleashes creativity and enables the development of digital-enabled (open) innovations. To grasp the rapidly growing community and economic impact empowered by Arduino, we analyse Arduino-based projects on Kickstarter. Kickstarter is a global crowdfunding platform focused on creativity that was launched in 2009.

Figure 1 presents an overview of Arduino-based projects on Kickstarter by status level for the 2009-2017

Figure 1: Comparison of funding of Arduino-based and other projects on Kickstarter, 2009-2017



Source: Kickstarter statistics. Accessed on 31.7.2017.

period. Kickstarter reportedly received USD 3.18 billion in pledges from 13.3 million backers to fund more than 350 000 projects. Almost 36 % of these projects are successful, meaning that they raised at least as much funding as they initially asked for. The majority of successful Kickstarter projects — roughly 56 % — raise funding of between USD 1 000 and USD 9 999. Projects are equally distributed across the other funding categories (around 12-14 %), except for the highest funding categories exceeding USD 100 000 and USD 1 million, elevating respectively at 3 % and almost 0 %. With respect to unsuccessful projects, a large majority of them (84 %) are only able to secure up to 20 % of the funding that was initially requested. Around 10 % and 4 % of the unsuccessful projects obtain respectively up to 40 % and 60 % of the requested funding.

In comparison, the number of Arduino-based projects on Kickstarter amounts to 495, receiving USD 14.8 million in pledges from 150 000 backers. The percentage of successful projects based on Arduino is significantly higher, amounting to 58 %, which almost equals the rate of unsuccessful projects of the overall Kickstarter database. In addition, the percentages of successful Arduino-based projects are systematically larger in the higher funding categories. This means that a larger proportion of Arduino-based projects attract higher funding rates compared to all Kickstarter projects. A similar pattern is observed for unsuccessful projects. While only 6 % of unsuccessful Kickstarter projects received more than 40 % of the requested funding, the percentage of Arduino-based projects amounts to 23 %.

Table 1 provides an overview of the median values of the requested funding (goal) of successful and unsuccessful (Arduino-based) Kickstarter projects, along with the actual pledges that they eventually secured. The ratio of both funding numbers is also provided (i.e. pledged/goal) as a measure of the effectiveness of the project in securing funding. The median value of the ratio for all successful Kickstarter projects equals 1.28, meaning that the pledged amount is 28 % higher than the requested goal at project launch. The equivalent ratio for successful Arduino-based projects is significantly higher, suggesting a pledged amount that is twice as high as the attempted goal. A similar pattern can be observed for the ratios of unsuccessful projects, where the ratio of Arduino-based projects seems to outperform that of Kickstarter projects as a whole.

As indicated in Figure 2, more than two thirds of the Arduino-based projects originate from the United States, while 20 % and 11 % are located respectively in the EU-28 and the rest of the world. Splitting projects up by categories as presented in Figure 2, Arduino-based projects mainly focus on do-it-yourself electronics (43 %) and hardware (35 %). While many projects focus on the further development of hardware components based on Arduino, there is much less focus on software improvements (around 10 %).

Implications of the new forms of organisation of digital innovation

We have already seen that the digitisation of information and knowledge and the accompanying digitally induced changes in the way we organise economic activities have a tremendous impact on our economy and society. However, there are some other characteristics of these processes that change the way that technology, economy and society (may) evolve.

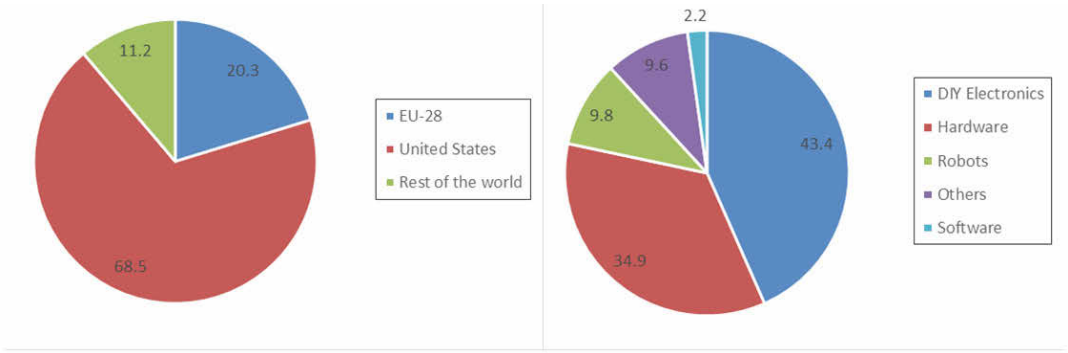
First, the increasing reliance on knowledge that can be seamlessly shared, distributed and easily modified creates new conditions for innovation. Knowledge, a key resource in the modern economy, is considerably different from other resources crucial to economic activity. Unlike material resources, knowledge is an input that has the property of increasing returns [32,33]. In other words, the wider it is spread and the more people have access and the possibility to contribute to its evolution, the more valuable it becomes. If no artificial barriers, such as exclusivity rights, are created, there is no cost to return each piece of a solution to the common pool of knowledge and, hence, further increase its value. This further

Table 1: Effectiveness of fundraising in Arduino-based projects on Kickstarter

	Arduino projects			All Kickstarter projects		
	Goal	Pledged	Ratio	Goal	Pledged	Ratio
Successful	5 000	10 473	2.09	4 000	5 119	1.28
Unsuccessful	10 000	1 275	0.13	7 000	63	0.01
Total	6 000	5 092	0.85	5 000	801	0.16

Source: Kickstarter statistics. Accessed on 31.7.2017.

Figure 2: Geographic origin and category of Arduino-based projects on Kickstarter



Source: Kickstarter statistics. Accessed on 31.7.2017.

increases the size of the 'library' of solutions available for further use by the collaborators and increases returns to knowledge use and production. Increasing returns puts us, as a society, into a different world, in which scarcity is replaced by affluence [33,34]. This new world has different economics compared to the one that operated under decreasing returns. It exhibits a different behaviour, style and culture. It calls for different management techniques, strategies and codes of government regulation. For example, the approach to knowledge spillovers in the digital economy is very different compared to the physical economy. Spillovers are desired, and increase welfare. Rather than granting exclusivity rights over knowledge and technology to individual actors, spillovers are seen as positive externality, and are encouraged by increasing the connectivity between the actors and their absorptive capacity. An emphasis is put on the discovery of technological opportunities, which often appear in the process of cross-fertilisation between distinct knowledge and technological domains [35]. The role of technological opportunities and cross-fertilisation between technologies is crucial for the introduction of innovations enabled by general-purpose technologies such as digital ones.

Second, the direction of technology development in self-organising networks is not imposed by a hierarchy. Decentralisation positions expertise as a source of power and the objectives are set based on the contributors' needs [36]. Rather than financial profit, the objective of the product development is to create solutions to problems. For example, under the open-source mode the incentive to develop a new piece of software is not to sell it for profit, but rather the promise that an existing problem will be solved or addressed in a more efficient manner. As a result, in contrast to the physical economy, we can see behaviour oriented towards value creation rather than towards rent seeking. Solutions to problems, for example more efficient and faster organisation of work or diffusion and use of technologies, are the main source of value creation. The incentives and the way problem-solving is organised are geared towards identifying viable solutions quickly and increasing the speed of technology evolution [37]. Everyone has access to everything and the right to copy, modify and combine it with other elements. The community makes collective decisions on what to do, which problems to solve and how to allocate resources. In other words, digitalised information and digital technologies support a democratic form of free culture [5]. As a result, some behavioural distortions created under the market mechanism can be avoided. For example, great scientific and technological efforts are made to design products that break prematurely, a clear rent-seeking strategy [38]. The rationale behind it is to generate long-term sales volume by reducing the time between repeat purchases. As most of the value created in self-organising networks is not generated through repeated sales of products, product obsolescence is not an economically viable option. 'The crowd' is instead interested in the best solutions available. This has considerable implications for value creation. For example, maintaining incumbent technology and postponing a switch to a new technology, which is more optimal from a social point of view, is a phenomenon frequently observed among profit-oriented companies [39]. This happens because producers and owners of technology take only profit maximisation into account and do not consider technological externalities. An example is a switch to energy system based on renewable resources [40]. Such a strategy is not an option in an innovation and production system that is constantly searching for improvement and superior solutions, because the value is derived through the application and use of these solutions, not through their sales on the market.

Summing up, digitisation of knowledge and new innovation forms and processes are challenging traditional forms of organisation of economic activities.

By shifting the focus towards problem-solving and value-creation activities, i.e. growing the pie, rather than rent-seeking behaviour, i.e. fighting for a bigger share of the pie, additional value comes from the workings of the self-organising networks and the organisation of incentives. As we are entering into an era in which universal access to and processing of the world's knowledge is technologically possible [41], the missing piece is the legal infrastructure that will make such access and processing viable.

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Article 6

O-zones for combinatoric innovation

Based on our prototyping in both the Skandia Future Center and Dialogues House, the following insights emerged on open innovation and the O-zone.

In this article we describe ecosystem requirements for collaborative and sustainable value creation. We refer to all of the biotic and abiotic factors that act on an organism, population or ecological community and influence its survival and development. Biotic factors include the organisms themselves, their food and their interactions. Abiotic factors include such items as sunlight, soil, air, water, climate and pollution. Organisms respond to changes in their environment by evolutionary adaptations in form and behaviour.

We are concerned with environmental interactions that influence the innovation behaviour of people and organisations. Sometimes this is also referred to as the intellectual capital multiplier effect on the intellectual capital, with the formula 'human capital times structural capital' (HC × SC). These occur in four 'spaces':

- social/cultural space, including informal relations, cultural aspects, networks and codes of behaviour;
- process/organisation space, in which formal relations and the organisation of activities and processes and systems take place;
- digital and virtual space, consisting of ICT-based systems, including communication resources, social media networks, workflow systems, transaction systems and mobile infrastructure;
- physical/real space, which directly interacts with our five senses: sight, smell, hearing, taste and touch.

Clearly it is important to strike the right balance in developing the four spaces. Insufficient investment in one or several subspaces will reduce the effectiveness of the other spaces, as a multiplier effect. The ecosystem space should combine these four spaces into one design concept.

There are numerous obstacles to collaboration and to the sharing of knowledge, including geographical distance, language and cultural differences, generation gaps and professional specialisations. Intellectual capital can only efficiently be shared and increased if people and organisations get to know each other and enter into a dialogue to explore what they could do together, driven by a collective ambition. Recent research by Professor Dan Siegel at the University of California, Los Angeles indicates that our mind is not

Figure 1: Four essential spaces in the ecosystem that make up an innovation environment

only brain activity per se but also the relational process. It might also be called relational capital.

It is a well-established fact that physical environments strongly influence human behaviour. Therefore, it is worthwhile to create a wise space, in Japan labelled an innovation network, where activities can naturally take place. In the last few years there has been increased interest in this aspect of supporting social and (collective) intellectual processes.

In open innovation one usually starts with the problem and then looks for combinations of knowledge assets to tackle it. In this article we describe a method that turns the sequence around: new combinations of intellectual capital are facilitated, followed by the question: what can we do with this? Or: where could this add value? We call this process combinatoric innovation, which we define as:

> the process of discovering new ways of value creation by combining and applying previously disconnected intellectual capital from two or more sources.

The basic mechanism behind combinatoric innovation is the extension of configuration spaces, which allows for the identification, explication and understanding of new categories of problems and solutions. Combinatoric innovation can be seen as a new aspect of open innovation in which there is a very important role for serendipity; for discovery by trial and error. It focuses on a specific way to explore the possibilities and create new opportunities for 'traditional' forms of open innovation. Because multiple mental spaces are involved, a considerable amount of creativity can be expected. It is also a mechanism that can be used to determine or develop 'blue oceans', a concept that was introduced by Kim and Maurborgne. Blue oceans are business models based on complete new sets of value propositions, making competition (for a while) irrelevant.

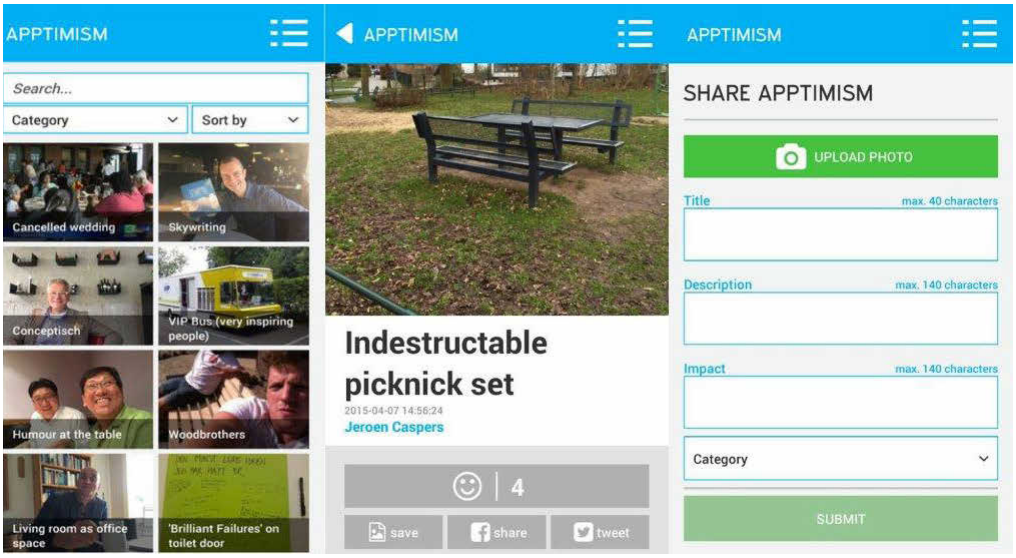
Combinatoric innovation is more a methodology comparable to systematic inventive thinking. In systematic inventive thinking one applies a number of principles to construct, out of existing systems, products or services, a half-fabricate with new, combined, changed or rearranged features. Then the following question is asked: what kind of new applications could be related to this intermediary result? From this point, converging takes place again and ways to achieve the application are being explored, resulting in engineering of the solution. Combinatoric innovation also leads to surprises. Generally one starts with a wide area of interest; a theme. However, exactly what problem or opportunity will be addressed is a matter of discovery. It is like the combination of DNA that gives us children with recognisable elements, but with also a largely unpredictable individual potential. Therefore it is the combination of DNA material that makes us unique human beings, whereas the building blocks are quite universal for all of us.

Combinatoric innovation is a group process, and therefore it is interesting to discuss the possible connection with communities, especially those focusing on intellectual capital-related activities. Communities are as old as mankind, but in recent times the word 'community' has acquired additional meaning in the context of new business models on the one hand and developments in the digital world on the other hand. It is generally perceived that communities are key constructs for business innovation and coherence in the new economy, and the challenge is to support the creation and leveraging of meaningful communities that add value to their members and their environment.

How can physical space enhance combinatoric innovation? There are various important aspects that affect interdisciplinary, creative and collaborative processes. Knowledge-working people spend more than 90 % of their time in buildings. Buildings and their interior design have a major impact on how people feel and behave. Companies and society are increasingly aware of the importance of factors such as aesthetics and caring environments. More and more evidence indicates that our surroundings have a bigger impact on our behaviour than previously thought. This is why the human dimension is becoming increasingly present in architecture and interior design.

Aesthetics improve emotional health, but play and exercise are also important elements of healthy workspaces. The fact that we, on average, spend much more time sitting (9.3 hours a day) than we do sleeping (7.7 hours a day) is one of the reasons why sitting is the new smoking. Our offices and company cultures are lagging behind on inviting and stimulating people to move more. Any place where people are received in a friendly manner is involved in hospitality and service to some extent. In Skandia Future Center it was the smell of freshly baked bread, along with specific music, that contributed to this special atmosphere, enabling people to feel comfortable and open for the dialogue about a better and sustainable world. Hospitality here refers to creating a pleasant environment from the moment someone arrives, in a way that opens the mind of the incoming people, i.e. reducing barriers of fear. Here, people get energy and here we see the concept of an 'O-zone', with the O standing for oxygen, but also optimism. This concept has been introduced by the International Institute for Serious Optimism (Dutch–Norwegian), the mission of which is to increase the world's 'O-level' by building, collecting, sharing and applying knowledge in the area of positive energy and realistic optimism. One

Figure 2: Apptimism: a tool for storytelling about 0-zones. See http://www.apptimism.eu



of the tools is an app (Apptimism) that can be used to collect cases where people experience the positive impact of positive environments.

Which physical interventions can contribute to a favourable environment for combinatoric innovation? We will explore these using the concept of a 'no-boundaries house' as an environment for new combinations, in which the process of serendipity is the key to accommodating innovation and knowledge work. A no-boundaries house is a place where people meet each other, talk, think, work, have fun and co-create; a kind of specially designed knowledge café. It is a 'co-laboratory', where people explore new paths together. In a no-boundaries house, unexpected meetings take place, new combinations of people and organisations arise and ideas, ideals and insights are exchanged. The physical aspects of the environment support these activities. And the intangible aspects are just as important as the tangible ones. The no-boundaries house, in other words, must have a 'soul'. The technology in the no-boundaries house supports the activities and processes that take place there. Technology can also help overcome the limitations of the facility's physical character. Ideally there would be no boundaries between the no-boundaries house and the world out there. Webcasting, narrowcasting and other internet-based communication, as well as tools such as videoconferencing, can significantly widen the scope of activities in the no-boundaries house.

The mission of the no-boundaries house is to create value by 'connective renewal'. It is organised around key concepts such as collaboration, innovation, entrepreneurship, knowledge sharing and sustainability. Serendipity is an important mechanism whereby new combinations lead to unexpected but valuable results. Those results can vary in nature and meet the various needs of stakeholder groups.

The proposition of a **no-boundaries open innovation house** focuses on the following four elements.

- Creating an attractive meeting place

The no-boundaries house needs appealing facilities and a high-quality programme to make it an attractive environment where people can meet each other both informally and professionally. The interior of a no-boundaries house is designed to stimulate valuable meetings. It brings to mind the weekly passeggiata, based on an old Italian tradition, during which everyone in the village goes out onto the streets in the evening to meet and catch up. The environment gives all visitors the opportunity to get to know people they would not usually meet in a very informal way. These could be very relevant people, such as captains of industry, top managers of public administration, researchers, start-ups, students and so on. It is important that visitors and users meet people there whom they enjoy meeting.

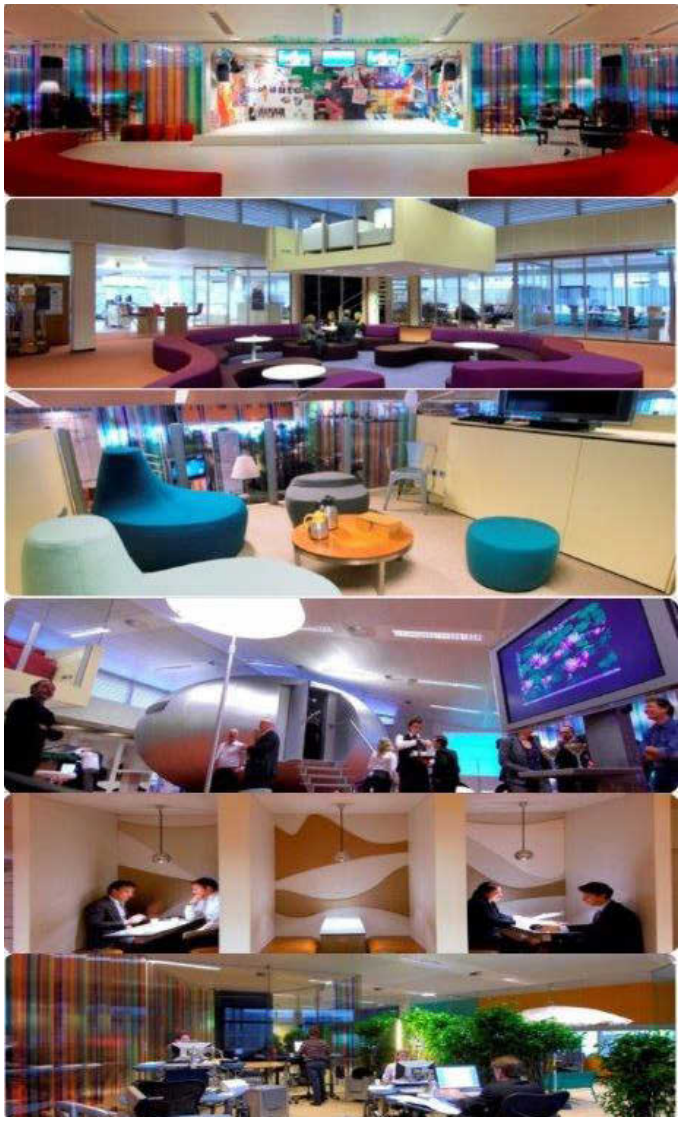
- Offering an Aha-'learning' programme: the no-boundaries academy

The programme established must be largely based on co-creation in order to stimulate dialogue and create an informative and relaxing environment. It might even be like the 'happy Friday' concept at the lab of one of the Nobel Prize laureates in the United Kingdom. It is said to have impacted the cross-disciplinary innovation outcome of graphene. Partners of the no-boundaries house play an important role in this. There is also room for input from anyone who has an idea or who wants to organise

Figure 3: Bird eye's view of the ABN Amro Dialogues House, Amsterdam

something that is relevant to the topics and objectives of the no-boundaries house. The no-boundaries house is also a space for conferences, lectures, workshops, performances, etc. Its programme is focused on thinking 'outside-in', connecting various worlds.

Figure 4: Impressions from the ABN AMRO Open Dialogues House



- Offering a work and study environment for students and professionals

The diversity of spaces in the no-boundaries house is very well-suited to working (together) and studying. A separate space can be set up as a 'smart working centre', the no-boundaries port, where people can 'dock' to work, discuss and study. Commuters who work for companies in hard-to-reach places, or who feel this is the best work environment, can occasionally or frequently use well-equipped workspaces with modern facilities. This can benefit employers as well, if productivity increases due to less travel time or a more effective work environment where other people can be met or invited. Self-employed professionals or small companies can also use it as a flexible working and meeting spot. This is in line with modern trends such as the smart working centres mentioned previously.

- Setting up an infrastructure for innovative entrepreneurship

A no-boundaries house is the location of choice for companies such as start-ups that do not yet need laboratory space or extensive technical facilities. The no-boundaries house offers access to a wealth of intellectual capital: knowledge, networks, (potential) customers, (potential) employees and fellow entrepreneurs. The environment stimulates and facilitates. The no-boundaries incubator additionally offers things such as access to 'smart money' from (informal) investors, coaching, shared services and facilities such as food service.

Many case studies emphasise the importance of a suitable physical space for the processes mentioned above. However, a physical space without interventions in the three other areas — cultural/social space, process/organisation space and virtual/digital space — will not lead to a fertile ground or culture for combinatoric innovation. Dialogues House and the Skandia Future Center were designed as open eco-environments for cross-disciplinary innovation effects.

In the recent past, ABN AMRO has gone through a rollercoaster period. Not only has it been facing the consequences of the credit and economic crisis, but it was also acquired by a consortium. The Dutch part was nationalised and integrated into part of another bank (which was acquired during the nationalisation process), and now it is being privatised again. In that period there was a strong need to build bridges with other stakeholders in society and focus on long-term and sustainable value creation. For this reason Dialogues House was developed, and it has been operational for almost 10 years with a strategy that is based on people-to-people interaction and collaborative learning, i.e. on combinatoric innovation.

From the weblog of a visitor (http://info-architecture.blogspot.com/2008/04/dialogues-house-2.html):

Sometimes you walk into a building and you just say: 'Wow!'. That's the experience I had when I visited the Dialogues House in Amsterdam. It's related to the ABN-Amro bank. As I wrote before I'd be there for a meeting with knowledge managers from large companies in the Netherlands. We had a great time. The meeting's topic was open innovation. The Dialogues House was set up to facilitate open innovation from inside and outside the bank. We also walked through the building. I also made some pictures you can find here. Go and have a look!

The Dialogues Incubator in particular has reaped the benefits of being housed in the Dialogues House. The primary objective of the Dialogues Incubator is to develop new sustainable value propositions based on the primary assets of the bank, i.e. knowledge, relations, reputation, systems, clients, etc. In short, the Dialogues Incubator has a wealth of intellectual seed capital at its disposal. The Dialogues House amplifies this, as there people can meet, discover new perspectives, work together, build synergies between ventures and discover the power of serendipity. It has truly been an O-zone for the people who work there and for business partners and visitors.

Work on 'wise places' has now emerged in Japan, including through the Japan Innovation Network and Professor Noburo Konno. See more at: https://www.facebook.com/jp.futurecenteraliancejapan.

Another very recent illustration of the futurising health search approach is from the 2016 Nobel Prize in Chemistry, which is going beyond the famous Tesla innovation network development and into imaginative nanocars and molecular machines doing health fact-finding in your body.

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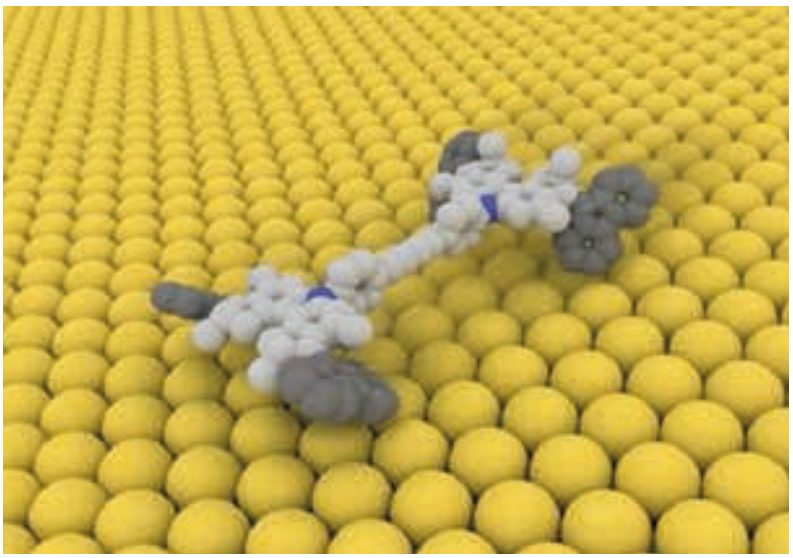


Figure 5: http://www.wired.co.uk/article/nobel-prize-in-chemistry-molecular-car **and photo from University of Groningen**

PART II

e-Platforms

Article 7

Accomplissh: creating societal impact from social sciences and humanities research

Accomplissh ('Accelerate co-creation by setting up a multi-actor platform for impact from social sciences and humanities') is a unique co-creation engagement platform focused on societal, cultural, economic or policy-related impacts originating from social sciences and humanities research. It is funded through the EU Horizon 2020 research and innovation programme. The Accomplissh consortium consists of 14 universities originating from 12 countries around Europe. For a geographic overview of the partners see Figure 1 below.

For the first time, results from both practice and the theory of co-creation and impact will be developed and tested in such a way that it is transferable, scalable and customised for academia, industry, governments and societal partners across the whole of Europe. The overall Accomplissh approach is shown in Figure 2.

Figure 1: Accomplissh consortium

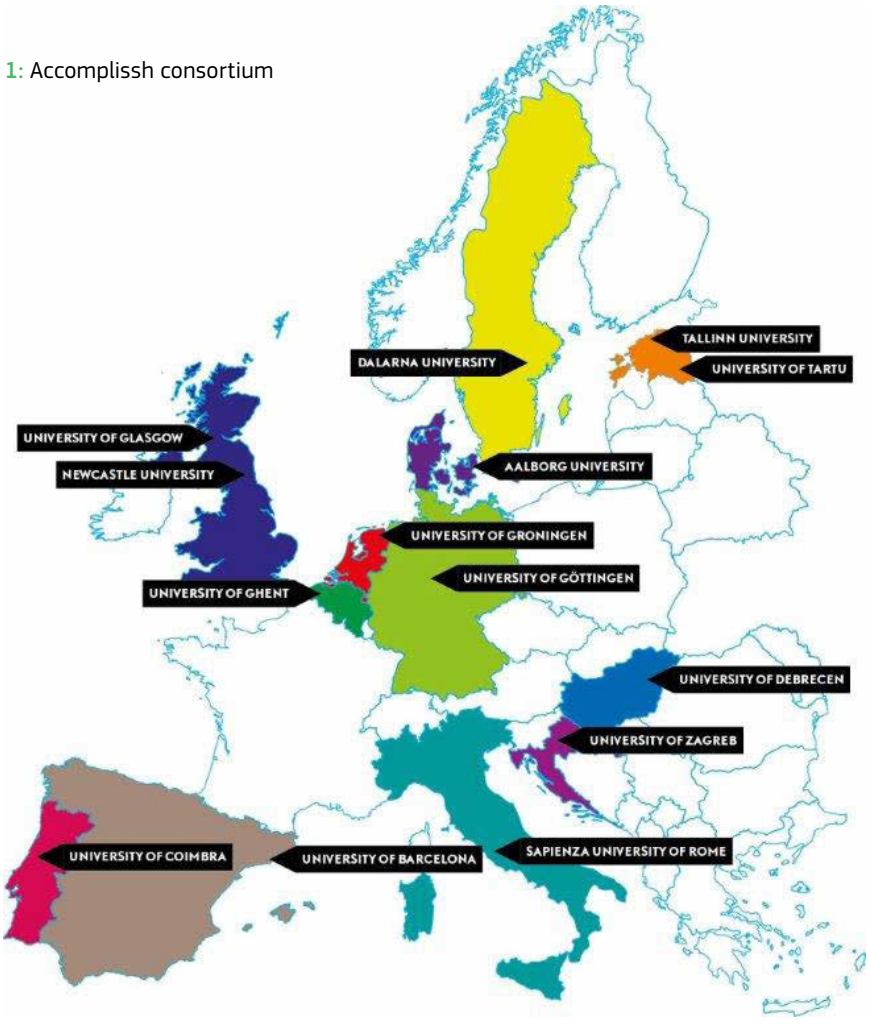
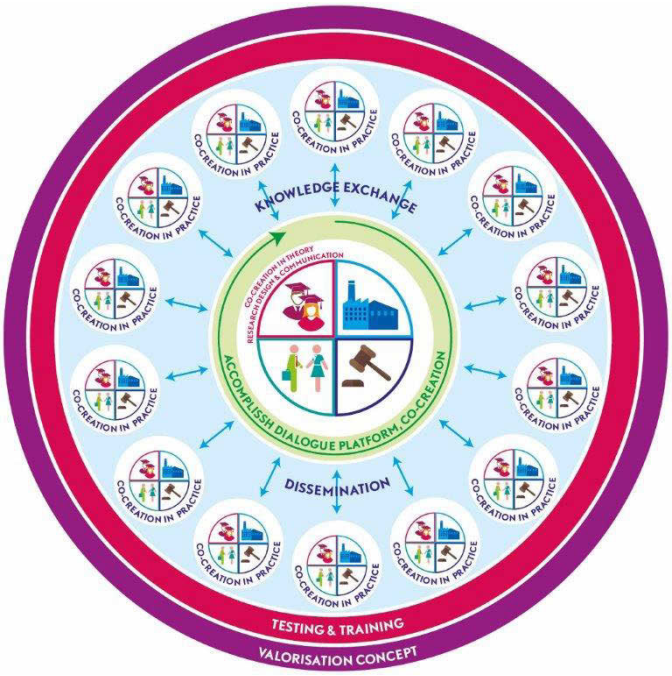


Figure 2: The overall Accomplissh approach



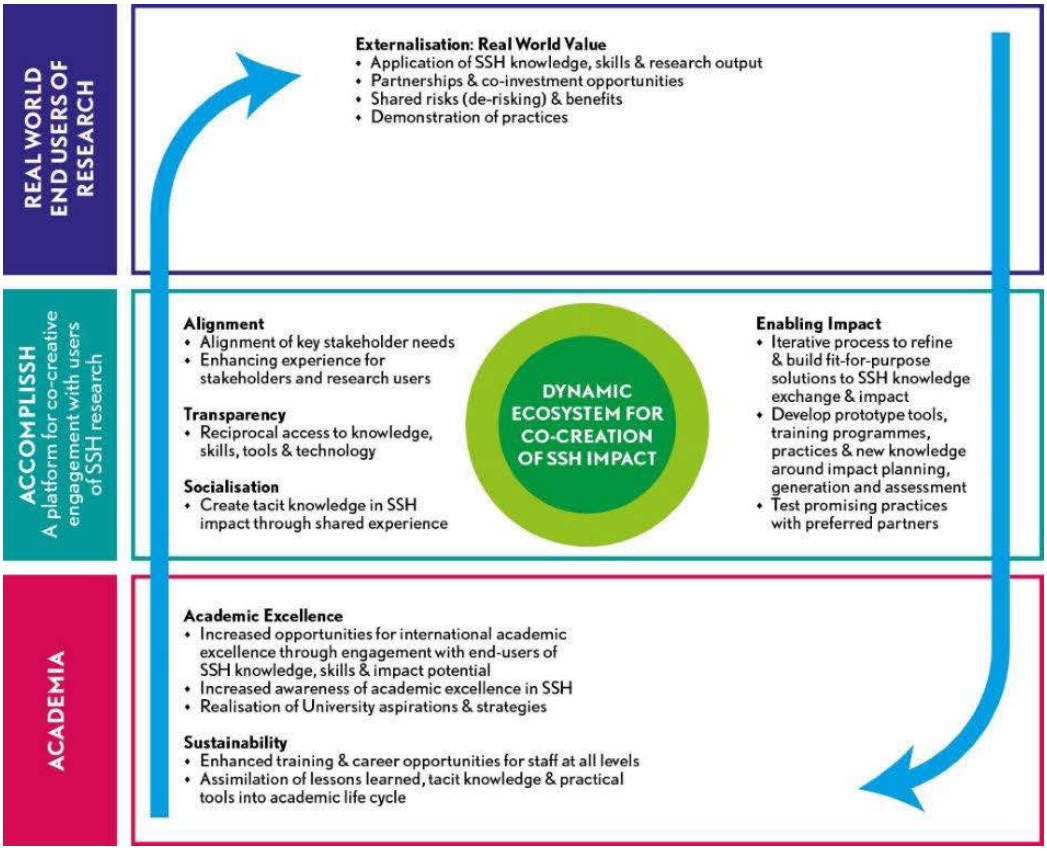
Introduction

Traditional knowledge-exchange approaches focus on linear processes: from academia to society. In order to address the most pressing societal challenges in our world today and achieve widespread and transformative societal impact, all relevant actors need to cooperate in an equal setting: co-creation. Co-creation brings the relevant stakeholders together and transcends boundaries, but it does not happen naturally. Therefore, the Accomplissh consortium is actively involving all partners from the so-called quadruple helix (industry, governments and societal partners) within the project to develop, define and train in co-creation and impact best practice. The project has chosen an open innovation 2.0 approach.

In the Horizon 2020 programme the European Commission has recently acknowledged the significant potential of social sciences and humanities (SSH) disciplines and research in contributing to and addressing the challenges facing society [1]. Societies are communities of individuals. Inside these communities, actors, entities and market systems are becoming more interconnected and are therefore complex [2]. As a result it is becoming more and more difficult to overcome societal challenges. For this reason, an innovative transdisciplinary co-creation approach is needed (see Figure 3).

Accomplissh is funded under the European Commission's Horizon 2020 programme, with a total budget of EUR 1 898 412. The Accomplissh project started on 1 March 2016 and had a life time of 3 years. Accomplissh is coordinated by Sharon Smit, Director

Figure 3: Transdisciplinary co-creation approach



Sustainable Society, University of Groningen, the Netherlands.

The Accomplissh platform consists of 14 universities originating from 12 countries. They represent all the subdisciplines in SSH. The academic partners are as follows: University of Groningen (Netherlands), University of Glasgow (United Kingdom), Aalborg University (Denmark), Dalarna University (Sweden), Newcastle University (United Kingdom), University of Zagreb (Croatia), University of Tartu (Estonia), Sapienza University of Rome (Italy), University of Göttingen (Denmark), University of Debrecen (Hungary), University of Ghent (Belgium), University of Barcelona (Spain), Tallinn University (Estonia) and the University of Coimbra (Portugal). Importantly, the commitment to integration of stakeholders from all sectors of the quadruple helix is in the DNA of the project, and key associations are shown in the diagram below (Figure 4).

Figure 4: Accomplissh quadruple helix

Open innovation and Accomplissh

The open innovation 2.0 approach introduced by the digital agenda for Europe aims at tackling Europe's key challenges by involving all stakeholders from the quadruple helix model [3]. Drivers of change are identified in a way that single actors could never bring forward on their own. A multi-actor co-creation approach takes full advantage of the cross-fertilisation of ideas. The Accomplissh project embraces this approach, which can be seen in the way the dialogue platform will be organised (universities together with industry, governments and societal partners as equal partners). By involving stakeholders from universities, industry, government and societal organisations we ensure that the potential impact of SSH research can be unlocked and used in the development of products, services and policies.

Open innovation 2.0 is based upon the principles of integrated collaboration, co-created shared value, cultivated innovation ecosystems, unleashed exponential technologies and extraordinarily rapid adoption [3]. The initiative states: 'innovation can be a discipline practiced by many, rather than an art mastered by few' [3]. The Accomplissh consortium strongly believes that it can foster the dialogue within the project timelines and pave the way for co-creation to be adopted by many more after the project.

The digital agenda states that much needs to be done to properly establish open innovation 2.0 in Europe. Partners in all quadruple helix sectors should make efforts to strengthen and establish the open innovation approach. Accomplissh will make a significant contribution to achieving these goals.

Realising Accomplissh's aims

The aim of the platform is to generate co-creation and impact approaches which are relevant and scalable for the whole of Europe. Testing and training are important elements in the implementation and further development of the co-creation and impact approaches. Instruments will be developed and tested to serve as guidelines for co-creation and impact. Training creates an innovative mindset among the quadruple helix partners in the various settings. This will contribute to the further development of SSH research design and communications, which are critical factors in the integration of co-creation and impact in academic culture and activity.

Accomplissh partners will test models iteratively in live research environments during the project cycle. The outcomes of that process will be used to redefine and reshape how we think about and carry out co-creation. Accomplissh will test how the chosen approach can exploit SSH research outcomes to their full potential, in the regional environment and with a high scalability factor for the whole of Europe.

The project creates platforms for dialogue both in the quadruple helix setting and in smaller academic settings. The smaller platform looks into barriers and enablers of co-creation from an academic perspective and brings forward new research design and communication approaches, with a specific role for research support officers as they help bridge the gap between science and society.

The wide platform facilitates a genuine dialogue on how to develop an innovative model of impact generation by involving government, industry and civil-society participants, together with academic partners. All academic partners will introduce their regional partner networks as important stakeholders in the project.

The images depicted in this diagram (Figure 5) were developed from real-time sketches captured during the first Accomplissh project management meeting. This summarised our discussions in visual form and encouraged interaction with the design community.

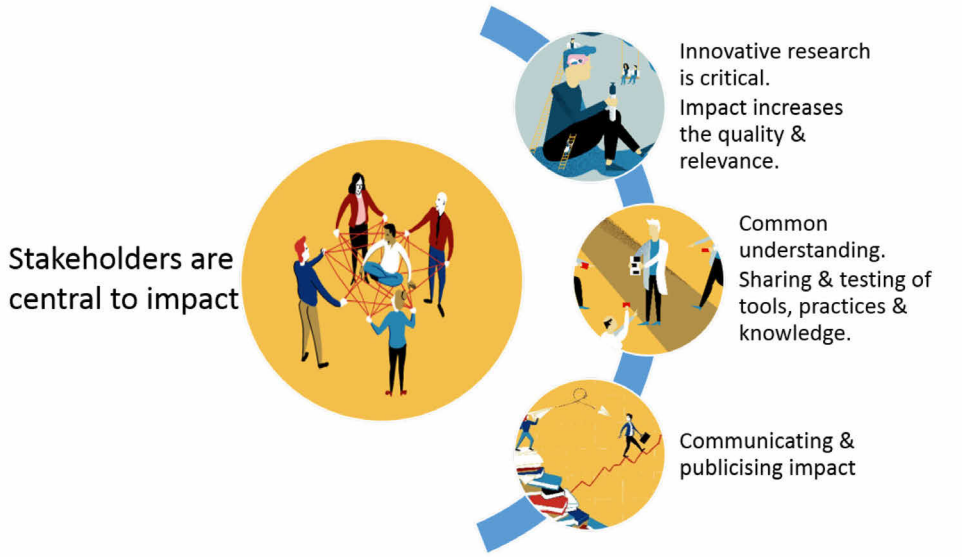
Project management

Accomplissh has set up a dialogue platform which will meet twice a year for dialogue and knowledge transfer among universities on SSH impact, methods and value chains, valorisation and co-creation. The platform is a sustainable mechanism for collaboration and dialogue, with the long-term aim of further developing the valorisation model with additional partners throughout Europe both during and beyond the lifespan of the project.

Project coordinator Sharon Smit is the chairman and supervisor of the Steering Committee. The Steering Committee consists of the project coordinator and two representatives of each work package. The Steering Committee is responsible for the management of all the activities performed within the project.

Accomplissh also works with an Advisory Group and High-Level Expert Group. The Advisory Group keeps the consortium focused, specifically with regard to the scalability and therefore the regional

Figure 5: Diagram of real-time sketches from Accomplissh



applicability of the valorisation model being developed in the project. The High-Level Expert Group provides both inspiration on and an international perspective on the development of the valorisation model. They play a crucial role in advising how to further integrate SSH research into the value chain of products, services and policy.

Increasing the value of social sciences and humanities research and integrating across the European innovation system

The platform raises awareness of the value of SSH research and the possibilities to integrate it across the European innovation system. Working with core (academic) and wide (quadruple helix) dialogue platforms contributes greatly to raising awareness of the value of SSH research.

Dialogue is a precondition for co-creation. Dialogue implies interaction, a deeper engagement and the ability and willingness to act on both sides. The wide platform is based on equality of the partners in the quadruple helix, which reflects the equality in the co-creation process. All partners in the Wide Platform are equal and joint problem-solvers. The Wide Platform is brought together from a commonly experienced urge to identify barriers and enablers of co-creation.

In identifying and laying these aspects down in a valorisation concept we expect to bring forward sustainable impact for Europe, since we do not aim at customising the concept. A basis will be formed that will be highly beneficial to the whole of Europe, with the ability to adjust to the local situation. This as a direct result of bringing together equal partnerships in the quadruple helix dialogue.

Innovation management

The overall Accomplissh approach is organised to stimulate innovation management, as follows.

- To increase the impact and adoption of the project results we involve lead users and end users directly in the project.
- In our checks and balances for the project we attracted representatives from the quadruple helix to inspire, advise, reflect and critically follow the project. The Advisory Group and the High-Level Expert Group contribute to an innovation management approach.
- We have organised feedback loops in our project, which is based on an open system that interacts with its environment. In our co-creation approach we work with inputs (co-creation theory), throughputs (platform and co-creation in practice) and outputs (results of synthesis of co-creation theory and practice). We are very interested in both the successes and failures of the system; both are needed to be built upon and to develop the valorisation concept. The project managers monitor feedback loops and take appropriate actions to reinforce a positive feedback loop or correct problems that create a negative feedback loop.

Addressing societal challenges in Europe

By strengthening the value of SSH research this project contributes to the economic and social progress of Europe, and therefore addresses societal challenges in Europe. The project contributes to a greater understanding of Europe by providing solutions, new insights and methods of co-creation and valorisation.

The development of new products and services will contribute to tackling unemployment and reducing inequality and social exclusion. New products will be developed and introduced to the market, leading to the innovative economic growth of the market. New services will be developed that will be better adjusted to the needs of end users, resulting in more inclusive measures that stimulate an equal society. Ever-growing global interdependencies urge Europe to bring forward new co-creation methods in order to innovate and compete with international markets such as Brazil, China and the United States. These co-creation methods will be brought forward in the project.

Early success

The ambitious nature of the project has ensured that it has met with early success in achieving its aims. Accomplissh recognised that there was an urgent need to develop tools and training to aid co-creation with stakeholders and to provide support for individuals and institutes throughout Europe. Initial activities therefore focused on the following areas.

Early engagement with key stakeholder groups. To collect first-hand experiences of both academic and non-academic actors to identify barriers and enablers of co-creation and impact we have conducted stakeholder focus groups. This is allowing us to generate an overview of existing research and policies in the field and to conduct primary data collection using a mixed-methods approach. Training in focused group skills has been delivered to all academic partners, and meetings of stakeholder focus groups held at partner institutions.

The early embedding of stakeholders at the heart of Accomplissh was reinforced through our first open dialogue meeting, which was held in Rome in November 2016. Co-creation sessions were presented jointly by quadruple helix partners to illustrate successes and issues on co-creation and impact.

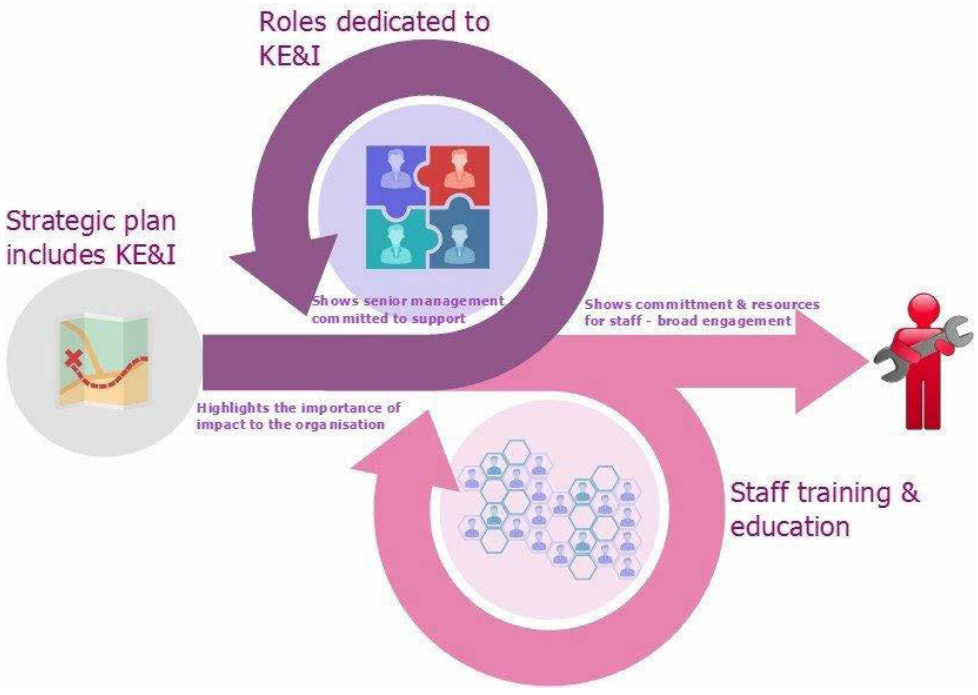
Working with early-career researchers. The inclusion and mentoring of early-career researchers is critical to training the next generation of impact-enabled researchers. Accomplissh partners in Glasgow and Groningen have taken an innovative approach to encouraging young researchers to think about co-creation and the impact agenda. These institutes have run 'Impact in 60 Seconds' competitions (the Impact Award, see logo below in Figure 6) where students were challenged to generate a 60-second video in which they presented their research and its potential for impact. The results are inspiring and fun, and show a genuine engagement in the co-creation process. Links to the videos are available online (https://www.rug.nl/research/sustainable-society/suso-and-research/impact_award; https://www.gla.ac.uk/colleges/mvls/researchimpact/competitions/impactin60seconds2016/videos; https://www.gla.ac.uk/colleges/mvls/researchimpact/impactinsixtysecondscompetition2015/videos).

Figure 6: Impact Award logo

Tools and training in impact. In order to develop and deliver the support for tools and training in knowledge exchange and impact we need to know what individual institutions have in place. We have conducted assessments of institutional support for knowledge exchange, co-creation and research impact. This provides a snapshot of where we stand in terms of key measures of support, and we can then benchmark progress over the course of the project and implement support (visual support in Figure 7). In parallel we have carried out an assessment of levels of staff awareness regarding knowledge exchange and research impact. This allows us to educate ourselves on how we, as institutions, can best support our academics to generate wider societal impacts; to raise awareness and begin to engage staff in our institutions around these issues; and to help us to identify the training and support needs unique to our institutions.

Networking with related European projects. In order to consolidate on a common purpose and develop an understanding of any interdependencies between Accomplissh and related projects on co-creation and research impact we have established partnerships with a number of groups, including Dandelion and Impact-EV. This has involved participation in joint meetings and the sharing of plans, resources and skills.

Figure 7: Benchmarking institute and staff awareness of impact provides a high-level overview of mechanisms in place in Accomplissh partner institutions. Assessments can be used to feed into personalised regional impact development plans



Project impact after 2019

We have set our objectives with sustainability in mind. After the project Accomplissh will form an open innovation network that all partners from across the sectors can join to learn and contribute to both the application and the further refining of the valorisation model. We believe that Accomplissh will establish a strong foundation for the valorisation concept; at the same time, we want to continue developing the concept in such a way that it has a sustainable impact on all levels of the partner sectors in the short and long term. This is what Europe needs to be more competitive in the global innovation playing field.

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Article 8

Novel ways to structure, manage, communicate, reuse and capitalise on multilingual knowledge in an integrated way

Systemic open innovation requires creativity
Creativity is born out of needs
Needs are satisfied through knowledge
Knowledge requires structure
Structure asks for teamwork
Teamwork needs interdisciplinarity
Interdisciplinarity flourishes through communication
Communication requires the will to succeed
Will to succeed asks for creativity
Creativity generates systemic open innovation

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Introduction

Everything that we do in life is connected with data, information, knowledge and wisdom. This is the most valuable intangible human asset because it encompasses history, traditions, cultures and explicit knowledge, and also more and more tacit knowledge thanks also to social media.

This sounds good, but such a valuable asset and capital is very fragmented, lies in 'cemeteries of information' and is not used because it still lacks the structure, methods and instruments needed to filter and offer them in a way that brings tangible benefits to the users.

The problems we are facing nowadays at the global level are: (i) a lack of interactive communication and common understanding that make human knowledge and wisdom available at international level; and (ii) the ability to recognise in a short time the value, or non-value, of the enormous amount of data and information we are confronted with.

The more new technologies gather data and information on a large scale, the more we are confronted with our limited capability to recognise the difference between the essential, the necessary and the nice-to-have of data and information.

Socioeconomic value of the e-platform

When we started developing what has become the PROMIS® e-platform [1] we were seeking solutions to a European socioeconomic problem: to help 23 million European micro, small and medium-sized businesses (SMEs), from all different sectors, to be compliant with norms and legal requirements at national and European level in the fields of environment, safety and health, and quality. At that time, in the year 2000, it was a real challenge because these three domains did not even want to talk to each other, and technology was not mature enough to answer the needs and requirements of European SMEs.

We had to first understand the multisectoral, multilayered, multinational and multilingual requirements of the users in order to address the problem in an appropriate and sustainable way. The major challenge here was to simplify complexity from an 'eagle's eye' perspective, meaning that we first mapped the overall situation, analysing and understanding the status quo in a comprehensive way.

To simplify complexity, we first created three new frameworks for structuring and filtering information.

- **The knowledge pyramid** from generic to sector, theme and domain oriented. 1st level
- **myPROMIS®** from generic to process oriented, integrated management system framework, tailored to the structure of an organisation. 2nd level
- **Individual workplace/dashboard** – answer of users' questions at one's finger tips. 3rd level

As a business-enabling open innovation, the PROMIS® e-platform at present organises and tailors

integrated process management, legislation, learning, training and community building, and helps to capture structure and interlink all relevant information. It supports knowledge structuring and sharing, multilingual online collaboration and communication, communities of knowledge, e-mentoring and the generation of additional services out of the knowledge and content available in an organisation.

From software to brainware

Everything that we have done in the last few years, and will continue to do, revolves around open innovation and the circular economy of knowledge from a practice-oriented and human-centred perspective, which was defined as follows: (i) structuring knowledge; (ii) sharing knowledge; (iii) valuing protected knowledge (intellectual property rights (IPRs)); (iv) communicating knowledge; (v) managing knowledge; (vi) reusing knowledge; (vii) capitalising knowledge.

The result is a cloud/software-as-a-service and intranet e-platform of interactive services that allows organisations and institutions to find their way in the maze of legal standards, norms and other regulations to which they are submitted and, at the same time, to structure their processes and knowledge in a way that results in improved access to customers, better relations with regulatory authorities and financial institutions, faster and easier certification, smoother audits, improved operations and significant cost reductions.

With the integrated management system myPROMIS® the processes of an organisation are described, steered and linked to all company-relevant data, documents, tasks, people, infrastructure, materials, processes, etc. In this way the e-platform brings order and transparency, reduces risks and creates the conditions for a process of continuous improvement in different types of organisations.

The knowledge management system and approach has two directions: one business oriented and the other education and training oriented. This approach aims at supporting the creation of alliances between institutional and private stakeholders. The most important advantage of the knowledge pyramid is that the information can be translated automatically into different languages. Having learning material in their respective native language represents an important motivational tool to all users [2].

The e-platform of platforms

The core of the PROMIS® e-platform is a meta-layer generic integrated management system framework which gathers all relevant existing data from the operative systems that are available in an organisation and, at present, are mostly non-connected islands or silos.

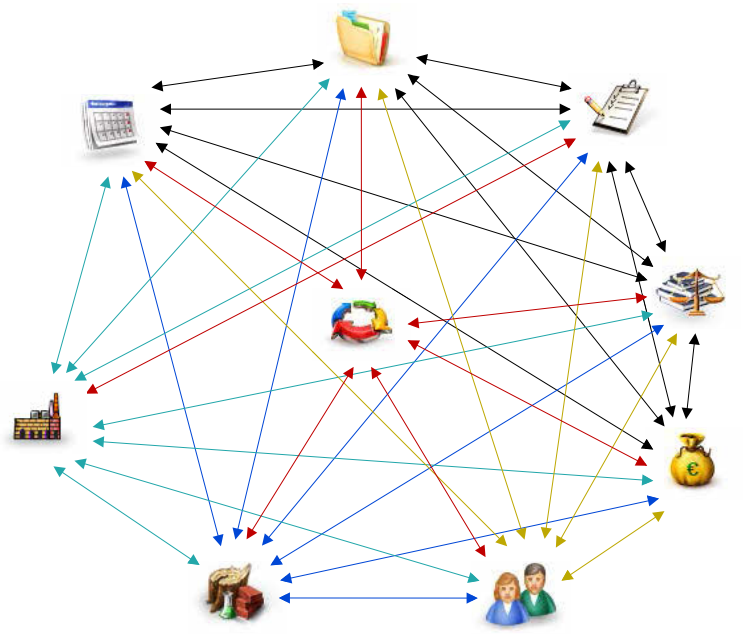
This generic integrated management system framework pursues a holistic, comprehensive approach linking all elements, objects and processes in a way that creates synergies, avoids redundancies, optimises economic value and achieves order and transparency. It controls the legal and normative requirements of an organisation into a single compliance-management system. In contrast to the operational enterprise resource planning systems with which the financial, physical and human resources are controlled, the PROMIS® core-component integrated management system manages the regulatory requirements that are necessary to comply with norms, standards and other legal requirements.

The possibility to link all individual containers with each other allows the creation of a data network that is a logical 'closed loop' in itself and is self-sustaining. Automated processes and procedures support a resource-saving maintenance of the PROMIS® integrated management system for any type and scale of organisation.

The knowledge within the organisation concerning 'how?', 'why?' and 'what are the rules?' is structured and made available to all managers and employees individually, in a task-related implementation and on a need-to-know basis so that all relevant requirements become transparent and are steered through the organisation to an easily accessed resource (Figure 1).

PROMIS® is an 'e-platform of platforms'. In addition to connecting organisations' systems at the operational level, it interlinks different types of stakeholder such as affiliates, institutions, regions and governments.

Figure 1:
Methodological Foundation (© 2000) — interlinking dependencies



The e-platform is available in nine languages and contains multilingual tools for both human and machine translation which allow the users to work in their mother tongue and to communicate online in all languages with the right to select the preferred machine translation.

The methodology is based on a system of order, in which all relevant knowledge and information related to the individual business processes and their derivatives are collected and maintained electronically, in a centralised form and free of redundancies, as much as reasonably possible.

It is also based on standardised reference models submitted for validation by neutral and independent organisations, and it is based on the collective experience and talent of the experts' community. The shared knowledge and innovations collaboratively developed by the community are continuously improved through the adoption of an evidence-based model of knowledge management [1].

This novel type of e-platform is now a multinational, multilingual and multi-client-enabled framework supporting multilingual integrated compliance and with online interactive collaboration between small and large organisations, experts, scientists and interested parties (e.g. suppliers, public authorities, banks). It is a generic framework to build and offer interactive services with sector- and theme-oriented turnkey solutions for organisations in Europe and beyond, with a high level of trust and confidence based on security, highly qualified, trusted community building and offering a balanced regulatory framework with clear rights regimes. Finally, its four innovative business models offer adequate protection and remuneration for rights holders.

Major components that build the systemic open innovation in PROMIS®

The e-platform consists of 79 modules in HTML5 and 2.0 technologies that allow the following.

All-in-one integrated compliance and governance

Instead of having 'islands' of different solutions in an organisation, PROMIS® offers a meta platform which collects all relevant data existing in an organisation and links all elements, objects and processes in a way that the users achieve great transparency and order. All norms and standards are available to all employees at their fingertips whenever and wherever needed, for example Occupational Safety and Health Administration 18000 (health and safety), International Organisation for Standardisation (ISO) 9000 (quality), ISO 14000 (environment), ISO 26000 (corporate social responsibility), ISO 27000 (ICT security), ISO 29990 (education), ISO 31000 (risk management), ISO 45000 (maintenance), ISO 50000 (energy), financial compliance and more.

Health and safety life cycle

Available at present: (i) current legislation; (ii) risk assessments (with stored standard catalogues); (iii) self-generated operating instructions; (iv) complete compulsory instruction and training scheduler; (v) accident report and statistics; (vi) medical check; (vii) competence, skills and training management; (viii) process descriptions and procedure instructions following related norms and standards; (ix) risk assessments (traffic light and Kinney methods); (x) responsibility matrix.

Life cycle of continuous improvement and reuse/capitalisation of knowledge

The toolbox allows the creation, administration, sharing and selling of additional services generated from the knowledge and content existing in an organisation.

The tools available at present are: (i) generator of multilingual questionnaires, surveys and tests; (ii) generator of knowledge pyramids/polyhedrons and 3D knowledge arrays; (iii) integrated management system templates; (iv) content management system; (v) report generator; (vi) report builder; (vii) administration of services and related members/clients/affiliates.

Communities of knowledge

Scientists, experts, managers, students and citizens can structure their knowledge and experience, then share/sell it in the desired language. In the past, offering content was perceived as a service consisting of pre-structured, static information. Now society and the market require that the systems allow users' knowledge to adapt and also 'customise' content to their specific needs and according to their own explicit and tacit knowledge. A clear structure was needed to establish communities founded on a collaborative model. This model is based on the concept of collaborative working environments and community building, which treats the collective wisdom and exchange of experience between public and private bodies, experts and their SME customers, and associations and their members as societal assets or 'common goods'. 'Common goods' are a kind of social capital that can be leveraged many times to both harmonise and improve the level of competitiveness and the quality of life [3].

The knowledge pyramids are produced by all those who are knowledge providers and are selected by/connected with those who learn from that knowledge, i.e. knowledge consumers.

In the knowledge pyramid the information can be structured using multilevel, vertical and horizontal

approaches. In such a way SMEs, enterprises, experts, associations and/or institutions can structure their knowledge in specific sectors, fields or domains into one or more knowledge pyramids. Afterwards, the content of the knowledge pyramid can easily be linked to a management system and directly connected to the relevant personnel and/or learners in a secure and protected way, also allowing communication and collaboration in different languages.

In addition to supporting the structure of multilingual information and knowledge, the pyramid is accepted more and more as an instrument to register and protect IPRs, also thanks to the innovative business model connected with it.

Multilingual communication
PROMIS® allows users to work in their mother tongue and to communicate online in all languages with the right to select their preferred machine translation.

Collaboration and online working
The e-platform is multi-client enabled, allowing the solution to be set up once and then copied to as many members/clients/affiliates as needed. Remote access is guaranteed and allows continual online work, collaboration and communication.

E-competence, e-skills
PROMIS® acts as a matchmaker between the competences of the personnel and the competences required by machines (e.g. servers or power engine), materials (e.g. toner or dangerous substance), etc. This is very important, in order, among other things, to support evidence-based compliance and to decrease risks.

E-training and e-learning
When someone's competence has expired the e-platform automatically sends them to the training module, where a trainer can generate training courses linking to external resources and/or reusing the knowledge and materials available in the organisation.

E-mentoring
When a person leaves an organisation, most valuable knowledge goes away with the person. With PROMIS® and the e-mentoring modules this knowledge is brought back into the organisation and provided in real time to the younger generation that has replaced the seasoned person who left.

Using this open innovation e-platform, dedicated information is made accessible to the learners in an interactive collaboration and e-mentoring mode, which improves the level of knowledge quickly and effectively while respecting individual knowledge ownership and methods (IPRs).

Standardisation

A business-enabling e-platform that brings novel methodologies, tools and business models inevitably also generates new terminologies, new professions and therefore new opportunities for qualification. In the case of PROMIS® the following two standardisations have been generated.

- CEN-CWA 16275 — 'Guidelines for the selection of consultants advising SMEs on integrated quality, environment, health and safety management systems' was developed by the consortium's partners during the deployPROMIS® project [4] and is now a widely required guideline for qualification worldwide (https://www.promis.eu/eu/wp-content/themes/promis/custom-2/files/CEN_CWA_16275_March_2011_FINAL.pdf).

- The 'Terminology policy to support generic applications of management systems with focus on smaller organisations in a multilingual environment' started during the PROMISLingua project [5].

Multilingualism
PROMIS® is currently in nine languages (graphical user interfaces, platform and structural content).

The implementation of multilingualism was accomplished by merging the multilingual workflow with the application management workflow in the following way: (i) integration, a key success factor because language technology has to fit seamlessly into integrated management systems. Natural language support is provided in two areas: (ii) tools for multilingual human translation; and (iii) tools for machine translation, including the collection of multilingual resources.

The tools must be flexible, adaptable to different configurations of languages and domains. This refers to the following integrated tools: (i) tools for content translation and localisation of the e-platform into different languages; (ii) tools for corpus analysis, sentential alignment, terminology extraction and machine translation; (iii) cross-lingual information retrieval and text-to-speech, including support for user query formulation, query expansion, synonym recognition, spelling correction, query translation into the document language(s) and support for document retranslation into the user's language.

The translation components are considered a quality assurance and productivity tool for humans, not a replacement [5].

When the content is structured in the e-platform, users can first select a preferred machine translation and then translate the content, in all languages allowed by the machine translation. As this happens in a secure and closed environment the e-platform allows the translation of case-sensitive content.

Business models and e-shop
The e-shop supports the sharing and/or selling of self-generated content and services (internal and external).

The four business models of PROMIS® are built upon what we believe is open innovation's mission:

- human-centred methodology and technology;
- respect for individual tacit knowledge and recognition of IPRs;
- clear definition between free-of-charge and paid-for content;
- clear and well-defined rules, duties and rights;
- collaborative community-based approach;
- communicate in different languages but always speaking the mother tongue.

And in this context of open innovation, ecosystem services are meant to:

- be multilingual, i.e. support communication and common understanding;
- structure and value existing, though non-structured, knowledge (internal and external);
- be interactive, i.e. support online working and collaboration;
- offer a high cost–benefit ratio and large economies of scale;
- embrace the whole of the ecosystem's life cycle; and
- support the process of continuous improvement.

The most important pillars of our business models are as follows.

Respect for tacit knowledge. A new paradigm of offering information to the users/customers. No longer offering content in a pre-structured way but valuing individual knowledge as intangible capital and building upon the fact that scientists, managers, experts and associations know best the needs of their customers, students and members. They are therefore well placed to do the job of structuring their existing content and knowledge; to link them to the common processes in an organisation; and to create turnkey sector solutions that can be offered as an innovative service to their clients and members. Industry, institutions, universities and associations have the opportunity to reuse and structure their existing content, data and expertise in the knowledge pyramids, as well as in the integrated management system, thus preparing turnkey sector solutions in such a way that their knowledge is offered to SME users at their fingertips and in full respect of their IPRs [3].

Win-win collaboration supporting public–private partnerships. Allows organisations to use cost-free content directly from institutions that are the owners of such knowledge and keep the responsibility for the quality, correctness and update of their content. In addition, thanks to the integrated management system, the content is brought to the employees with the logo and the look and feel of the institution/university/enterprise that provides the content.

'Industrialising knowledge'. I.e. do a good job once and sell/share it thousands of times.

After quality assurance and the signature of contracts covering the IPRs, as well as rights and duties, the knowledge pyramid and template solutions are offered to the communities via the e-shop and in the language-related countries. The content providers of the structured knowledge pyramids (scientists, experts/consultants, individuals, SMEs, institutions, associations, etc.) remain the owners of their knowledge and of other self-generated services (e.g. questionnaires, templates, files, e-training courses). Such services can be shared for free (e.g. among institutions, associations, chambers of commerce for their SMEs) or can be provided as a subscription service.

The services offered by this e-platform not only respond to private and public SME organisations' steadily increasing requirements and needs from different types of regulations, norms and quality performance standards at local, national and international levels; they also respond to the increasing needs of harmonisation, cross-lingual communication, collaboration and participation that European private and public organisations are experiencing in their natural cross-border market in Europe and beyond.

This e-platform provides the answer to major requirements of the digital agenda 2020, and in a digital single market that is still very fragmented PROMIS® will be a decisive ICT framework to enhance the competitiveness of European organisations and allow them to unleash their potential [5].

Systemic open innovation in PROMIS®: from theory to practice

The understanding of Bror Salmelin's spirit of open innovation refers to the fact that:
In the European context, open innovation is now used as a synonym for modern, highly dynamic and interactive processes … This new innovation culture leads to simultaneous technological and societal innovation and encouragement. We need

to be daring and also experiment with disruptive approaches as gradual improvement does not properly reflect the potential that the omnipresent, fast-developing ICT provides for parallel innovations. [7].

In our context **systemic open innovation** embraces all of the bits and pieces that interconnect knowledge on the journey from the theory to practice, and means going from a mere technology- and only money-driven society to:

human-centred politics *, human-centred security *, human-centred technology where the human person is core

Considering this as essential, the understanding of open innovation from the side of the PROMIS® community is based upon the following strategic framework.

During the 'Eighth European Innovation Summit — Future Now!', organised by Knowledge4Innovation, which took place at the European Parliament on 14-17 November 2016 in Brussels [8], the results of well-administered European Commission funding and successfully deployed knowledge-intensive interactive services for systemic open innovation were discussed during a 1.5-hour round table, using the example of two practice-oriented international pilot projects presented by their decision-makers: (i) Global Crisis and

Figure 2: Open innovation strategic framework

Disaster Resilience (Figure 2); and (ii) the WePROMIS® e-mentoring pledge to the Grand Coalition for Digital Jobs [9].

Hosted by the Member of the European Parliament Lambert van Nistelrooij with the participation of Bror Salmelin (DG Communications Networks, Content and Technology), Bernd Reichert (DG Research and Innovation/Executive Agency for Small and Medium-sized Enterprises) and Caterina Berbenni Rehm (CEO of PROMIS@Service and International Coordination of Deukomm). The global crisis and disaster resilience framework was represented by Ing. Albrecht Broemme (President of the German Federal Agency for Technical Relief) and Colonel Marc Mamer, Treasurer of the International Association of Fire and Rescue Service and President of the Fire Brigade Federation of the Grand-Duchy of Luxembourg. The WePROMIS® e-mentoring pledge was represented by Marie-Anne Delahaut, President of the Millennia2025 Women and Innovation Foundation.

Global crises and disaster resilience

This strategic programme aims at developing opportunities for goal-oriented coordination between operating institutions across Europe and around the world towards a uniform global approach to the prevention and management of global crises and disasters based on an algorithmic description of the sequence of events in the chain of cause and effect [10].

The call of the Tübingen Declaration of 8 July 2014 for unrestricted and uncensored dialogue between people everywhere [10] serves as the basis. Priority is given to the personal security and safety of people against all forms of violent threat.

Figure 3: *Source:* www.promis.eu

To realise this, open innovation interactive and multilingual services [11] have been developed with the support of the European Commission and will be the starting point to promote global communication and to facilitate conformity with legislation by:

- offering multilingual support, largely to avoid serious mistranslations;
- maintaining conformity with legislation and promoting evidence-based decisions;
- a multimodal, learning and multilayered knowledge and expert system (ecosystem) with high reliability and security by means of robust rights management that allows user-defined access to information with various levels of privacy;
- standardising terminology to promote mutual understanding and trust;
- implementing knowledge transfer between generations (e-mentoring).

Embedded in this programme is the MultiUniversus framework, already developed by a Capuchin friar [12], for implementing medium- and long-term strategies over the next 80-100 years and promoting dialogue between cultures and religions objectively and with clear goals in mind. This incorporates natural and social sciences. In an effort to promote social and cultural development, MultiUniversus focuses on the improvement of standards in the areas of each citizen's personal security, health, environmental protection, education, learning, culture and socioeconomic well-being.

The implementation of and communications within the global network is based upon the e-platform that supports future-oriented worldwide alliances through multilingual communication, along with clearly defined and harmonised rules, obligations and rights.

WePROMIS® — e-mentoring pledge to the Grand Coalition for Digital Jobs

The Millennia2025 Women and Innovation Foundation [13], a Unesco consulting partner, is a community of international voluntary researchers with 10 694 members in 137 countries. Its key values are equality between women and men, the respect of rights and diversity, the development of human capital and digital solidarity through e-skills, knowledge, communication and support with those who cannot access communications tools and who are nevertheless drivers of changes. The objective is to structure science, technology, engineering and mathematics scientists and other knowledge-supporting citizens, business start-ups, employees and students in building communities of knowledge and e-mentoring between the mentors (science, technology, engineering and mathematics scientists, corporate business leaders) and mentees (citizens, students, employees) at the international level. The Millennia2025 Intelligence Platform powered by PROMIS® [14] is developing e-skills to help mentors and mentees in the following areas.

Learning:
- how to structure knowledge and share it worldwide in any relevant topic, theme and domain;
- new skills by communicating directly with the mentors selected in the Millennia2025 community.

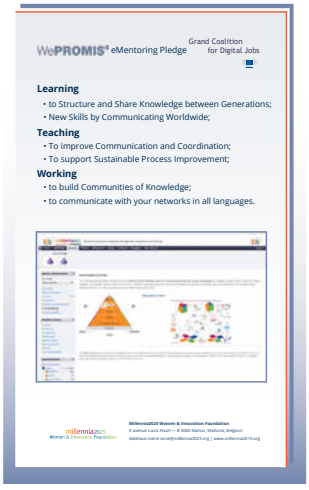
Teaching:
- how to structure and publish courses, lessons and online training with a high level of quality;
- how to improve internal communication and coordination throughout organisations and networks;
- how to support sustainable process improvement.

Working:
- to build communities of knowledge and contribute to equality between women and men and to women's empowerment;
- to create multilingual questionnaires and surveys to optimise research, user needs and market analysis;
- to communicate with your networks in all languages.

Conclusion

Innovation in Europe is still neither open minded nor on a 'fast track', because 'small tracks' are not enough to find fast solutions to big challenges. There is an important chance for Europe to open highways in order to find better solutions on a 'fast track'.

Figure 4: E-mentoring pledge



To achieve this, human factors based on human-centred security and human-centred politics are key to complementing the existing human-centred technology, because international challenges can only be faced and solved on a global level with: (i) worldwide communication and common understanding; (ii) intercultural and cross-cultural dialogue; (iii) knowledge transfer between seasoned and younger generations; (iv) communities of knowledge, where respect for tacit knowledge and recognition of intellectual property is key to developing structured intellectual capital.

However, it is not only about communications, as the processes are much more complicated than that. We need collaborative environments because of the complexity of the issues and their interdependence. And communication needs to lead to dialogue for understanding. As a consequence the trust-building process (by doing things together towards one common goal) in these collaborative environments is key to scaling up or failing [7].

We are all willing to create a European space, engaging people in the frontline to structure, share, reuse and communicate multilingual knowledge and asking all policymakers (e.g. the European Parliament, the Council of the European Union, the European Commission, the European Committee of the Regions) for active support towards better and shared futures.

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Article 9

A multi-collaborative growth model for the health and care sector: a reflection on the current state of play

Abstract

This article presents the benefits of multi-stakeholder collaboration and cross-policy approaches to the health and care sector. The advantages of thematic communities of practice and multi-policy approaches to foster growth are discussed by facilitating the creation of relevant priorities with respect to healthcare challenges and better incentivised migration of the competencies of people across the innovation chain. The applications of the multi-collaborative growth model for research, innovation and translation are assessed by presenting six examples of communities of practice and their underlying contexts covering e-health and ageing. Additional examples of integrated policies/strategies at local, national and EU levels support the rationale for collaborative networking and policymaking that address large health and care challenges. Finally, the findings provide practical measures for the healthcare community and point towards new ways of working.

Introduction

The aim of this paper is to present a multi-collaborative systemic growth model for the healthcare sector, motivated by the newly established policy of the European Commission regarding knowledge sharing and collaboration [1]. It also considers the recent report by the European Political Strategy Centre [2].

This model is part of a growing body of work focused on developing open innovation systems [3] that can be used to bridge, inter alia, European Commission policies, networking support and funding in healthcare delivery settings. Communities of practice (CoPs) and professional collaborative networks are promoted, contributing to the core of the health innovation infrastructures [1,4,5]. This paper emerges from the author's experience in supporting e-health research and innovation. Due to the complexity of the healthcare sector only the surface is scratched.

There is evidence to suggest that the translation of scientific results into clinical practice fails if the underlying science is not solid and proven in digital health [6]. An effective innovation ecosystem handles systemic failures and facilitates efficient utilisation of resources. Here streamlining frameworks and infrastructure investments can be designed to benefit the innovation ecosystem as a whole, which, by extension, can reduce the negative impacts [7].

This paper will discuss the rationale for why integrated policies and centralised decision-making are often necessary to address large societal challenges. Using a 'two-valley innovation chain maturity model' [8,9] framed by a quadruple helix [2] the paper will show how thematic bridges between policy and intervention can be built. In addition, the incentives to operate in and between different segments in the innovation chain will be discussed and supported by several examples from healthcare delivery systems. Some key areas of interventions emerging from market sounding and knowledge brokerage in the ecosystems for both early adoption of new solutions/services and large-scale deployment will be addressed and examples given. Furthermore, some aspects of the relationship between the multi-collaborative growth model and the European Commission's financial innovation support in Horizon 2020 will be presented. Finally, practical measures to use the findings to bridge the gaps between policy/strategy development, financial support and new ways of working will be discussed.

On an integrated policy and strategy for the healthcare sector

To deliver integrated policy work a collaborative policymaking and knowledge-sharing [1] approach should be promoted. This article uses the terms policy and strategy as a pair. Nevertheless, the centre of gravity is clearly on multi-strategy addressing outcome and impact indicators. It is assumed that mandates from all policy actors are given and there are benefits to all. A starting point for integrated health growth policies/strategies could follow roughly the logic of quadruple helix categories, i.e. related to academic [10], industrial [11], user community [12], government [13] or hospital [14] growth strategies. Additionally, there is a converging view on both sides of the Atlantic that the single-policy/strategy approaches should be complemented by integrated policy/strategy to facilitate a balanced approach, to optimise the resourcing and to maximise the impact of the efforts for the healthcare sector [15].

Relevant examples of integrated growth policies/ strategies in health and care areas include the following.

- Liverpool Health Partners (LHP) brings together the Liverpool City region's leading hospitals and academic institutions to improve health and deliver exemplary research, education and healthcare [16]. Committed to implementing and disseminating outcomes of research and innovation, LHP provides education, training and service-delivery improvement opportunities across its partners and beyond, collaborating with the National Institute for Health Research Collaboration for Leadership in Applied Health Research and Care North West Coast and the Innovation Agency North West Coast Academic Health Science Network.
- A recent report jointly prepared by three Finnish ministries [13], Health sector growth strategy for research and innovation activities, from June 2016, builds a rationale for comprehensive multi-collaborative government strategy necessary to improve impact and to overcome fragmentation and inefficient networking. The report addresses many shortcomings of traditional practice and proposes corrective measures to repair the ecosystems. Examples of such issues include the insufficient development of university hospital clusters and other leading hospital clusters, along with regional ecosystems from the point of view of research and innovation infrastructures. Additionally, there has been insufficient cooperation between universities and general institution-centred thinking that prevents the creation of large, thematic entities and projects. While 'bottom-up' funding is necessary, courage is also needed to make centralised decisions in specific areas of competence that are believed to generate future demand for inventions and derived innovations.
- The European Innovation Partnership on Active and Healthy Ageing [17] combines selected themes (e.g. integrated care during the past 7 years) with the assistance of a set of multiple policies driven by regions and healthcare service providers for large-scale deployments. The unmet needs of healthcare services were developed by mapping digital transformation in market sounding processes.

More generally, a number of EU health policies are addressed in research, innovation and deployment initiatives in various Commission directorates-general, for example DG Communications Networks, Content and Technology, DG Health and Food Safety, DG Research and Innovation, the Joint Research Centre (JRC), DG Internal Market, Industry, Entrepreneurship and small and medium-sized enterprises (SMEs) and DG Employment, Social Affairs and Inclusion. However, an assessment of their integration [18] is outside the scope of this paper.

Multi-collaborative growth models in the healthcare sector

It is increasingly recognised that there are numerous ways to model, classify, address and help understand various barriers to economic impact and clinical practice from research excellence.

Two of the most commonly used models to understand the non-linear aspect of growth are the two-valley innovation chain model and quadruple helix model.

The innovation chain maturity model with two valleys (see e.g. [19,20,21]) appears to be well established from the perspectives of medical research and the economic impact of technology development both emerging from research excellence (see Figures 1 and 2). In these figures the horizontal axis presents the maturity levels (for clinical practice or technology

Figure 1: The two valleys of the medical research-to-practice continuum [19]

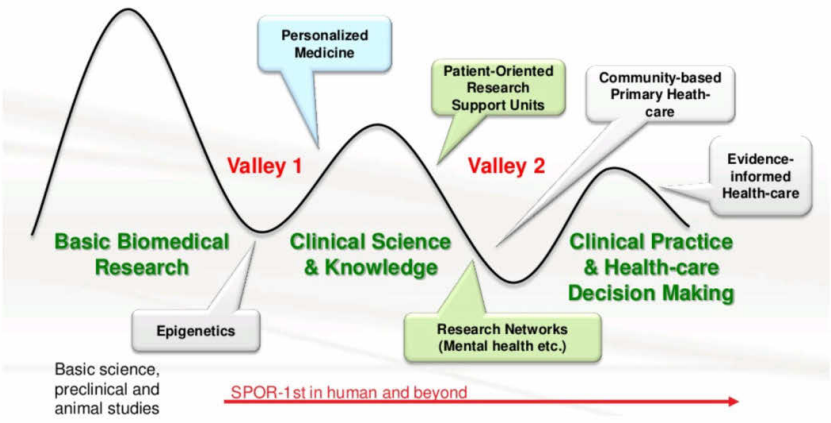
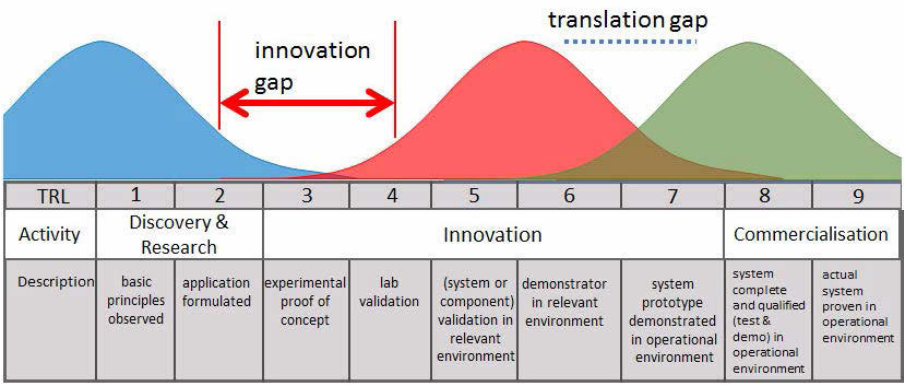


Figure 2: The innovation chain: barriers to economic impact from research excellence [9] (TRL indicates the technology readiness level.)



readiness level). Valley 1 refers to the decreased capacity to translate the results of discoveries generated by basic research in the laboratory into practice and to successfully commercialise the discoveries. This has a negative impact on the research and knowledge base. Valley 2 refers to the limited capacity to synthesise, disseminate and integrate (translate) research results more broadly into practice and economic value. In this paper, valleys 1 and 2 refer to the 'innovation gap' and 'translation gap', respectively. The examples of the areas of interventions in Figure 1 are given to strengthen the credibility of the model but are not necessarily accurate or up to date; however, they serve the purposes of this article.

This paper classifies the ecosystem types of Figure 1 and Figure 2 into three main categories:

(a) research ecosystems for basic and applied research and proof of concept;
(b) innovation ecosystems for validation, prototyping, early adoption in healthcare services, first customer;
(c) scaling up for clinical practice and wide commercialisation.

Each ecosystem type (hill) in the two-valley model represents a number of key features, for example different sets of attitudes, success factors, skills, competencies, experiences, connections, de facto incentives, perception of issues on intellectual property rights (IPRs), value of regulation, resources, etc. Typical performance metrics relevant for each of the three ecosystem types include the following.

(a) For the scientific community, the number of published scientific papers, patents and licensing agreements.
(b) For the user, health procurer and supplier communities in the key performance areas (KPAs, i.e. quality of healthcare, sustainability and economic value) are broken down into highly case-specific key performance indicators (KPIs). Any legal, regulatory certification and ethical issues may fall under the category of quality of care. Here the KPAs might only be addressed partially, and the risks are high and often mitigated by public and private financing. Failure to address any of the three KPAs as early in the innovation process as possible would lead to delays.
(c) For a community of political decision-makers and service providers (e.g. city and procurement hubs of university hospitals) that make large-scale deployments and investments in solutions and services by addressing big societal challenges, the full KPA metrics and maturity models on outcome and impact are developed and shared (see e.g. Mafeip [22]).

Importantly, the interrelationships between the ecosystem types are non-linear. There are cultural differences and conflicts between expectations (e.g. KPAs and KPIs) that need to be managed to bridge the innovation and translation gaps.

In simplistic terms these can be summarised as follows.

- The two-valley innovation chain model suggests the need to address all maturity levels for exploitation of the results of the research in a non-linear manner. However, the main limitation of that model is a lack of evolving system structure in different ecosystem types.

- The quadruple helix model suggests that the non-linear interdependencies between the four types of actors (academia, procurer, industry and user) should be in balance when optimising the resources and maximising the impact in professional collaborative networking, thematic CoPs, market sounding and knowledge-brokerage situations. Nevertheless, this model does not efficiently address bridges between the ecosystem types, for example the migration of competences along the innovation chain.

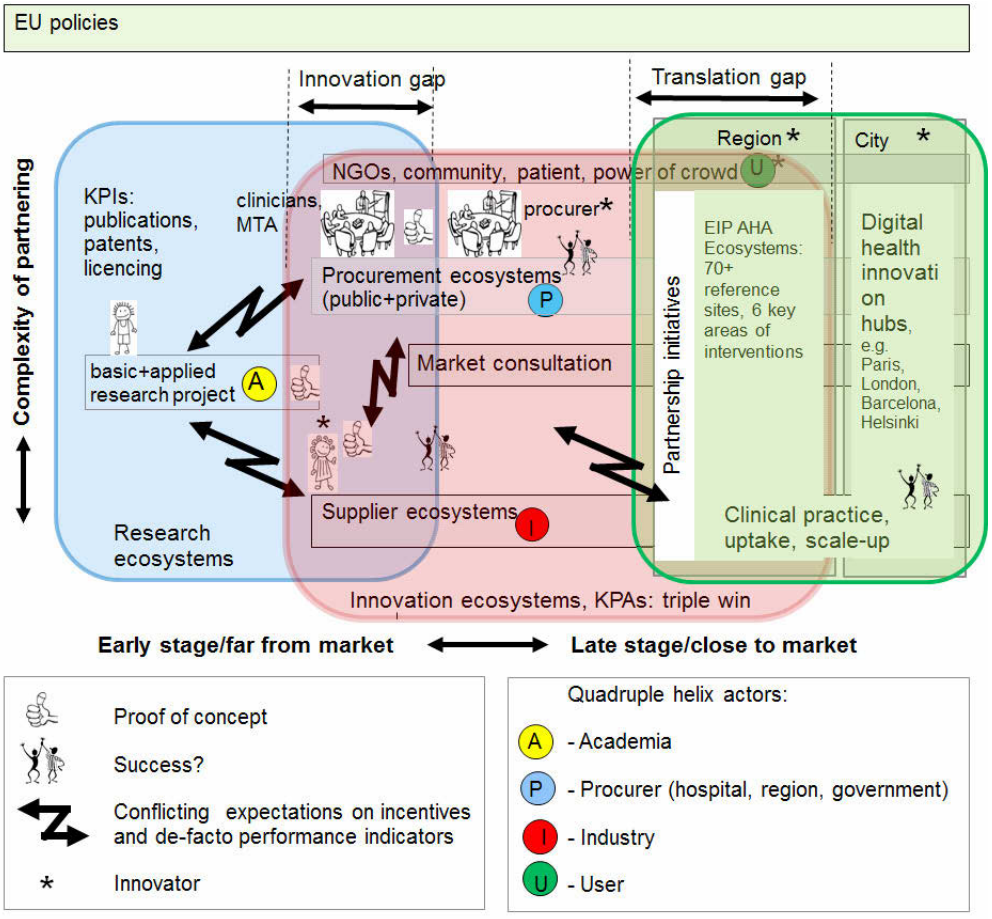
The combination of these two models paves the way towards non-linear multi-collaborative innovation ecosystems (Figure 3). Here the model can acquire competences from neighbouring ecosystem types and therefore dynamically renew the CoPs over time by providing a basic structure for collaboration between the actor types. The model is a map for growth situations and helps to understand the needs for appropriate framework conditions (e.g. metrics). It is important to note that one of the limitations of this model is the lack of detail to 'connect the dots' in real-world settings; however, this is the task of the actors themselves.

The choice of the quadruple helix model in this article is supported by a recent study conducted by the JRC [23] indicating clearly that high innovation-potential projects report overall the highest share of end-user engagement. The statistics were based on the responses to questions from the 'Innovation radar questionnaire' [24]. Further strong statistical evidence of the efficiency of user innovation in healthcare environments is described in a recent Swedish report [25]. The hospital clinicians are given access to 'makerspaces', i.e. staffed facilities with prototyping tools and the expertise in using them. Findings suggest that almost all innovations developed in the makerspaces are user innovations and that the potential returns in scale from the first 56 innovations developed in the makerspaces would be 30-80 times the required investment.

The non-linear multi-collaborative growth model (i) covers all maturity levels for exploitation of the results of the research for renewal over time, (ii) explains the non-linear interdependencies between the quadruple helix actors, (iii) optimises the use of resources by maximising impact and minimising the time to it and (iv) highlights the need for professional collaborative networking. These features are relevant for managing the expectations throughout the innovation chain and between the actor types.

The model of Figure 3 is characterised by the following interdependencies.

Figure 3: Schematic presentation of the non-linear multi-collaborative growth model consisting of two-valley innovation chain complemented by quadruple helix model/process. The examples are given for introductory purposes only. Abbreviations: MTA: medical technology assessment; KPI: key performance indicator; KPAs: key performance areas in triple win: quality of care, sustainability and economic value; NGO: non-governmental organisation



- Both collaborative policymaking and broad professional thematic collaborative networking are necessary to maximise systemic impact (e.g. between the quadruple helix actors and between the ecosystem types).

- Thematic or heuristic competences may migrate freely along the innovation chain and between the quadruple helix actors (e.g. from large-scale deployment to academic institution in a research ecosystem).

- Iterative feedback functionalities are necessary to speed up growth (e.g. knowledge brokerage between the procurer and the user or between academia and the supplier).

- It is difficult to see the full system impact and relevant priorities based on predetermined organisational contexts (e.g. line organisations of public administration or a narrow technology silo as a starting point for development of the unmet need by the procurer and user communities).

- The speed of progress is proportional to the complexity of partnering and collaborative policymaking (e.g. fast prototyping for early adoption differs from large-scale deployment).

- The institutional framework conditions of the European Commission should integrate all systemic aspects (e.g. measuring the performance based on non-linear metrics).

- Any business model can be mapped against the model (e.g. B2C, R2B, B2P2R, etc.), following the cascaded knowledge-brokerage situations (Z-shaped arrows that are a graphical representation of non-linear interactions or diverging expectations on incentives).

Based on these characteristics we can demonstrate that a linear exploitation model of research results represents only unilateral communication and/or dissemination, but not knowledge brokerage, which is a necessary element to set realistic expectations and address growth. The linear models (e.g. as designed separately from the demand/supply sides or academic perspectives only) have been widely criticised as too simplistic to describe the complexity and diversity of the innovation process [2]. This suggests that an integral collaboration in a well-networked ecosystem with legitimate incentives is necessary once the underlying science is solid and proven.

Therefore, to ensure positive systemic impact all framework conditions related to the thematic KPAs, collaboration and communication infrastructures must facilitate feedback loops that provide relevant challenges to the less mature segment in the innovation chain.

Mapping key areas of intervention and incentives

The European innovation partnerships sit well with the logic of broader networks as a key success factor for an innovative Europe. Yet they will need to be open by design to smart regions, Horizon 2020 teams, European Institute of Innovation and Technology communities, etc. [2]. A European Innovation Partnership is not by nature open to all the developments because large-scale investments require rigorous financial risk management that filters out those themes and actors that are positioned low in the innovation chain. Nevertheless, scientific excellence, suppliers' development efforts and early adoption are essential prerequisites for renewal and future large-scale deployments of solutions and services in healthcare settings. Therefore, it is important to nurture related ecosystem types as well. Professionals should be incentivised contributing to the broader development in the innovation chain, for example covering concept development, culture to foster IPRs, standardisation and regulation.

Figure 3 can be simplified with three concrete health-service demand-driven examples (use cases) under qualified key areas of intervention (i.e. diagnosing, mental health and ageing) in the innovation chain (see Figure 4).

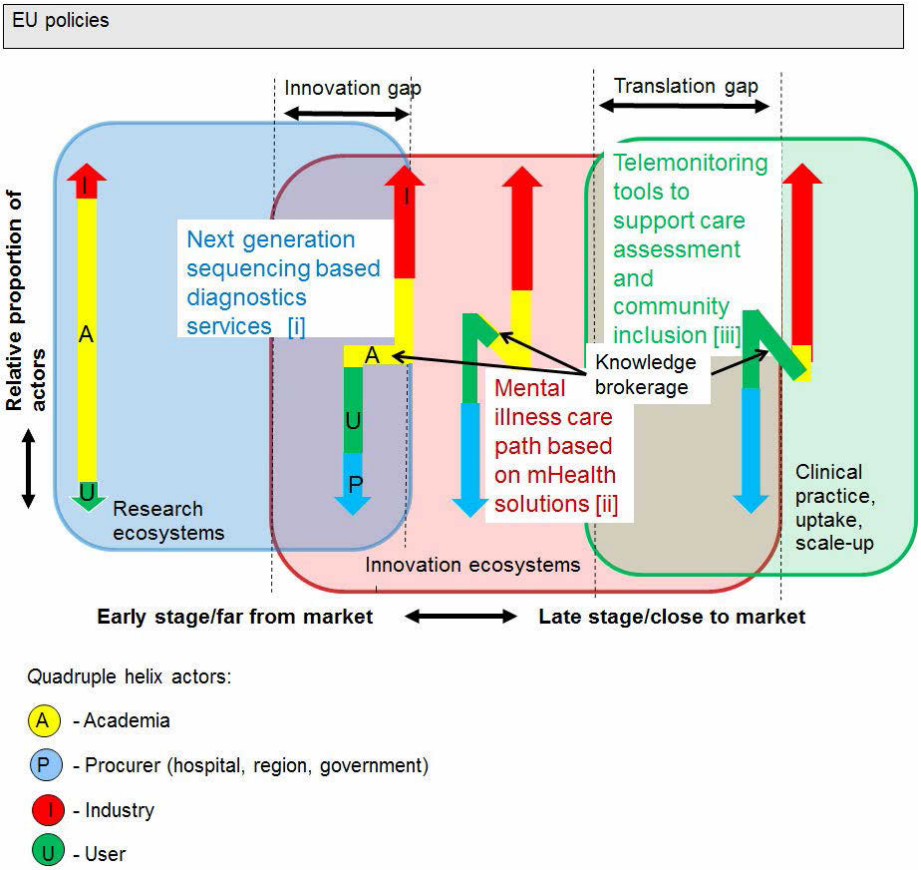
The Z-shape in vertical arrows in Figure 4 is a graphical representation of the market brokerage situation (non-linear process) between the quadruple helix actors. The straight vertical arrow on the left represents a traditional collaborative research with all actors involved but linearly targeting a proof of concept. The colours in the arrows demonstrate an indicative proportion of all four stakeholder groups in the quadruple helix at different maturity levels. The proportion of academic partners providing scientific value is high in the lower part of the maturity axis (straight arrow), while the commitment and leadership of procurers, industries and users increases when the innovation value and time to impact becomes more critical. The level of knowledge brokerage and market consultation increase respectively.

Three use cases in Figure 4 have been selected to illustrate the knowledge-brokerage situation between supply and demand within each selected key area of intervention (i.e. diagnosing, mental health and integrated care services).

A use case [i] in next-generation sequencing in key areas of diagnosing is on the verge of entering the innovation ecosystem in tertiary care [26]. There is

Figure 4: Approximate positioning of three use cases of health services under qualified key areas of intervention in the maturity context of the multi-collaborative growth model of Figure 3

[i] Fast diagnostics services: next-generation sequencing [26].
[ii] Mental health services: mental-illness care path using m-health solutions [27].
[iii] Integrated care services: telemonitoring tools to support care assessment and community inclusion for older people and those living with long-term conditions [28].



a strong scientific background and the time appears ripe for building the path to national deployment. Another use case [ii] in mental health is a service that uses a mobile app to improve the care path [27]. Early adoption has taken place and the first contracts between the health-service providers and the supplier have been established. The third example [iii] is related to the large-scale deployment within the European Innovation Partnership on Active and Healthy Ageing [28]. The National Health Service in Scotland aims to provide a more preventative and proactive approach, supplemented with telemonitoring tools to support care assessment and community inclusion for older people and those living with long-term conditions.

Migration of competencies of people along the innovation chain

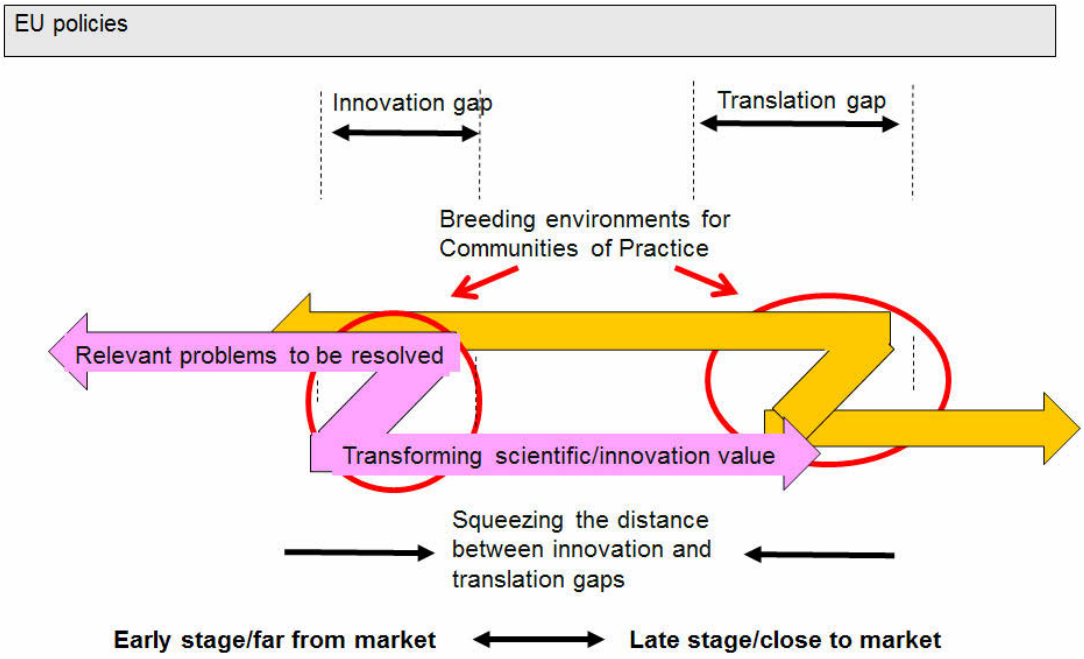
Based on current knowledge management theory and practice it is now a widely accepted principle that the effective establishment of a dynamic CoP requires an underlying virtual breeding environment (or cluster network) [29] consisting of a balanced set of professionals including policymakers. Therefore, Figure 4 can be developed further (see Figure 5) to represent a schematic view of the migration of scientific/innovation value and relevance across the innovation chain based on people's competences.

It can be deduced from Figure 5 that there is an opportunity to open programmes and partnership initiatives to people across the innovation chain using the full capacity of thematic competencies — in the best cases between the two breeding environments as well. The distance between the two gaps should be squeezed and development accelerated.

In simplistic terms the fundamental difference between the multi- and single-policy/strategy approaches are as follows.

- For multi-policy/strategy approaches integrated policies, centralised decision-making and priorities facilitate free access to people's competences and address special aspects of growth

Figure 5: Schematic presentation of the migration of knowledge (scientific or innovation value and relevance) along the innovation chain of Figures 1-4. All quadruple helix actors are involved. The two breeding environments create temporary CoPs that address the knowledge brokerage dynamically. The Z-shape of the arrows is a graphical representation of a non-linear process (or knowledge brokerage). All measures that squeeze the distance between the innovation and translation gaps are useful to speed up the adoption and scale



across the innovation chain. The needs of the users and other demand-side actors define the key areas of interventions or challenges in appropriate knowledge-brokerage settings with respective ecosystems leading to win-win situations.

- Single-policy/strategy approaches can resolve common issues within the policy priorities of the cluster based on static plans (e.g. expanding technology offerings or specific regulation). The ability to acquire competencies and set relevant priorities that realistically address the key health and care challenges and growth in the innovation chain is limited because of the imbalanced incentives of actors and narrow feedback loops. This situation can be perceived as a high-cost systemic failure in terms of impact.

The two breeding environments for dynamic CoPs in Figure 5 address innovation and translation gaps. The incentives to operate the two environments are fundamentally different for the following reasons.

- The early adopters and suppliers take on board new scientific results with high growth potential addressing the innovation gap. The higher risks are often mitigated by substantial risk funding by public agencies and private investors. An indicative time frame for early adoption is usually short, 1-2 years, and if successful for large-scale deployment, typically 3-5 years.

- The policy priorities (i.e. key areas of intervention) in the translation gap are ranked based on rigorous economic risk management of large-scale investments, including full triple-win analysis of KPAs and their case-specific KPIs. For large-scale deployment an indicative time horizon for scaling up innovation/improvement is typically 1-2 years, which filters out innovations that are too risky.

Therefore, one of the key roles of the institutional support is to facilitate a framework that squeezes the distance between the innovation and translation gaps and takes on board the whole innovation chain. This would include the breeding environments and their temporary CoPs, for example by providing critical mass for both market consultation and migration of thematic competences.

Some such breeding environments for CoPs or clusters can already be identified. An example of a breeding environment addressing the translation

gap in Europe is the activity of a large number of regions, other decision-makers and stakeholders that resulted in the European Innovation Partnership on Active and Healthy Ageing. Six qualified themes and respective action groups (or CoPs) were originally selected and more are under preparation [30] by mapping the demand and supply. Two other examples of health-sector-specific breeding environments addressing both innovation and translation gaps and prioritising qualified themes are the European Procurers Platform — eHealth — Transforming the market for eHealth Solutions [13] and the International Network Supporting Procurement of Innovation via Resources and Education [31]. They have consulted many stakeholders in healthcare delivery from both the demand and the supply sides, for example by defining joint statements of unmet needs.

Insofar as opportunities at the European Commission are concerned, the thematic CoPs and professional networks that uphold the priorities of the European Commission and link them to decision-making processes [1] could serve the purpose of improving the expected impact of the research and innovation investments. It appears that more concerted efforts are needed in terms of internal and external collaborative policymaking, networking, knowledge management and innovation acceleration, nurturing and breeding environments to cover the whole spectrum of scientific areas. To maximise efficiency the focus should be on frameworks that support, analyse and synthesise relevant thematic CoPs rather than on narrow single-policy issues with unclear KPAs insufficiently bridged with key areas of intervention.

One of the main roles of a breeding environment is to facilitate the rapid creation of temporary CoPs. They could evolve into collaborative innovation projects or key areas of interventions in large-scale deployment activities.

Collaborative policymaking and design [32] that address growth and uptake should be at the core of thematic breeding environments. This closes the feedback loop between research and innovation investments. Failing to acknowledge the importance of collaborative policymaking has negative consequences, including unbalanced priority settings, inflated resources and unrealistic expectations on impact down to practical micro levels. The efficiency of multi-policy/strategy approaches obviously relies on knowledge brokerage between a very broad set of different demand- and supply-side actors. Hence a broad 'bandwidth' of actors, but thematically prioritised and therefore thin consultation in breeding environments, would safeguard the manageable creation of new relevant themes over time. Single-policy/strategy approaches may lead to relevant demand/supply knowledge brokerage as well, but tend to move towards historical static linear plans [2, p. 301]. This limits growth, agility and renewal by design. Single-policy/strategy approaches may also lead to an inventory of a number of choices being unable to lead to the most useful priorities for the ecosystem. Even disruptive technologies and related ecosystems would benefit from collaborative policymaking.

Since healthcare falls under the competence of the Member States as per the Lisbon Treaty [33], European Commission support cannot directly address operational healthcare services. Therefore, the centre of gravity of Commission financial support in the framework programmes is naturally lower in the innovation chain. However, ecosystem-centric large partnership initiatives (e.g. public–private partnerships or European innovation partnerships) have significant potential to be promoted by the European Commission and they may create relevant challenges to be solved in the thematic innovation and research ecosystems.

Hence, from these findings, supported by examples based on secondary evidence, growth obviously happens in the innovation chain when the unmet needs are met in market consultation and the competencies migrate freely in broad knowledge-brokerage settings between the ecosystem types in agile CoPs and their underlying breeding environments. This free migration can only happen when the policies serve legitimate purposes within important societal challenges.

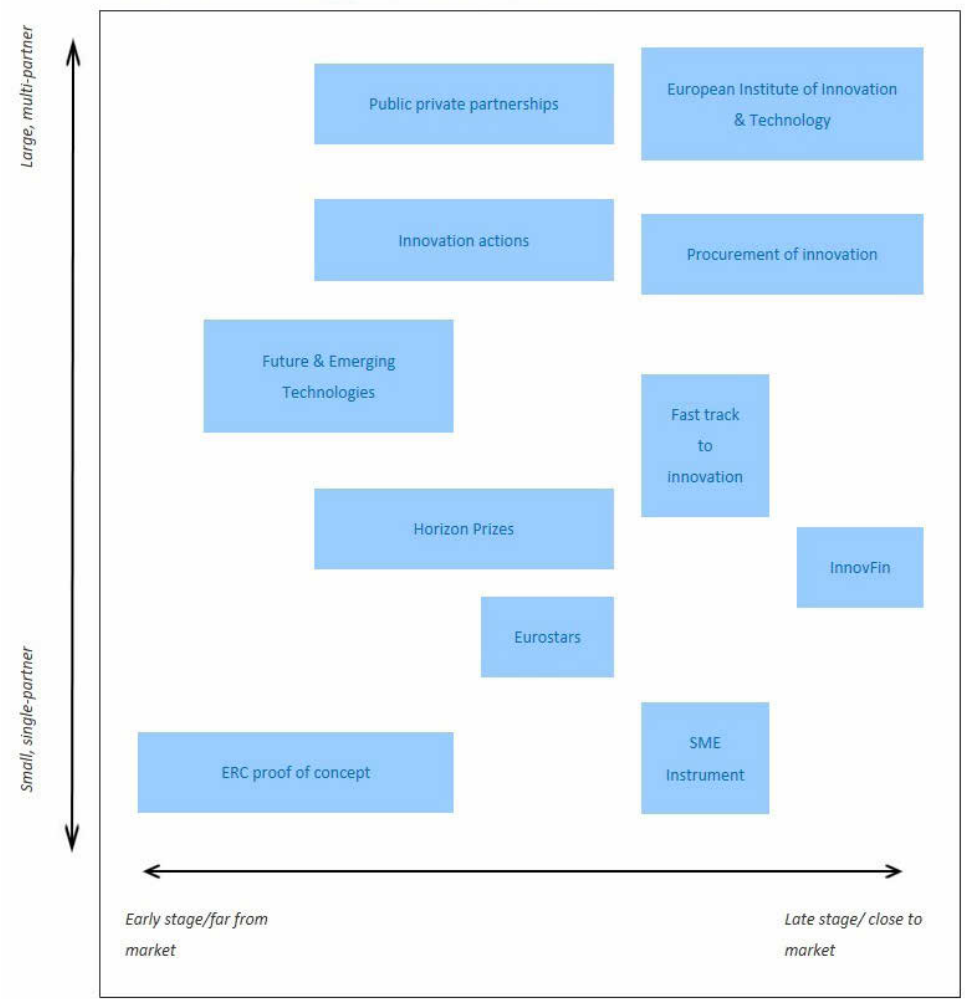
To facilitate EU-wide growth, various measures are needed to bridge agile knowledge brokerage and public financial support which will be discussed in the following sections.

Mapping the multi-collaborative growth model with European Commission innovation support in Horizon 2020

In accordance with the European Innovation Council background information [34], innovation is supported by 11 instruments in the Horizon 2020 programme as mapped in Figure 6.

Because the locations of each instrument in Figure 6 are suggestive there is considerable flexibility to use one or several instruments for a single challenge. Of course, no accurate mapping between the systemic views of Figures 1-3 and the view of the financial instruments in Figure 6 can be deduced. Furthermore, the overview of the innovation support does not fully provide an understanding of the mappings in the functional view of Figure 3 context. However,

Figure 6: Overview of innovation support in Horizon 2020



some critical observations and correlations can be identified, including the following.

- The functional view of Figures 1-3 defines what instruments or combinations of them are relevant for specific situations in the maturity axis — not vice versa.

- The instruments and the specific topic-related conditions written into the European Commission Horizon 2020 work programme fine-tune the actual position of the topic in the presented model.

- In order to avoid an arbitrary selection of the instrument it is necessary to understand very early in the process the level of maturity of the topic inside the theme (or the key area of intervention) and the anticipated primary target group in the systemic context.

- Research and innovation actions (RIAs) support traditional linear basic and applied collaborative research, including scientific excellence and proof of concept. However, RIAs support neither any established innovation system nor open innovation principles by design, and are therefore not particularly optimised to address the KPAs of the innovation and translation gaps. The market consultation does not take place during the project by default. However, if the innovators in an RIA project are already well networked with the ecosystem higher in the innovation chain then growth potential exists. Generally there is a low risk of not meeting the proof of concept and administrative objectives but a high risk of not overcoming the innovation and translation gaps resulting in the expected impact.

- Innovation procurement [35] instruments support triple and quadruple helix approaches and empower clinicians and health procurers to tackle needs in a selected key area of

intervention that addresses specific health-service-related KPAs and KPIs for business in a consultation process. These instruments do not explicitly address the incentives of users (e.g. patients and clinicians) by design, which is a shortcoming that should be carefully mitigated in each case.

- Since innovation procurement addresses service- and supplier-related KPIs in knowledge-brokerage settings there is a higher chance for positive impact than in the collaborative research instruments (e.g. RIAs) from the systemic perspective. Innovation procurement, and in particular pre-commercial procurement, is in principle a very beneficial instrument for SMEs in healthcare settings because of the existing demand for the developed or purchased innovative solutions. This is evidenced by the historically large participation of SMEs (71 %) in the winning tenders [36] in European Commission-funded pre-commercial procurement projects.

- Innovation actions can typically target large-scale deployment and the translation gap when the unmet need is very well understood and an industrial contribution could realistically be expected to lead to measurable service- and business-level KPIs.

- Coordination and support actions can be used flexibly to support thematic approaches. A well-designed coordination and support action involving all ecosystem actors could provide a long-term strategic breeding environment, managing expectations, creating and supporting relevant CoPs and addressing gaps.

- The SME instrument is a good add-on to the systemic picture if the unmet needs are well understood and consulted.

- The scientific/innovation challenge defines its position in the functional view followed by a well-designed architecture of instruments. They should not be mapped as such to the functional view of Figure 3.

- In order to facilitate multi-policy/strategy development some budget should be allocated to legitimate multi-policy themes (e.g. to the operation/nurturing of environments for CoPs).

To be able to use the instruments effectively to address the KPAs and underlying KPIs it is necessary to understand each specific thematic situation in the systemic context. It is also important to understand any shortcomings of the instruments in terms of innovation and its impact, which can be undertaken by means of systematic assessment. From the systemic perspective, administrative success and proof of concept are necessary, but are insufficient to address growth aspects related to transformation of innovation to clinical practices and economic value, including first customers. A well-justified selection/combination of instruments relates clearly to the overall performances of the institutions as well.

While the findings of the previous section elaborate the systemic prerequisites for growth in a multi-collaborative model, this section discusses how the financial instruments can fit into the picture. From the systemic point of view, to implement an integrated multi-policy/strategy it is necessary to establish a multi-collaborative environment. Therefore the design of financial support is critical, and may need concept development for a multi-instrument approach to improve speed to impact by bridging different ecosystem types in the innovation chain. An obvious starting point is to get different instruments to work together on given key areas of interventions in one or more ecosystem types.

Using the multi-collaborative model to bridge policy/strategy development, financial support and new ways of working

Given the two central aims — that key European Commission policies and strategies should support growth in the health sector across the innovation chain, maximising the expected impact, and that the communication on knowledge management at the European Commission [1] is an adopted position facilitating professional collaborative networking and thematic CoPs — the multi-collaborative model reveals the following.

- An integrated balanced multi-policy, multi-strategy, purpose-driven environment appears necessary to set relevant legitimate goals and to facilitate easy migration of the thematic (or even heuristic) competencies across the innovation chain. This approach would facilitate addressing large challenges in the health sector and is an area of future investigation.
- The roles of the actors and systemic interdependencies across the innovation chain of Figure 3 become evident.
- A well-developed taxonomy and mapping of pertinent themes, topics and issues against the growth model is necessary to assist Commission services and external actors to better set short- and long-term goals and to collaborate. The roles of the actors, including the European Commission, should be established in the highly non-linear environment of innovation support, for example by introducing new ways to use the

financial instruments or assisting the market to have improved access to relevant competencies across the innovation chain.

- The multi-collaborative growth model in Figure 3 sets a simple and flexible functional foundation for the use of public funding instruments (e.g. the Commission's Horizon 2020 framework programme). They should be used holistically as part of the case-specific architectures that support the internal/external CoPs by design.
- In general, any issues related to the key challenges or needs can be mapped in the growth context thematically, for example by regulatory, standards, IPRs, etc. benefiting the actors in their own ecosystem.
- The external/internal CoPs and underlying breeding environments should be given a relative autonomy to make progress and to avoid those historical monoculture processes that compromise the impact.

Further findings concerning CoPs

- The need for a federated institutional approach, including the creation of institution internal and external breeding environment(s) for temporary CoPs, is emerging. This could speed up innovation and scaling, improve the opportunities for renewal over time and lessen the risks of static plans.

- Thematic CoPs and professional networks that uphold the priorities of the European Commission and link them to decision-making processes should be established with jointly agreed key priorities and purposes.

- The communication structure facilitates integrity and addresses KPAs that are critical to make progress in healthcare delivery settings. The impacts and multiplication factors could be improved by working on common challenges.

- The external CoPs could nurture ecosystem-specific growth/innovation accelerators (e.g. for SMEs, demand-side actors and academic clusters). These clusters/accelerators should be complemented by Commission internal CoPs to facilitate better migration of competencies by compatible streamlined governance practices.

- Therefore, the knowledge management methodologies and lessons learned for professional collaborative networking should be fully taken on board in health-sector research and innovation activities, for example convening mechanisms, events and social engineering, by defining a common taxonomy for knowledge management in health, ICT and other related applicable sectors, connecting the right people with ideas, piloting and defining case-specific metrics.

Conclusions and recommendations

The presented robust multi-collaborative growth model can be used to optimise integrated policy/strategy and Commission financial and collaborative networking support by providing a structure for decision-making processes and a rationale for professional collaborative networking. The model helps bridge the EU policies with Commission innovation support in framework programmes and partnership initiatives.

The model reveals that the growth potential is improved when the legitimate unmet needs of health-service providers and users are addressed. The support is optimised for all actors in their own ecosystem type (research, innovation and scale of clinical practice) and the competencies can migrate freely between those types. It is suggested that an integrated policy/strategy approach facilitates better prioritisation and incentives for people to interact with relevant ecosystem actors than in the single-policy/strategy approach. This points to new working methods, i.e. the creation of breeding environments of a more permanent nature that establish temporary CoPs. This would facilitate the renewal of themes over time, minimising the shortcomings of static linear plans.

Furthermore, the model suggests that once solid scientific evidence exists the Commission policies/strategies should support the early adoption and upscaling of business solutions in the respective healthcare service ecosystems. Therefore, in those cases financial support should be designed as an architecture of instruments matching with the presented growth model, not piecemeal as could be the case in single-policy/strategy topics. To fill in important gaps a sufficient level of collaborative policy/strategy-making, knowledge sharing, joint decisions and dedicated budget are necessary to address large health and care challenges, regardless of the scale and maturity level. Of course, it must be recognised that the development and application of instruments and models of growth are not simply technical processes but are framed by wider cultural, economic and political contexts [37].

The findings are validated in six practical examples in the healthcare sector. Additionally, three examples of integrated multi-policies and strategies complementing single-policy approaches are given at national, local and EU levels to support the credibility of the rationale presented in this paper. The findings support the recent efforts

calling for knowledge sharing and collaborative innovation [38].

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Article 10

Service innovation dynamics towards open and social innovation

Introduction

This chapter explains how service innovation is becoming more open and more social. Building on some examples of services becoming open and social (Section 1), the linkages between service innovation and both open innovation and social innovation are presented (Sections 2 and 3, respectively), leading to a multi-agent model for service innovation in an open and social context (Section 4). The chapter concludes with some final comments and policy implications (Section 5).

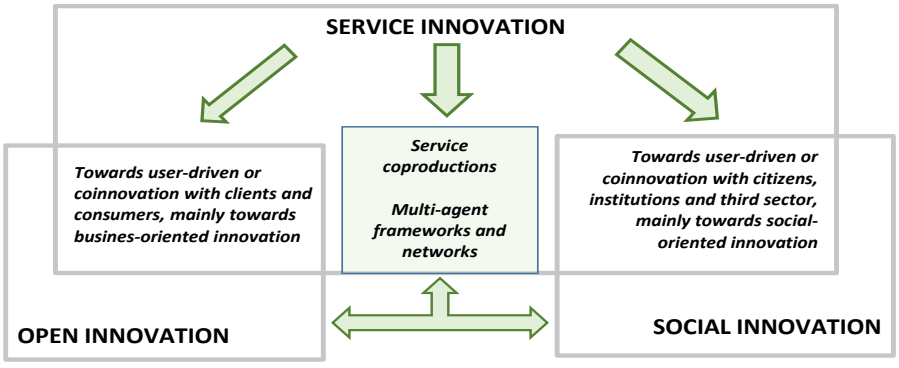
Services becoming open and social

Pioneering forms of innovation are arising in parallel to the vast plethora of economic, societal and technological changes stirring our increasingly hyperconnected world, which, in contrast to what occurred in the past where innovation mainly served the process of industrialisation, are making citizens' needs, well-being and quality of life the centre and main focus of most innovations currently taking place. This explains why innovation is increasingly being targeted at addressing major social needs and challenges, such as population ageing, social exclusion, health and education, promotion of well-being and climate change. In this context, current innovation dynamics are much more open; users take a leading role and different organisations in the socioeconomic systems are fully engaged. They transcend the traditional (technoeconomic) understanding of innovation, and new practices such as personal fabrication, open innovation, user innovation, design innovation, community innovation, crowd sourcing, etc. have gained momentum. In parallel, the traditional linear innovation processes are being outplaced or complemented with new innovation modes within more complex innovation systems. In this context, three major new ways of innovation have emerged in recent years or decades.

- Service innovation, as the necessary complement to the most traditional technological goods innovations, enabling the creation of new intangibles, and combinations of tangibles and intangibles, to increase growth and welfare in society. Increasing societal needs and challenges require new or improved services.
- Open innovation, as a business model that facilitates knowledge and technology transfers across organisational boundaries, where innovation is the result of applying both internal and external ideas and resources, thus highlighting the cooperative and collective nature of innovation.
- Social innovation, as a new way of generating innovation processes oriented to social goals, implying the involvement of social actors. Here, different roles and new modes of interaction broaden innovation solely out from the economic domain to also include the social and public domains [1].

Figure 1 below illustrates the interrelated nature of these three major forms of innovation: service

Figure 1: Bridging service, social and open innovation



innovation, open innovation and social innovation. As can be seen, the three phenomena may be considered to be different angles from which to approach innovation in a connected way. In fact, when assessing one of the three in depth, we arrive at the other two. For example, innovating in ways that deliver better services and social welfare coincides with the growing demand of citizens to be fully involved in finding collective solutions to social issues (i.e. service and social innovation become open). The concepts of co-creation/co-production and user-driven innovation are the foundations of a shared conceptual framework, as highlighted by the figure. The approach is also multi-agent, as it takes into account the role of voluntary groups, third-sector (non-profit) and social organisations, public-sector institutions and private-sector businesses to consider innovation in user-led market and non-market goods and services. The multi-agent framework is useful to define innovative service co-productions, as it involves the potential to understand the engagement of society and the ample constellation of relationships created around the set of agents involved in different kinds of co-production/co-innovation processes.

Examples of how service innovation is becoming more open and more social abound. In fact, for clarity's sake, it is possible to classify them under three different categories of cases showing that service innovation has become (i) more open, (ii) more social and (iii) both more open and more social. The literature has often provided examples of open innovation in services, like the ones included in Chesbrough in 2011 [2]. He compares the case of Lego, which followed an outside-in strategy, welcoming new external contributions for design and eventually leading a new service industry related to the teaching of robotics using Lego, to the case of Amazon, which followed an inside-out strategy, welcoming revenues from external use of a company's knowledge through helping retailers to have their own internet retailing and offering customers the use of cloud computing. Other examples of open innovation in services can be found in the creation of living labs by telecommunication companies for physical places where client engagement is produced to design new service experiences; in transport apps where collective co-creation is needed — the already classic examples of Waze, Uber, Car2Go, etc.; or in the use of big data in innovation strategies by sectors such as banking, retail, transportation and health.

Examples of services becoming social innovations can also be found in many sectors and areas, but in particular those related to social services, smart cities-related services, tourism innovation in rural areas, energy efficiency, and transport and logistics. Many public–private third-sector innovation services in Europe can be considered to be social innovations to a large extent [3]. In the developing world there are some paradigmatic examples, such as the case of M-PESA, a world-leading mobile-money system operated by Safaricom, Kenya's largest cellular network, becoming a general money-transfer scheme, useful in countries where many workers in cities send money back home to their families living in rural villages.

There are also examples of service innovation that are both open and social. This happens in the creation of implementation of innovation in rural areas, where the transformation of farm areas into tourist destinations involves an open, wide-ranging effort to have local communities leading the change process with the co-innovation support of many agents in the innovation system. Another good example of how service innovation has become more open and more social at the same time can be found in the educational sector, in the form of massive open online courses (MOOCs), summarised in Box 1.

BOX 1: The MOOCs case of social and open service innovation

MOOCs are a relatively recent innovation (some early experiences were undertaken in 2006-2008, though the first major MOOC was delivered by Stanford Professors S. Thrun and P. Norvig in 2011, when they taught an artificial intelligence course at Stanford that drew 160 000 online registrants) that has attracted a great deal of attention recently and became the educational buzzword in 2012 [4]. The emergence of MOOCs has opened strategic discussions about the disruptive innovative character [5], as for some scholars MOOCs seem to be heralding a change in the educational landscape that poses a real threat to the current models of provisioning degree courses. Beyond this particular consideration, there is no doubt that MOOCs can be considered both an open and a social innovation. Even though the origins of MOOCs can be traced to the open education movement, embodied by the development and adoption of open educational resources, what makes them embrace the concept of open innovation fully is the way that different actors engage in the learning experience, thus influencing the learning outcome. MOOCs have come to break the linear learning scheme of the past, in which learning was mainly a (unidirectional) process of knowledge transmission, to promote a different learning experience. In this different experience the learners are members of a learning community, and the final educational outcome is the result of infinite interactions provided by different members of the community (not only learners but also tutors and curators, amongst others) who engage in a myriad of co-creation processes mainly channelled by virtual platforms. The interactive character of learning is regarded as highly valuable by participants [6]. As a paradigmatic case of social innovation, MOOCs courses are offered free of charge, to any number of people, anywhere and anytime, and enable access to higher education and beyond for people who cannot afford a formal education and are disadvantaged. In this respect MOOCs can be regarded as contributing to the democratisation of education [7]. In addition, they can reduce the mismatching of skills and aptitudes and the needs of the industry sector in many countries. This disconnect is fostering huge unemployment amongst youths and adults, and particularly among vulnerable groups. MOOCs can be useful in providing job-oriented training and skills development, and a number of policies and initiatives in certain developing countries are emerging to strategically leverage online learning, including MOOCs, for workforce development and upskilling programmes.

Bridging services and open innovation

Innovation is changing rapidly, becoming increasingly distributed. In today's complex world, a single organisation faces increasing difficulties in conducting innovation in isolation, which makes the centralised, inward-looking approach to innovation inefficient. As a result, the use of collaborative and open approaches to innovation has increased, based upon the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for the external use of innovation [8]. This trend for increasing openness in the innovation process of organisations has also been supported by other factors such as the institutionalisation of the information society, the rise in the mobility of qualified workers across firms' boundaries, a decrease in the productivity of the innovation process and the rise in the number of technological options and opportunities to be exploited externally. Openness involves information and knowledge being approached from external as well as internal sources, but equally importantly, valuable ideas can leave the innovation process at any stage. Despite a certain conceptual ambiguity about the term, openness is thought to be mostly approached through the formation of alliances and partnerships with private organisations and with the scientific and technological system, benefiting from sharing of knowledge and spillovers, licensing intellectual property, launching new spin-off companies and developing mergers and acquisitions.

Innovation scholars have long highlighted the collective nature of the innovation process. Accordingly, the open innovation model chimes, among other things, with previous research on systems of innovation (as firms rarely innovated in isolation from the economic system), on strategic cooperation (where private and public organisations seek to generate synergies and cross-fertilisation effects by pooling their complementary assets), on absorptive capacity (as firms are critically reliant on recognising, adopting and exploiting external knowledge) and on user-developed innovations (by recognising users as fundamental contributors to innovations in many different sectors). The definition of open innovation also allows us to underline how previous related concepts from the service innovation discipline reflect central aspects of the model, as in the case of the multi-agent framework, which enables explicit consideration of the characteristics of economic agents and of their interaction in the processes of co-creation and diffusion of service innovations. From this perspective, service innovation is seen as an interactive process in which multiple actors play a role.

Open innovation is a relevant dimension for service firms. However, as a result of the traditional association between in-house R & D development and innovation performance, the initial discussion around the open innovation model placed the focus more on product and technology innovation than on service innovation [2]. Most research works were intended for large technology-based companies, where the notion first started, leaving service innovation partially overlooked in the open innovation-related literature. Service innovation scholars amply emphasised this product-technological myopia. R & D expenditure is highly concentrated in just a few firms, most of which have formal and distinct R & D departments, an organisational arrangement that is uncommon in the service sector [9]. The typically used R & D-related measures were rather simplistic and under-reported the innovation activities of many small firms and service providers, which rarely engaged in formal R & D processes. Given the relatively low intensity of R & D in most service companies [10], the open innovation model also emerged as a more plausible response to the innovation process in services (i.e. business services) because of the increased possibility of using external sources as innovation inputs.

Around a decade after Chesbrough's (2003) conceptualisation of open innovation, the open innovation 2.0 paradigm (OI2 onwards) emerged as an innovation model based on extensive networking and co-creative collaboration between all actors in society (civil, academic, business and government) to drive structural changes [11] around cultivated innovation ecosystems in search of shared value and enabled by the collision of three megatrends: digitisation, mass collaboration and sustainability. Although broadening innovation networks increases the likelihood of finding innovative solutions, the wide-ranging feature of networking may not be the only fundamental attribute to bear in mind. As a consequence of dealing with increased external contacts, firms face organisational and cultural issues. Understanding service networks (i.e. interdependencies between the multiplicity of actors and stakeholders and the distribution of tasks or services) adds a level of complexity to the phenomenon. Therefore, networking behaviour, instead of extensive networking, may be the key characteristic for success. In this respect, over-searching, by spending too much time looking for external sources of information and knowledge, may lead to inferior innovation performance. In other words, wide and deep searches for sources of information and knowledge may be curvilinearly related to innovative performance. While there may be a positive initial effect on openness, firms can over-search or come to rely too heavily on external sources.

Moreover, within this OI2 model, citizens and users (adopters of the innovation) are thought to take a prominent role as active and integral participants and contributors throughout the whole innovation process in the co-creation of solutions that meet their needs. This again links the OI2 model with the

service innovation discipline, as the latter has traditionally considered users (customers) one of the basic, inherent and most common partnerships for service innovation. Service innovations often arise from the close collaboration between the service provider and its customers, as person-to-person interaction is a constitutive element of the service provision itself. Service innovation is to a large extent user-driven, and directed towards providing a specific user experience [12].

As service complexity rises the user becomes a co-producer of a service innovation. The interaction required in service co-production leads citizens and users no longer to serve as mere suppliers of information but as key contributors of innovation. Effective service innovation would therefore require citizens and users to be a fundamental part of innovation ecosystems, which allow creativity beyond organisational boundaries to be shared and applied through a co-creation process of innovation. This would lead organisations to adopt novel structures and to develop new abilities designed to face emerging issues (i.e. the trade-off between personalised services and asset-based services; networking governance; or the exploitation of the present and future ICT environment in the provision of public e-services).

Bridging service and social innovation

Some of the definitions of social innovation pinpoint services as just one possible outcome among others that include products, models and processes. As an example, for the TEPSIE project (2013) [13], social innovations are those that are good for society, enhance society's capacity to act and present some particular features (e.g. novelty, implementation rather than merely development of new ideas, meeting social needs, effectiveness, empowerment).

Nevertheless, the service-dominant logic, which highlights the service function incorporated in every product [14,15], opens the door to regarding services as a dimension of the nature and outcome of any social innovation. This is somewhat similar to the approach followed by international policy organisations that have defined the concept of social innovation. Hence, the 2000 Organisation for Economic Cooperation and Development (OECD) LEED Forum on Social Innovation [16] stated that 'Social innovators identify and deliver new services that improve the quality of life of individuals and communities, using innovative processes aiming for instance at new labour market integration, social inclusion, finding new ways to address healthcare, education delivery, resource efficiency and environmental challenges', in the same vein as the European Commission in 2011 [17]. For the OECD, social innovation 'seeks new answers to social problems by: identifying and delivering new services that improve the quality of life of individuals and communities; identifying and implementing new labour market integration processes, new competencies, new jobs, and new forms of participation, as diverse elements that each contribute to improving the position of individuals in the workforce.' As can be seen, both definitions consider services to be the outcome of social innovations. This is somewhat surprising as services are generally excluded from the definitions of social innovation (or they are considered just a part of them), but it is entirely justified on the grounds that new services are delivered targeted at improving the quality of life of individuals and communities. In fact, services are areas where many social innovations take place. Most relevant examples of social innovation are implemented in services sectors, such as health (e.g. preventive treatment), education (e.g. new pedagogic techniques), financial services (e.g. microfinance, mobile banking, financial inclusion, cryptocurrencies), ICT services (e.g. services based on social networks), tourism (e.g. rural tourism initiatives), social services (e.g. innovations for inclusion) or environmental services (e.g. smart cities).

Furthermore, the linkages between services/service innovation and social innovation are not restricted to outcomes. Other elements may also be included such as the inputs for social innovation and the participatory process of social innovation in service co-productions.

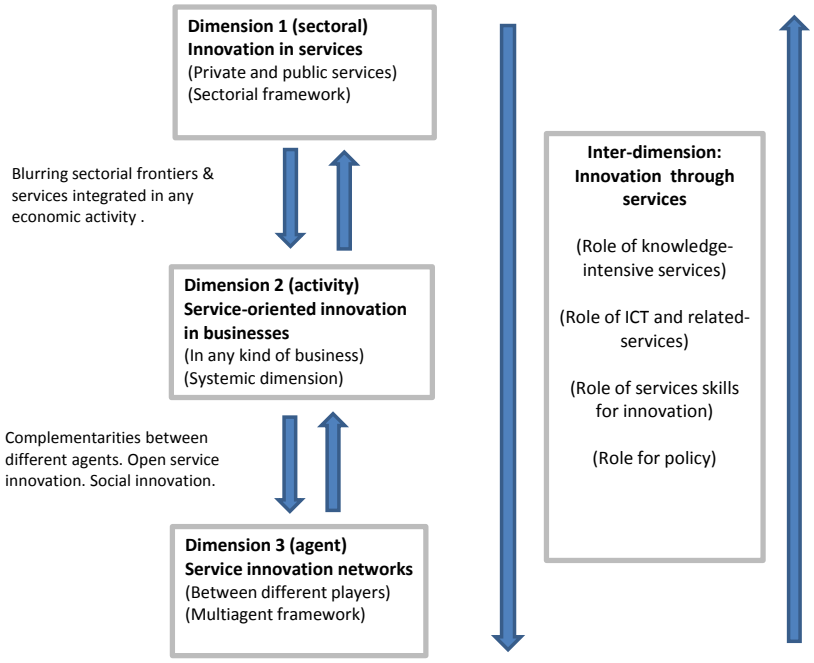
Regarding services as inputs for social innovation, service innovation can be considered a dimension that lies behind any social innovation process. Knowledge-intensive services are a case in point, because, as sources of service innovation, they ultimately play a facilitating role in both the creation and the implementation of social innovations, be they in the private sector, the public sector, the third sector or organisations in general, and including the participation of citizens.

Finally, regarding service co-production, the participatory nature of service innovation is conducive to social innovation. A certain level of service co-production by users is required for the participatory processes characterising social innovation to take place. The following section explores the role of co-production in bridging the concepts of social and service innovation with open innovation by exploring a multi-agent model.

Service innovation in multi-agent frameworks

Co-production is also fundamental when explaining social innovation as a particular case of service innovation, and facilitates the introduction of the open innovation concept. In accordance with the three-dimensional framework proposed by Rubalcaba et al. in 2012 [18], Figure 2 illustrates this framework, which consists of innovation in service sectors (i.e.

Figure 2: Three dimensions of innovation through services



Source: Based on previous work by Rubalcaba [18].

representing the traditional literature in innovation in specific services), service innovation (i.e. covering most of the management and marketing approaches to service innovation) in any kind of business and services as multi-agent co-productions. This latter approach is based on the multi-agent perspective on service innovation [19,20] and can be considered a framework of social innovation when the agent dimension and the activity dimension are linked together. The activity dimension in the multi-agent framework stresses the non-technological aspects of innovation leading to the inclusion of social issues and social actors in the development of new services.

Once a new solution (social innovation) emerges in the form of services within the socioeconomic system [21], civil society is embedded in the innovation process and the role of users becomes prominent. Here again citizens become active actors and innovators, not passive consumers of new services. The concept of co-innovation particularly stresses the importance of customer–producer interactions in innovation activities. Typically, citizens and organisations participate in developing innovations not with a clear profit motivation as their main target, but for the benefit of civil society. They serve as a medium (mediator) to achieve a result or to transfer information in order to improve existing services or organisational forms. Finally, citizens, and their well-being and quality of life, become the object of their own innovation developments, thus becoming entirely user centred, as service innovations aim at overcoming societal issues that civil society is facing and will continue to face in the future. The improvement of future standards of living is the outcome of service innovations, and citizens and organisations are the final beneficiaries.

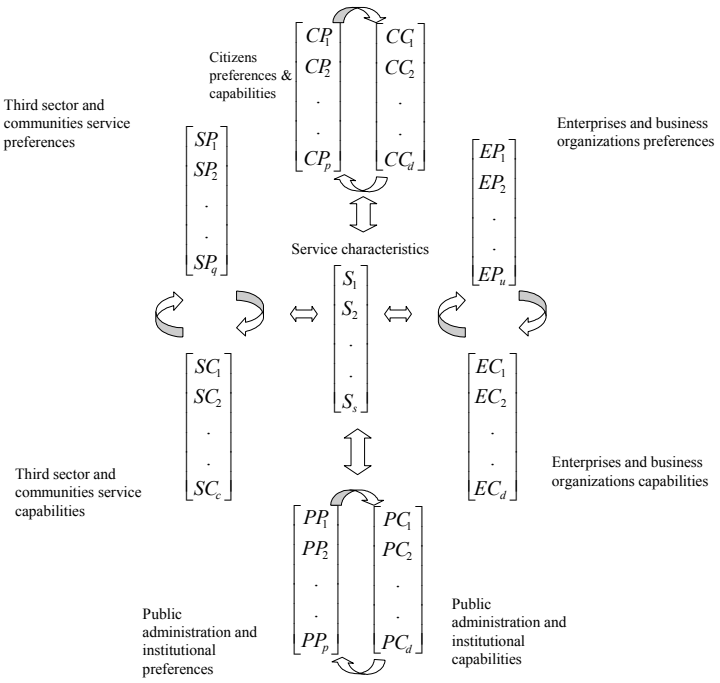
The activities and actors involved not only show the multifaceted nature of social innovations, but also reveal the specificities of these innovations. The interactions taking place comprise much more than a traditional service relationship; the sources and goals of innovation are more diverse, and the participation of actors is varied, including some voluntary elements. Social innovations may: (i) appear among individual citizens who respond to pressing social problems; (ii) be produced by private, public and third-sector organisations separately or in cooperation; or (iii) result in fundamental changes at the societal and policy level. Research in these three areas has resulted in focusing on the following topics respectively: the empowerment of citizens and stakeholders; public–private partnerships and the so-called social economy; and the governance and management of social and system innovations. The social economy consists of non-profit organisations, cooperatives and associations, social entrepreneurs and partnerships between the public and third sectors. Social innovations may be produced either autonomously by the third sector, with state support, or in partnership with it. In such partnerships the role of the actors from the third sector may range from that of subcontractors to common

design and implementation of social policies with the public stakeholders [22]. The private sector can also participate in social innovation processes [3].

Within this framework service innovation and open and social innovation are mutually reinforcing. Social innovation commonly occurs in the form of a service, and can take place in the governmental sphere (in areas such as healthcare or schools), in the business sector or in the third sector. As the subject of action, citizens play a fundamental role as producers of social innovation, social innovators or social entrepreneurs, working at the crossroads of market, state and civil society and often receiving backing from the public and third sectors. In order to respond to an unsolved societal issue, social entrepreneurs and social agents aim at identifying and delivering new solutions within the system to improve the well-being and quality of life of individuals and communities. While meeting social needs and tackling societal challenges, social innovations empower people and create new social relationships and models of collaboration. Cross-sectorial collaborative approaches favouring cooperation between the public, private and third sectors facilitate the emergence of effective responses to social needs and challenges.

Based on these elements in the multi-agent framework, Figure 3 represents a multi-agent model rooted in the 1966 work of Kelvin Lancaster [23] on product characteristics and consumer demand. It provides a framework for understanding the processes and outcomes of service, social and open innovation. It also enables explicit consideration of the competences and preferences of citizens, organisations and policymakers and of their interaction in the processes of the co-creation and diffusion of innovations. Here, the interactions between the provider and users have been replaced by interactions between different organisation types (private, public and third sector), thus stressing the open character of innovation. The third sector represents the interests of citizens and target communities in specific innovations; business organisations and firms represent the interests of the markets; and policymakers represent the interests of the overall population in a given country, region or municipality. Citizens may also interact by participating individually (e.g. social innovation through online platforms) or by being represented by the third sector. The greater or lesser use of third-sector organisations and citizens in developing social innovation in services may depend on a variety of conditions such as the sector, the country or the social structure. As can be deduced, this multi-agent model conveys the relevant features of the open innovation 2.0 paradigm, as the promotion of social innovation is based on the role of extensive networking spanning organisational boundaries and likely driving structural changes, as well as the strong engagement of citizens in scaling up innovation [11].

Figure 3: A multi-agent and multi-role framework for social and open innovation in services



Source: Extended and adapted from previous models mainly by Gallouj [24][25] and Windrum [20][26].

The model is useful to illustrate real situations where strong interactions amongst the agents involved lead to rich co-innovation dynamics. In this sense the importance of the ServPPIN (public–private innovation networks in services) project must be stressed here, as it provided practical cases in which to calibrate the validity of the conceptual model presented. ServPPIN carried out 40 case studies between 2008 and 2009 in seven different countries across the following sectors: transport, health services, knowledge-intensive services and tourism. This case-study approach highlighted the importance of innovation networks over their life cycle and the development of cooperation and interaction between public and private organisations and third-sector organisations in developing and delivering innovative services.

A major example is the health sector, where new co-innovations are increasingly outcomes from interactions between hospitals, patients, voluntary/third-sector associations and policymakers. Moreover, the role of voluntary/third-sector organisations in acting as interfaces between citizens and the other actors to co-produce and participate in the innovation process must also be highlighted here [20]. The health sector provides strong evidence for bridging service innovation and social innovation [26].

Concluding remarks and policy implications

This article has explored the relationship between service innovation and social and open innovation. They can be considered different dimensions of complementary and highly interrelated innovation processes, as their frontiers are blurred and a wide array of commonalities amongst the three concepts arises, even though differences and singularities are also visible.

Open and social innovation in services can contribute to the development of the service economy in Europe because they are capable of performing different specific tasks in the innovation process: they can use complementarities and synergies between heterogeneous partners in the process of knowledge creation; they facilitate technology and demand matching by involving consumers, non-governmental organisations, etc.; they help translate social preferences not reflected by market prices into demand; they account for the growing complexity of many contexts and technologies; and they support systemic innovations and transformations that require the involvement of a large number of heterogeneous partners.

However, due to the characteristics of social, open and service innovation, innovation may be hampered by market failures or allocative inefficiencies, and systemic failures or evolutionary inefficiencies. The former includes private underinvestment in innovation due to the presence of externalities, asymmetric information and incomplete credit markets, market power failure due to lack of competition, economies of scale/resource immobility, etc. The collaborative/cooperative element of the types of innovation addressed in this chapter makes policy rationales particularly relevant. In this sense, and based on policy work for ServPPINs [27], three broad areas of possible policy intervention for growth and welfare contribution seem to be especially appropriate:

- strengthening service-specific innovation and innovation capabilities;
- facilitating cooperation and networks involving service firms;
- empowering the public sector and the third sector with respect to cooperation (which is particularly important for social innovation).

In order to encourage the development of open and social innovation in services a predominantly horizontal service-oriented innovation policy is advocated. In this sense, service-oriented innovation policy is not necessarily aimed at specific service sectors; in contrast, it can be seen as a predominantly horizontal policy that requires a high degree of sensitivity to innovation in the sectoral policy domains. Policies to boost open and social innovation in services must be based on the approach that promoting service innovations should be considered a systemic task that is useful to any kind of economic activity, thus implying that the development of public–private innovation networks should be encouraged across a broad spectrum of policies.

Accordingly, the policy should be cross-sectoral and its promotion may be based on a full range of policies, such as: R & D policies (joint participation of public and private partners, promotion of full engagement in R & D activities vs diffusion of knowledge, projects for further research on services, public–private interactions, innovation networks and social innovation); innovation policies (support for clusters and innovative industrial policies); public procurement (promotion of innovation and quality, promotion of networking between public and private sectors); and regional policies and initiatives for innovation. Moreover, the role of open and social innovation in services can be further promoted and understood via consideration of their impacts on other policies, such as internal markets, health, transport, tourism, competition, etc. With respect to this, the encouragement and protection of competition may be complementary to the changing role of the public and private sectors in service provision. Both the European Commission

and Member States play a relevant role in enforcing competition and related policies; transposing and accomplishing the aims of regulations in a timely manner; and promoting a receptive climate in favour of giving options to the consumers of public services. Two final and more specific challenges for policymakers are worth mentioning here to help foster open and social innovation in services. The first has to do with learning lessons from existing social/open innovations linked to services and scaling them up within the framework of systemic transformations. The second stresses the importance of devoting further efforts and research to developing meaningful metrics and indicators covering open/social/service innovation that is needed to facilitate the measurements of new forms of innovation, which ultimately may provide sound guidance both to organisations involved in innovation strategies and to policymakers willing to implement well-targeted policies.

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PART III

Regions and cities

Article 11

Co-creating smart city visions and roadmaps: bridging cultures in policymaking. Cities as game-changers for innovation

Introduction

In previous editions of this yearbook we have described the process of open innovation in the domain of smart cities and smart urban lighting, based on the experiences in the city of Eindhoven. The process started off with a vision and a roadmap for urban lighting that was co-created with stakeholders of the quadruple helix in 2012. In subsequent years, various projects and public procurement procedures were organised to start the realisation of the shared ambition, among others the seventh framework programme for research and technological development pre-commercial procurement project Enigma.

One of the main prerequisites of open innovation is cooperation within the quadruple helix. To come to a real participatory process turns out to be challenging, especially when the participants are this different. In this edition we therefore emphasise our experiences in co-creation by describing a practical example of a project.

During earlier projects it became clear that driving innovation in smart city solutions towards better quality of life for people in the cities requires a new approach to innovation and the scalability of solutions. Special attention needs to be paid to the continuous development of an open, multi-purpose democratised platform (a mash-up of data, services and products) to enable a diversity of propositions. Projects are the context-specific connection that enables partners to develop appropriate local solutions to answer questions that have a global impact. However, we have the ambition not only to see solutions as local pilot projects, but also to seek ways to scale up those solutions. This is important for companies to develop sustainable business, but also for faster development of the platform and thus to realise more effect for citizens. Solutions that work for one city cannot simply be transferred to other contexts; they may need to be tuned to the specific new 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 make adjustments over time and to further develop the platform. This in turn will enable further development of new propositions.

To realise the development of open platforms requires collaboration with other cities with similar needs. This was the reason the city of Eindhoven applied for a Horizon 2020 project to enhance the capacity of public authorities to plan and implement sustainable energy policies and measures through energy roadmapping for smart cities. In the roadmaps for energy (R4E) project eight partner cities together develop visions and roadmaps in co-creation with local stakeholders to formulate requirements for solutions from specific needs in the cities. This will enable the search for scalable solutions — solutions that share a common platform but are tailor-made to the context of implementation and allow add-on of locally developed applications and services.

The R4E project therefore creates open innovation ecosystems on two levels: the European level with eight cities; and the city level with all local stakeholders. This poses challenges relating to bridging cultural differences in the approach on two levels: on the European level between the different ways of working; and within the cities between the public, private and people partners in the local ecosystem. In this article we describe the experiences in R4E. The second section describes the project and process in more detail. In the third section the experiences with creating the two different ecosystems are described. Finally, in the fourth section the key success factors relating to bridging cultures in policymaking are provided.

The role of municipalities in the smart city challenge

Cities need to react to new, disruptive transformations caused by the digitisation of society and associated solutions to ensure that technology is applied to truly contribute to a better quality of life for their inhabitants. On the one hand this means giving participating citizens the space and opportunities to become enthusiastic and involved. On the other hand it means ensuring that smart city systems enable co-creation of human-centred personalised services that meet people's needs and contribute to economic resilience.

In smart cities citizens live together well, public interests are safeguarded and new technology creates business opportunities for companies and contributes to an attractive economic climate, while protecting people from undesirable commercial interests. The role of municipalities cannot be overestimated, i.e. to achieve liveable and resilient cities by reducing energy consumption and increase the production and use of renewable energy. Cities across Europe have shown their commitment to playing this key role by endorsing, in large numbers, the targets as set out in the Covenant of Mayors.

They have also engaged in the development of the strategic energy action plans required by the covenant. Energy planning is high on local agendas across the EU, and the interest in the smart cities concept has further raised the attention of local authorities and is directing their policy attention to the integration of local energy, mobility, digital and innovation policies with a view to becoming truly smart cities. However, the actual implementation of strategies and plans continues to be a difficult exercise, for many reasons. Challenges include: financial 'surprises', such as the recent economic and financial crisis; changes in competencies because of the shifting of responsibilities between government levels; difficulties within organisations with meeting the necessary, and changing, skills and capacities; and a lack of knowledge on the current state of affairs concerning technological and organisational innovation.

A full reliance on industry to develop solutions may result in commercial solutions that are not necessarily in line with longer-term societal ambitions or do not sufficiently safeguard public interests. Municipalities will need to drive innovations in the desired direction: improving the quality of life for their citizens.

Co-creating smart city visions and roadmaps

A new co-creation policymaking process

In the R4E project energy roadmaps are developed. The R4E partner cities implement a similar participative process for vision and roadmap development that enables continuous cross-city learning and exchange of experiences, challenges and best practices. In each city a local ecosystem is built of relevant parties and connected to the ecosystems of the other cities and internationally recognised thought leaders. These connected ecosystems are the foundation for extended collaboration between the partners to drive innovation for sustainability purposes through joint projects, such as joint transnational procurement of digital platforms for smart city solutions.

Since energy and smart cities are too broad to cover in one roadmap, R4E focuses on three themes within the domain of sustainable energy that are closely linked to the municipalities' main responsibilities: smart buildings, smart mobility and smart urban spaces (see also Figure 1).

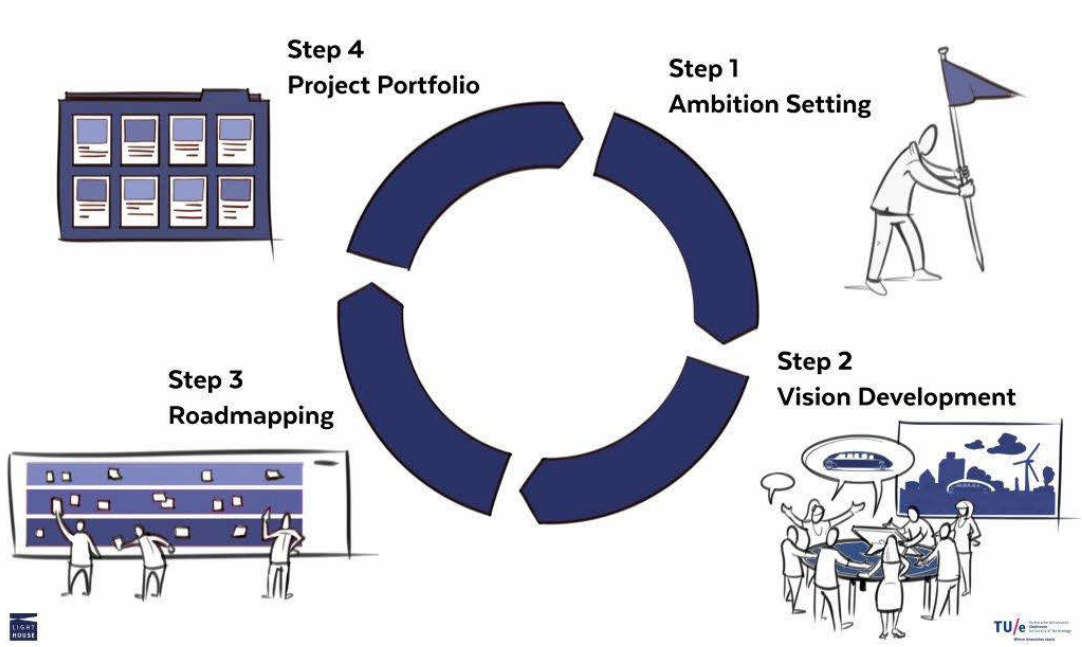
Figure 1: Focus areas in the domain of energy for smart cities

A four-step approach

In the R4E project a structured, four-step approach is applied: 1. ambition setting; 2. vision development; 3. roadmapping; 4. project portfolio (see also Figure 2).

In each step the relevant (local) stakeholders are invited to co-create in workshops or interviews. The workshops are held in the participants' own language and are tailored to meet cultural needs.

Figure 2: Four-step approach to co-create visions and roadmaps



Step 1 — ambition setting

The first step sets out the ambitions for the project. For this purpose, several sessions are organised with policymakers, strategic managers from different sectors within the municipality and external stakeholders. The workshops are structured with posters, on which the results of a brainstorming session are clustered and prioritised. Then, in a plenary session, three strategic ambitions for the city for the year 2050 are formulated, using the input on the posters. Figure 3 shows photos of the ambition setting workshops and the result: prioritised strategic ambitions.

In parallel, an assessment of the ecosystem takes place: who are the stakeholders and which ideas and initiatives can be included in the next steps.

Figure 3: Ambition setting

Ambition = what aspiration does the city have for the future?

Series of interviews/workshops to define the scope, aspirations and specific ambitions for each city

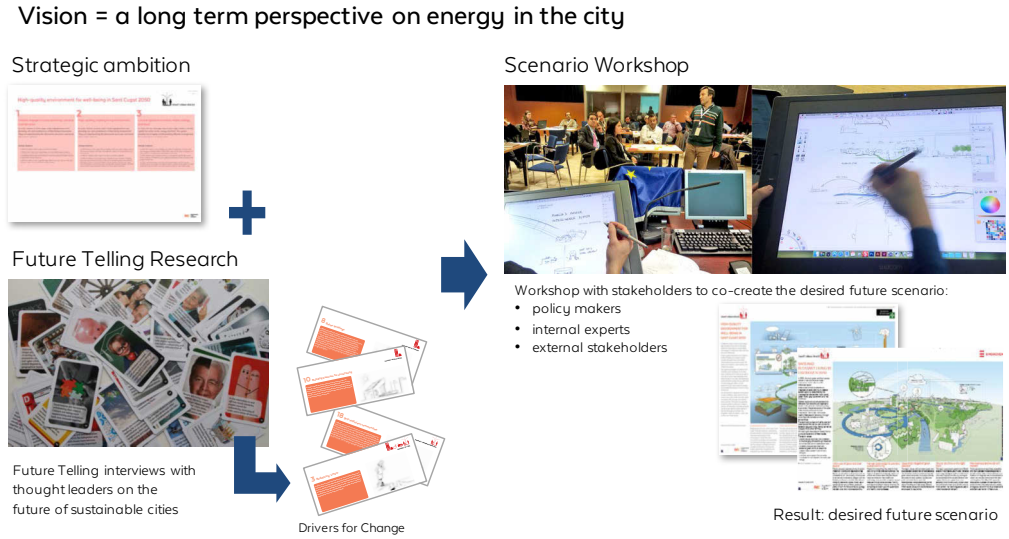
Workshops structured with posters to facilitate interaction and in-depth discussion between all stakeholders:

- policy makers
- internal experts
- external stakeholders

Result: prioritised strategic ambitions

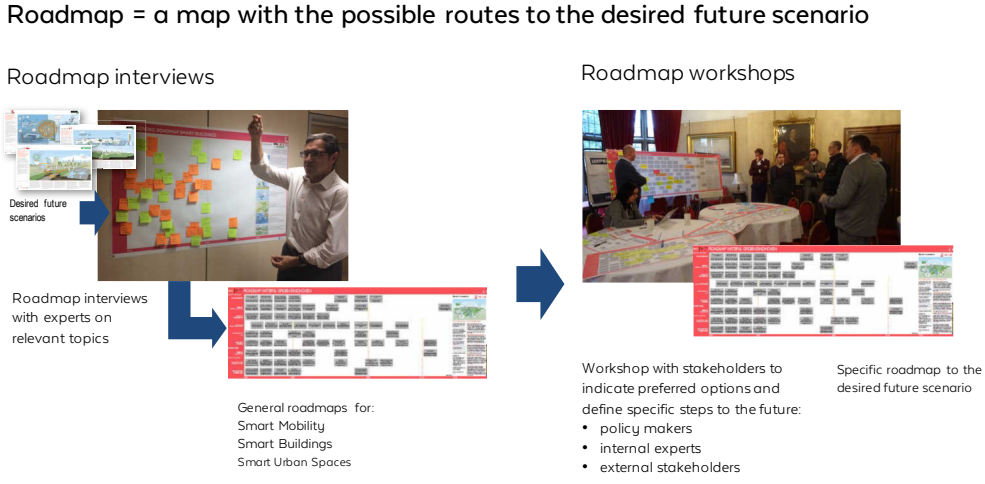
Step 2 — vision development
The second step is to develop a desired future scenario. For the scenario development the 'future telling' methodology is used. Interviews with a diverse group of experts from different disciplines and with a broad perspective on the future of cities result in rich 'stories' that are analysed to identify key drivers for change. Combining the drivers for change with the cities' ambitions enables the stakeholders to develop the desired future scenario for their city. In an interactive workshop with all relevant stakeholders the desired future scenario is described in its key elements and visualised. The result is a visualisation in which the participants recognise their input as they have been engaged in the process. Figure 4 shows how the desired future scenario is developed.

Figure 4: Vision development



Step 3 — roadmapping
During this step the desired future scenarios are used to identify existing and future technologies and developments that will enable realisation. The information for the roadmaps is collected through interviews with thought leaders in different thematic areas. The result is a general roadmap in which opportunities and developments are plotted on a timeline to provide insight into the required steps and milestones towards the desired scenarios. In roadmap workshops with all stakeholders in the city the specific milestones and project ideas involving local companies and knowledge partners are defined to realise the city's specific desired future scenario. Figure 5 shows the process of roadmapping.

Figure 5: Roadmapping



Step 4 — project portfolio
During the final phase a project portfolio is generated with new projects and initiatives to reach the ambitions, visions and roadmaps of the cities. This portfolio provides an overview of city-specific and joint projects, and includes a plan for further joint activities with other partner cities.

In between — joint workshops
After each step a joint workshop is organised with all partner cities to share results and to investigate commonalities and differences between the cities and their needs. Using the same process in all cities allows the creation of a common language to talk about abstract concepts such as visions, ambitions and roadmaps. In this way the cities are better able to indicate common and specific needs and choices in their cities.

Creating open innovation ecosystems

As stated, the R4E project creates open innovation ecosystems on two levels: the European level with eight cities; and the city level with all local stakeholders.

Developing a European-level ecosystem
The partnership was built by the team of the municipality of Eindhoven, based in the Eindhoven Brainport EU office in Brussels. This team has strong relations with other European cities and regions, collaborates a lot with them in Brussels and is active in different European networks.

The call for proposals under the Horizon 2020 programme focusing on 'Enhancing the capacity of public authorities to plan and implement sustainable energy policies and measures' was identified as a good opportunity for the city of Eindhoven to improve the impact of energy (action) plans, such as the Covenant of Mayors, and to spread throughout Europe the knowledge and experiences obtained by Eindhoven in developing roadmaps. At the same time, increasing the number of cities that are familiar with roadmapping is a relevant step towards pan-European open platforms and innovation ecosystems for smart city services.

A partner search was begun through the Eurocities network, explaining briefly the call, the focus and objectives of the project idea and the kind of partners being sought. Eindhoven is member of Eurocities, a network of 130 major European cities and 40 partner cities across 35 countries. The partner search resulted in the expression of interest of around 15 cities from nine different countries. Eindhoven also received expressions of interest from a couple of cities with which Eindhoven has close relations.

In order to develop a strong consortium the following requirements were taken into account with regard to the partner cities:

- a maximum of eight cities to be partners;
- a good geographical spread;
- the drive of the cities to participate in this project;
- the commitment and input of partners during project development;
- European added value;
- previous roles and experience in European projects and networks;
- the endorsement of the Covenant of Mayors.

Before the project proposal was submitted two partner meetings were organised: one at an early stage to discuss more specifically the focus of the project; and a second one a few weeks before submission to jointly go through the proposal, to add missing information and to make the final modifications.

These preparatory meetings are very important in the development phase of a project in order to see whether or not the different partners click, to ensure that everybody understands the project idea and agrees with it and to discuss the details. After the first partner meeting the partnership was further defined. Some partners indicated that they were not able to continue, and others expressed their commitment to continue the work. Also the project was given more focus, and the three focus areas of R4E — smart buildings, smart mobility and smart urban spaces — were chosen.

With those focus areas it also became clear what kinds of expertise and what kinds of knowledge partner were needed to complete the consortium.

TU/e LightHouse was involved from the beginning, and had an important role in the development of the proposal because of its experience in the development process of specific local roadmaps. Other knowledge partners were sought by asking around in networks, resulting in the involvement of TU/e Smart Mobility and the Universitat Politècnica de Catalunya. A final city was included in the partnership through the latter's connections.

The R4E consortium consists of 10 partners from six countries: Estonia, Italy, the Netherlands, Spain, Turkey and the United Kingdom. This extensive geographical coverage is an important asset of the R4E consortium, since it shows that the process of visioning and roadmapping is applicable in different countries, all with different climates, cultures and habits, including one non-EU country (Turkey).

Figure 6: R4E partners

The core of the R4E consortium consists of eight committed cities with an ambition to overcome the current difficulties in implementing energy ambitions and willing to learn to develop vision-creation and roadmapping capacities within their organisation so as to improve the actual implementation of energy strategies and plans.

The cities play the role of actively participating clients. As owners of problems the cities co-create specific ambitions, strategies and plans on future energy development in a participatory approach with knowledge institutes, industry and stakeholders. The eight cities are spread over the whole of Europe, with a balance between north and south, between hot and cold climates and between large and small. Furthermore, the cities vary in their implementation capacity. Some have more own financial resources than others; some have more regulatory powers than others. All cities participate in joint workshops with other cities to optimise cross-city learning experiences.

The value of each other's capacities, tasks and experiences among the consortium members, together with good geographical coverage, is essential to emphasise the added value of each of the partners and to demonstrate the potential of replication of the activities and outcomes of the project.

Developing city-level ecosystems

Smart city sustainable energy policies require an integrated approach across sectors, for example linking social, mobility, real estate and digital policies. Moreover, successful implementation inevitably implies cooperation between the city and local and regional stakeholders to gather innovative ideas and concepts, to create ownership and thereby to achieve effective and efficient implementation. Therefore, in the R4E project an inclusive process is applied, engaging key stakeholders from business and knowledge sectors and from local and regional stakeholder groups at different stages.

The first round of workshops was on ambition setting. The main purpose of this step was to familiarise people with the project and the way of working and to make a start on developing the ecosystem. Therefore, the intention was to engage policymakers, strategic managers from different sectors within the municipality and civil servants in the area of the energy roadmap. Also, external stakeholders in the focus area were invited to a workshop to add their ideas and thoughts to the process.

Both the way of working (brainstorming session) and the way of thinking (setting ambitions for 2050) proved to be very new to everybody involved. Adaptions of the process had to be made due to

cultural differences and city practicalities in the cities, as detailed below.

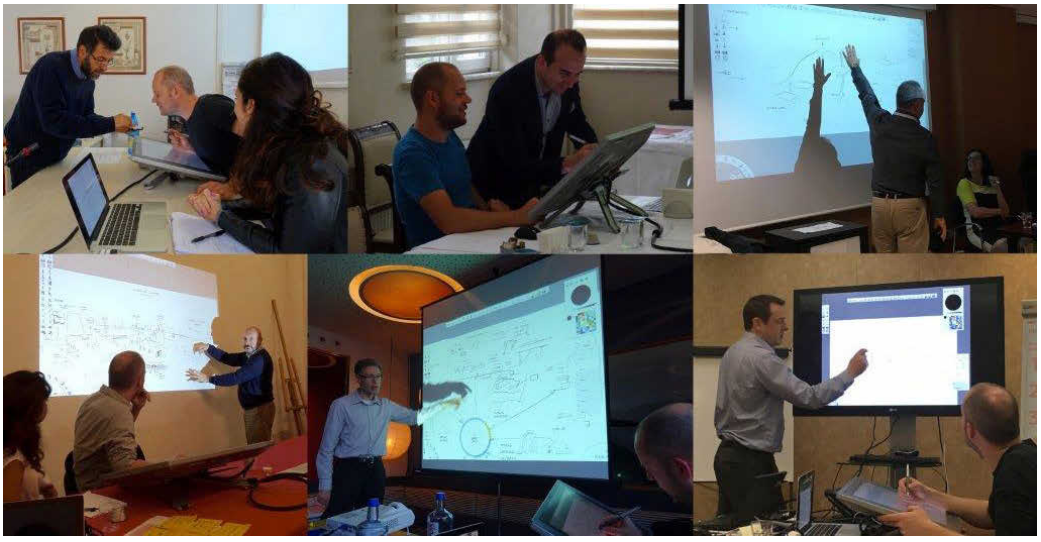
- Flexibility was built in to be able to speak to the policymakers. This proved to be the same in every city; it is difficult to make set appointments with mayors and aldermen. This resulted in separate interviews, during lunch breaks or at the end of the day. There proved to be a wide spread in the level of engagement at this early stage — some politicians expressed strong ambitions, others wanted to be more informed about the project.
- The timing of the workshops, especially when external stakeholders from companies or organisations were invited, was adapted to the (cultural) circumstances to ensure participation. For example, in Spain the afternoon workshops were scheduled towards the evening.
- Workshops, with brainstorming and teamwork, are a challenge in cultures that are not used to this way of working. For example, in the workshops in Istanbul we adapted the way of working because the participants spanned a range of hierarchical relationships, and we held parallel interviews with the main participants.
- Actively working with external parties was quite new for some cities (and their stakeholders). In this first round it turned out to be difficult to have a good balance between internal and external stakeholders.
- The tone of communications between municipalities and their stakeholders was new in some cases. The conventional way of talking to citizens was in public participation procedures and feedback rounds, where citizens criticise new plans and policies. For the citizens it was new to be asked to express their wishes and dreams in advance; for the civil servants it was new to listen to these wishes without becoming defensive.

The second round of workshops was on vision development. The aim in this set of workshops was to agree on one visual — a future scenario for the city — based upon the input of all (internal and external) stakeholders. Again, this was done on the basis of a co-creative approach with local businesses, organisations and citizens to define the 'need'. The main experiences in this step were as follows.

- Many of the stakeholders of the first round of workshops participated again in this series, resulting in better understanding and more familiarity on the part of the participants with the process and the co-creative approach. The earlier experience also resulted in more confidence from the stakeholders (as well as the cities) in a good result.
- Again, the way of working — creating a future scenario and working in small teams — differed in the different cultures; there were striking differences in the way teams approached a task.

  - In Turkey all teams instantly approached the task in a systematic manner: analysing the problem, generating ideas and presenting a full solution in the end. This resulted in a rich future scenario, understood in its challenges and solutions by all stakeholders present.
  - In the Netherlands the culture of the Dutch consensus model resulted in a scenario where all options were included and no clear decisions were made, so as to keep options open.
  - In Estonia the participants tended to apply a constructive dialogue, consequently adding

Figure 7: Jointly creating a visualisation of the desired future scenario (Forli, Istanbul, Murcia, Palermo, Sant Cugat and Newcastle)



ideas in a 'yes, and' manner. This eventually resulted in one of the most futuristic scenarios of all.

- Actively creating a visual together turned out to be very inspirational, across cultures. A visual is a good way to express ideas and to bring them together. In the workshops stakeholders actively participated with the visualiser and people laughed a lot during the workshops.

The third round of workshops was on the city-specific roadmaps, aiming for the definition of the first project initiatives towards the desired future scenario. Here, external stakeholders in particular were invited to add their ideas and thoughts to the process and bring in their expertise to start new projects. In this step the challenges are the following.

- After the difficulty of getting people to think into the future in the first two workshops, this time it turned out to be difficult to get them into the present again, specially to get them beyond defining aims and abstract goals and start defining activities and projects to realise the visions.
- Defining a new role for public–private cooperation: what to expect from future cooperation? One challenge is bridging cultural differences within the cities between the public, private and people partners in the local ecosystem. Typically, business people prove to be impatient when it comes to implementation. When they recognise the value of a project they would like to go straight into realisation, whereas people from the public administration are concerned about the processes and legislation requiring change before implementation is feasible.

A multi-level learning ecosystem

In the joint meetings between the different steps in the project the cities shared their city-specific results (ambitions, visions, roadmaps) and their experiences in the approach (way of working). This resulted in rich discussions and learnings. These included topics such as the following.

How to involve politicians in the project
All city representatives struggled with this issue. Councillors need to be involved, since they are in charge of the energy transition and made commitments. However, in their busy schedules with daily emerging issues, it is difficult to connect them to a project dealing with a more distant and less urgent future, such as R4E. Jointly it was decided to arrange an official moment in all cities at which politicians would sign an official statement, to also provide them with an opportunity to endorse the vision for their city and overall project goals. Pictures of all these sessions were shared through the project website to create a community of supporting politicians.

How to involve external stakeholders in the project
The success rate of involving external stakeholders in the workshops differed greatly. In some cities over 35 participants joined the workshops, involving all relevant partners — companies, knowledge institutes, public partners and civic organisations. Other cities had difficulties in providing momentum for all parties concerned. In this aspect the cities helped each other. The Spanish partner, with a very high success rate, explained not only why and who he invited, but also shared experiences in how the invitation was written, how to implement a personal approach and relationship with the participants and how to keep them engaged during periods of project silence.

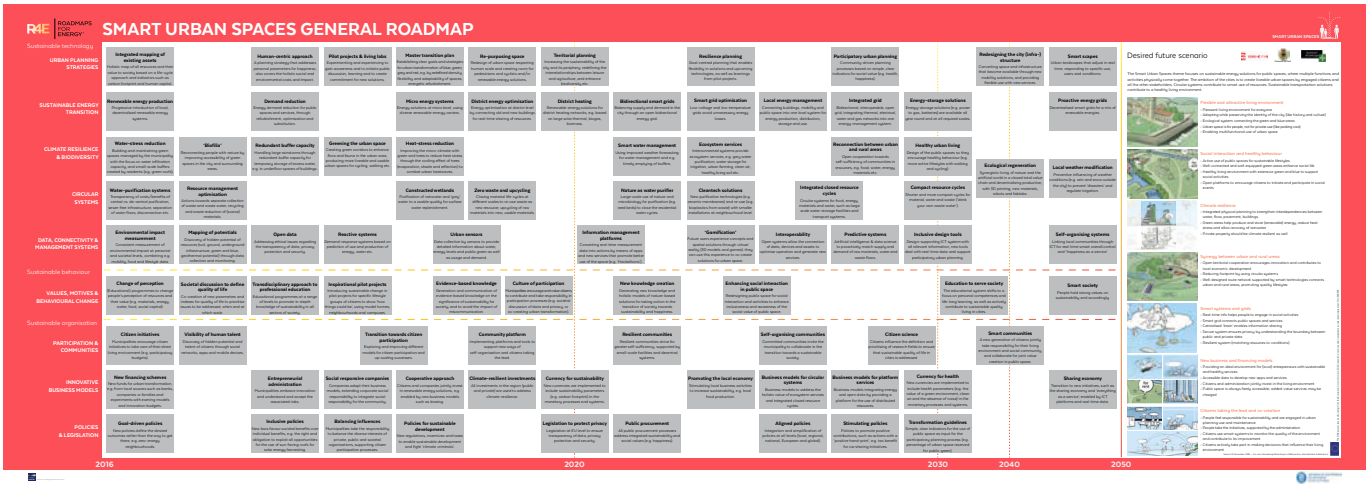
How to involve citizens in the project
Although less relevant for the stage the project was in, the cities also shared their experiences in citizens' participation. Tools and websites were exchanged and evaluated, with participants learning from each other's experiences.

How to create joint learnings
Also, the content of the city results was shared between the cities, searching for common interests. After the creation of the vision the cities shared and analysed their needs in the three focus areas, resulting in the identification of common needs. These common needs describe a deeper, general understanding of the societal needs in the cities, as for instance in Figure 8 for smart urban spaces.

These common needs were the basis of the roadmap interviews, during which 25 experts were interviewed, looking for technological developments and solutions that contribute to the realisation of the societal needs.

The last step in the project is the project portfolio. This portfolio provides an overview of both individual and joint projects, including financial possibilities for joint initiatives. Although this phase is just beginning to take shape, confidence is high that this will lead to insights into joint initiatives and to a demand for platform solutions. This will enable the search for scalable solutions — solutions that share a common platform but are tailor-made to the context of implementation. When this happens the common knowledge of these cities will actually become a driver to become game changers for smart city innovation.

Figure 8: Common needs and general roadmap for smart urban spaces



Conclusion: bridging cultures as the key to success

In the R4E project we applied a vision and roadmapping approach to create energy roadmaps. This approach strongly depends on the open innovation 2.0 characteristics. The difference between 'regular' energy strategies and action plans and energy roadmaps is threefold.

Firstly, the much earlier and more developed engagement of local stakeholders. These include not only those who benefit from the strategy, such as citizens, but also relevant research and industry partners that offer a much clearer picture of the future potential of the city when it comes to measures and technologies selected, and of impossibilities when it comes to the situation of the city today.

An active focus on collective learning, both within each city and between the cities, creates a will and a platform to learn. Inclusive local workshops within the cities engage key stakeholders within the region and create a joint path towards the future of the city. Knowledge sharing between the cities creates a network of municipalities that understand the future possibilities and can position themselves in the movement.

Secondly, the method of backward planning, in which a joint desired future scenario for the city is a starting point for the creation of a well-developed path to get there. Local companies, entrepreneurs, knowledge institutes and citizens' organisations are invited to co-create, and therefore become jointly responsible for decisions taken along the way. This creates insights into relevant activities and projects that will be relevant not only in the short term but also in the long term, contributing to the energy transition at large.

Thirdly, a visual way of working is adopted in policymaking, enabling stakeholders to be included from different disciplines and knowledge levels to imagine the future possibilities and create a joint vision/visual to base decisions on, enabling 'icons' that they later can easily relate to. This provides a clear, jointly created and visual starting point for the creation of a well-developed path to get there. People can relate to it and define their own stake and role in its further development and implementation.

Municipalities can be the major game changers in smart city innovations if they are willing to take the lead in initiating new, co-creating policymaking processes. In the R4E project we experienced the same as in the Enigma project: cities have common societal needs on specific topics at a deeper level. Only in the application do they become more specific. This indicates that solutions such as open platforms are a sensible and sustainable way to meet these needs. It is then also of interest for companies that are seeking scalable solutions.

Cities are the key to safeguarding longer-term societal ambitions and public interests, and therefore to identifying societal needs. They cannot rely on industry alone to develop solutions, as this may result in commercial solutions that are not necessarily in line with societal needs within the city. Therefore, municipalities will need to drive innovations in the desired direction through the co-creation of roadmaps with the quadruple helix structure. This will ensure a shared vision and roadmap, enabling short-term decisions and actions with a

long-term perspective. The continuity of the roadmaps is ensured through the active involvement of different relevant stakeholders, thereby enabling sustainable businesses, financial models and plans to spur innovations to realise the shared vision.

In this the cities can support each other in strong consortia: in European cooperation the added value of working with each other, across cultural boundaries, enables understanding of the societal challenges that smart city development will bring in the future. Together it is easier to explore, to investigate and to better understand the forces behind the phenomenon, and to see how it can be addressed.

The city of Eindhoven is committed to bringing innovation in such open innovation smart city platforms to the next level. One of the initiatives currently being set up is a pan-European dynamic procurement system for an open 'plug-and-play' smart lighting platform, which will enable cities in to procure proven but tailored smart lighting solutions and will allow the continuous development and adoption of new applications and services.

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Article 12

Turkey: a regional hub for start-ups

Introduction

In our increasingly globalised and interconnected world, numerous new regional hubs are emerging, each one attracting global talent and investment. This has also happened in Turkey, where, since 2010, increasing interest in and support for entrepreneurship has spurred the creation of Turkey's entrepreneurial ecosystem. Indeed, the start-up ecosystem in Turkey — and Istanbul in particular — has become an important start-up hub for the regions of eastern Europe, the Balkans, the central Asian republics, the Middle East and north Africa. Success stories within the last few years have further increased the activity of start-ups and investors, both in Istanbul and in other regions of Turkey.

This article aims to provide a snapshot of Turkey's start-up ecosystem. We first provide the reader with an overview of recent developments in Turkey's start-up ecosystem and an overview of the current state of investment and capital available to start-ups. We will see that much remains to be done in order to bring the level of investments in Turkey up to that of existing global hubs such as Finland and Germany, with global start-up hubs in Helsinki and Berlin respectively. However, it is also clear that, along with countries such as Israel and the United Arab Emirates, Turkey has become a hub for start-ups from the regions mentioned above.

We continue with brief discussions on a number of initiatives and support programmes provided by the public sector, universities, the private sector and citizens. We will see that Turkey has seen exponential growth in the number of innovative public policy and support initiatives provided to entrepreneurs and that the start-up ecosystem has assumed a prominent role in Turkey's overall development goals. Finally, we provide an overview of Turkish success stories and end with an overview of the incubator and accelerator 'StartersHub', which is a prominent example of a Turkish organisation providing financial support in and supporting Turkey's flourishing start-up ecosystem.

Creating best practices across sectors

Turkey is making concerted efforts to increase support for start-ups, drawing on examples from other countries while shaping its own start-up ecosystem model. Indeed, Turkey is innovating in the public, private and academic sectors in ways that further strengthen the ecosystem. Examples of this range from implementing new start-up-friendly regulations to creating one-stop shops for start-ups. The points below list recent developments in the Turkish start-up ecosystem.

Public sector

- The public sector has adopted the entrepreneurial mindset, focusing on performance and experimenting with different flexible models for supporting start-ups.
- Start-up-friendly regulations are currently being crafted in order to: (a) streamline the process of start-up exits; (b) support start-ups in the form of tax, personnel and credit advantages; and (c) incentivise larger companies to buy out start-ups.
- The government aims to increase the percentage of high-added-value Turkish exports, particularly by supporting start-ups.

Universities

- Entrepreneurship education curricula have adopted a system which is based on the 'work model' instead of the 'work plan'.
- The young generations of today are being trained in the entrepreneurial mindset (do-it-yourself, the maker movement, fab labs) and in how to design and code.
- Lifelong learning is increasingly popularised, with new programmes being developed and becoming more available.

Private sector

- StartersHub is a world-class entrepreneurship platform acting as a catalyst in the region's entrepreneurial ecosystem.
- A start-up-friendly company index is being created which will reward companies that collaborate with entrepreneurs.
- In coordination with industry, qualified internships are being started, employing students older than 16 years old.

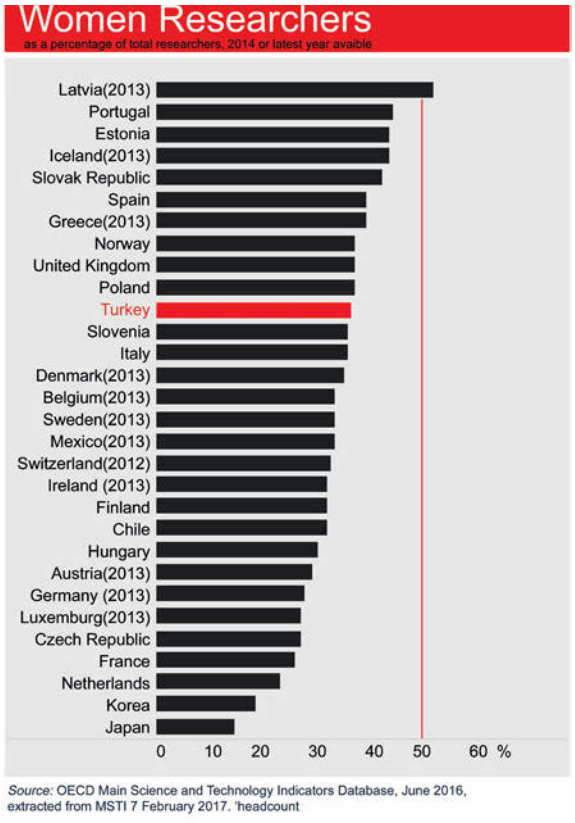
Citizens

- Turkey is undergoing cultural changes, with start-ups and mentors realising that failure is

a learning experience rather than something to be afraid of.

- Turkish society is becoming more familiar with 'open innovation' infrastructure, including the concept of 'living labs'.
- The percentage of researchers in Turkey who are women is higher than in many other Organisation for Economic Cooperation and Development (OECD) countries (see Figure 1 below), which means more potential for innovation and job creation.

Figure 1: Percentage of researchers who are women across 30 OECD countries [1]



These developments have emerged hand in hand with an increasing number and variety of active players in the entrepreneurship and start-up ecosystem. Table 1 [2] below shows the variety of actors in the Turkish ecosystem as of 2010 and 2016. We can see that the number of actors has risen dramatically over the past 6 years, especially among accelerators, venture capital firms and business angel networks. The increasing number of actors and the support provided by Turkey's public and private sectors are mutually reinforcing, constituting a driving force behind the country's ecosystem.

While the number of ecosystem actors has increased substantially over the past few years, aggregate investments in Turkey still lag behind western European global hubs such as Germany, the Nordic countries, France, Spain and the United Kingdom. However, from Figure 2 on the next page we can see that Turkey has higher levels of investment than most countries in the regions of eastern Europe, the Balkans, the central Asian republics, the Middle East and north Africa. Only Israel and the United Arab Emirates experienced higher levels of investment in 2016.

In 2016 the top three performing verticals in Turkey in terms of investment were the fintech, SaaS and real estate sectors. Of the total USD 67.2 million invested in Turkey in 2016 roughly 42 % was invested

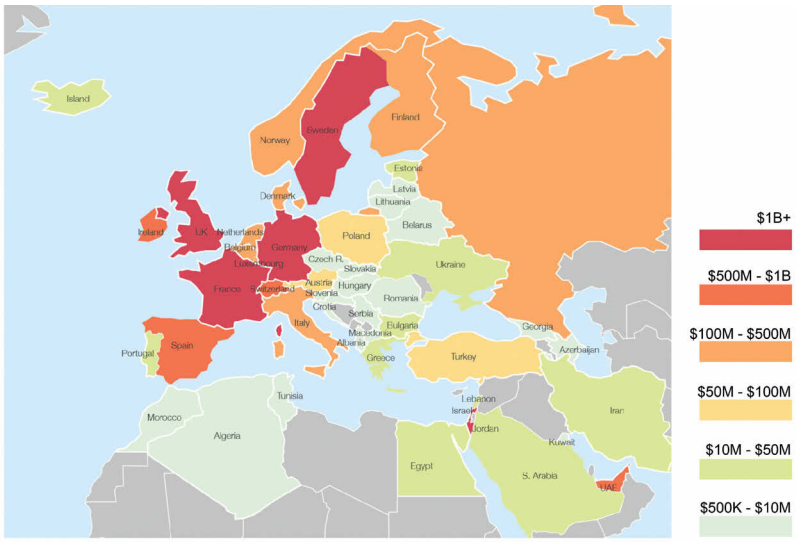
Table 1: Number of actors within the Turkish start-up ecosystem, 2010-2016 [2]

Number of Entities	2010	2016
Business Angel Networks	1	14
Tech Accelerator Funds	2	4
Venture Capital Funds	3	29
Accelerators	5	24
TechnoParks	32	41
Annual Tech Summits	2	3
Nfo's & Organizations	15	17
Goverment	5	5

in the fintech sector, 16.5 % in SaaS and 12 % in real estate. Graphs 1 and 2 below show that total investment in Turkey has not reached a stable level over the last several years. This is despite increased efforts to raise capital, as depicted in Graph 2, which shows the total number of investor rounds for each year since 2012. Even though the total number of rounds has nearly doubled compared to 2014, total investments decreased sharply after 2013 and have not reached the previous highs reached in 2012.

Yemek Sepeti remains Turkey's most successful start-up. Table 2 below lists other Turkish start-ups

Figure 2: Investment levels across three continents [3]



Graphs 1 and 2: Total investment in Turkey (USD) and number of investor rounds [3]

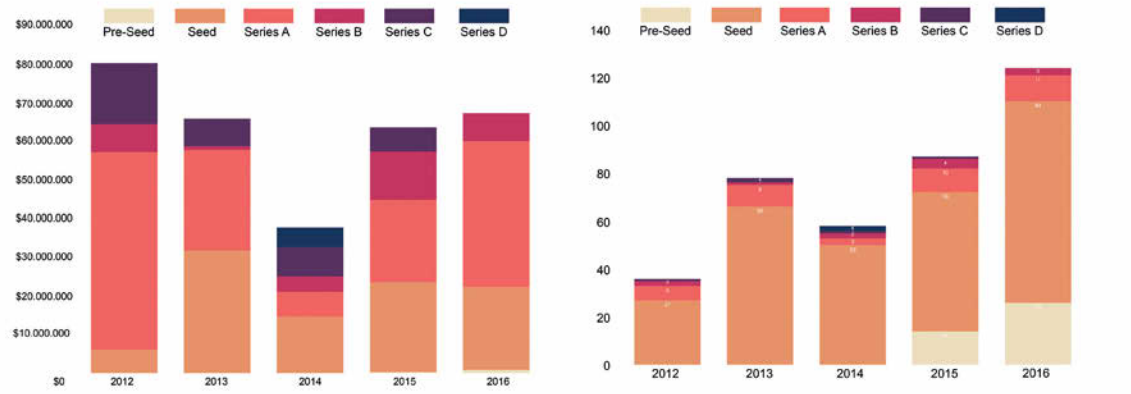


Table 2: Start-ups that have made major exits [3]

Startup	Acquirer	%	Amount ($M)	Year
Yemeksepeti	Delivery Hero	100%	$589m	2015
Sadecehosting	Telecity Group	100%	$47m	2013
Probil	Netaş	100%	$31m	2011
Mikro-ödeme	Wirecard	100%	$30m	2014
Netsis	Logo Yazılım	100%	$12m	2013
Lidyana	Hubert Burda Media	22%	$5,9m	2013
Idefix	Doğan Müzik Kitap (D&R)	100%	$5m	2013
Arabam	iLab	100%	$4,2m	2015
öde.al	Sankonline	51%	$3m	2015
Coretech	Logo Yazılım	100%	$2,6m	2011
Cicek.com	Çiçek Sepeti	100%	$1,4m	2013

that have made successful exits, but Turkey has yet to produce a unicorn that may attract more talent and investment.

Support provided by the public sector

Tübitak — the Scientific and Technological Research Council of Turkey

Tübitak supports Turkey's sustainable development by leading, contributing to and innovating in science and technology. Tübitak supports academic and industrial R & D not only by providing support through its Ar-Ge institutes but also by shaping Turkey's regulations around science and technology.

Tübitak aims to strengthen Turkey's competitive advantage by funding initiatives led by universities, public institutions and industry. Through its Individual Young Entrepreneur programme [4] Tübitak has supported 1 354 ideas, 551 ideas turned into project plans and 220 ongoing projects. In addition, Tübitak provides five different national grant and support programmes that target the start-up ecosystem [5]. One of them, Tübitak's 1514 Venture Capital Funding Programme, provides grant support to venture capital funds that has been instrumental in establishing new funds. Finally, in order to foster and strengthen entrepreneurship at universities, Tübitak has created the Entrepreneurial and Innovative University Index, designed to increase competition between universities in providing support programmes for entrepreneurs.

The Undersecretariat of Treasury

Turkey's Undersecretariat of Treasury operates under the office of the prime minister, administering and directing government support for the start-up ecosystem. The Undersecretariat also provides guidance in strategy and implementation. Additionally, the office provides Turkish investors and investment agencies with the opportunity to take advantage of tax credits through its Individual Contribution Certificate [6] (BKS — Bireysel Katılım Sertifikası). Since 2013 the office has provided 408 certificates to angel investors in Turkey, 40 % of whom have a background in engineering. Also, since 2014, 27 angel investors have received approval and invested a total of EUR 2 million. Finally the Undersecretariat accredits investor networks, and has accredited a total of 14 networks to date.

The Small and Medium-Sized Industry Development Organisation (Kosgeb)

Kosgeb is a public entity dedicated to strengthening small and medium-sized enterprises (SMEs), including start-ups, through various support instruments in financing, R & D, common facilities, market research, investment sites, marketing, export and training. Kosgeb offers a total of 10 different programmes targeting entrepreneurs and SMEs. Table 3 below lists six of these programmes and the amounts of financial support they provide to entrepreneurs.

Kosgeb's newest programme is its International Incubation and Accelerator Center, which offers financial support to universities and technoparks to establish incubation centres abroad. So far this programme has supported the creation of two accelerator programmes abroad: ODTU's T-Jump and İTÜ's Gate projects. Both programmes help start-ups enter new markets and move to international start-up hubs such as Silicon Valley.

The Turkish Growth and Innovation Fund (TGIF) [8]

The TGIF is a fund of funds with a focus on private equity, venture capital, angel investors and early-stage investments in Turkey. The fund was launched in May 2016 with a total of EUR 200 million contributed by Kosgeb (EUR 60 million), the Industrial

Table 3: Financial support provided by Kosgeb [7]

Support Program	Maximum Contribution of Total Costs	Maximum Total Contribution
Technology Promotion and Commercialization Center (TEKNOPAZAR)	100%	€ 30K
KOBİ Development Support Program	60%	€ 90K
Entrepreneurship Support Program	60%	€30K
Collaboration and Cooperation Program	50%	€ 280K
Thematic Project Supoort Program	60%	€ 45K
KOBİ Project Support Program	50%	€ 45K

Development Bank of Turkey (EUR 20 million), the Undersecretariat of Finance (EUR 60 million) and the European Investment Fund (EUR 60 million). The fund of funds will invest 40 % of its commitments into other seed, early-stage and start-up funds and start-up accelerators. The remaining 60 % will be invested in funds that target growth investments, such as expansion capital, replacement capital, mezzanine and buy-out capital.

Universities in the Turkish start-up ecosystem

***Koç University Incubator (Kworks)* [9]**
Koç University's Incubator and Accelerator Programme was founded in 2015 to support early-stage start-ups. With grant support from Istanbul's Development Agency in 2016, Koç University continued providing support to start-ups through the Kworks Entrepreneurship Research Center. To date, Kworks has added value to 50 start-ups and has helped catalyse EUR 2.5 million of investment in these start-ups.

***Özyeğin University — Entrepreneur Factory (Girişim Fabrikası)* [10]**
Özyeğin University's incubator programme, Entrepreneur Factory (Girişim Fabrikası), has been active for the past 5 years. In this time period it has received over 3 500 applications, 250 of which have been accepted into its programme. Of the 61 start-ups that have successfully completed the programme, 48 are actively continuing operations. To date Özyeğin University's incubator programme has employed 230 people and has catalysed investment of over EUR 3 million.

***Boğaziçi University — Imagine (Hayal Et)* [11]**
Boğaziçi University's incubator programme, Hayal Et ('Imagine' or 'Dream'), was founded 5 years ago. To date more than 250 start-ups have applied to the programme and 16 have been accepted for support. Bulent Üner, director of Boğaziçi University's Technology Transfer Programme, says: 'Our programme takes in a total of 12 start-ups: six that are already incorporated and six that are on the verge of incorporating.'

Boğaziçi University's incubator programme has graduated numerous successful start-ups. One of those success stories is Genomize, which is creating products around analysing human DNA. Genomize's software is being used in hospitals and laboratories. The Genomize team won an acceleration grant from ACT (Accelerating the Commercialisation of Technology) and is also receiving financial support from Tübitak's (Scientific and Technological Research Council of Turkey) 1512 Grant Programme. Genomize also won first place among start-ups applying for awards from the Royal Academy of Engineering's Leaders in Innovation Fellowships.

***Istanbul Technical University (İTÜ)* [12]**
ITU ARI Teknokent has contributed significantly to Turkish technological development by hosting 260 companies with over 6 500 staff. ITU ARI Teknokent offers many services, including tax incentives and work space, making it a major attraction for global technology companies and an important interface for university–industry collaboration in Turkey. The following programmes that specifically target start-ups are located at and administered by Teknokent.

- İTÜ Magnet: Teknokent's scale-up incubator. It was opened in 2017 as a working space bringing high-potential start-ups, investors, accelerators and independent experts together to create a growth-oriented entrepreneurial community.
- İTÜ Gate: Teknokent's international accelerator. It was started in 2014 to bring the best technology start-ups with market-proven products to the global market via the United States. With offices and mentors in San Francisco, New York and Chicago, İTÜ Gate helps Turkish technology-based start-ups to access the international market, providing them with training, mentoring and business networking.

Middle East Technical University (ODTU)
Similar to ITU ARI Teknokent, ODTU's Teknokent provides services to Turkish companies while hosting a number of programmes specific to start-ups, including the following.

- ODTU: New Ideas New Businesses (YFYI) [13]. Since 2005 ODTU Teknokent has been hosting the YFYI country-wide technology-based acceleration programme. YFYI is Turkey's first entrepreneurship support programme and accelerator, providing training and mentorship to new technology start-ups.
- ODTU: Animation Technologies and Game Development Center (ATOM). ODTU Teknokent also hosts ATOM, the first gaming acceleration programme in Turkey. ATOM aims to promote animation technologies and game development among university students and has supported the establishment of 25 new companies to date.
- ODTU: T-Jump, San Francisco Center. YFYI and ATOM entrepreneurs can not only tap into ODTU Teknokent's resources, but also have access to ODTU's incubation centre, T-Jump, located in San Francisco, United States. The primary objectives of the centre are to enhance the

export of new technologies out of Turkey and to establish internationally successful companies by facilitating entrance into the United States market and start-up ecosystem.

***Bilkent University — Cyberpark* [14]**

With a total of 18 universities, Ankara has the second largest number of universities after Istanbul. Bilkent Cyberpark is Turkey's first private science and technology park, and was established in 2002 in a joint effort between Turkey's first private university, Bilkent, and its affiliate Bilkent Holding. Cyberpark plays a significant role in Turkey's technology start-up ecosystem with approximately 240 high-tech companies, six research centres and over 135 incubation graduates.

The Cyberpark Accelerator Programme is a joint collaboration between Bilkent's Cyberpark and Innosphere in Fort Collins, Colorado, United States. CAP is a 16-week-long mentorship and business development boot camp for ICT companies aiming to penetrate the United States market. In 2015 CAP was recognised with a Most Innovative Solutions award, a contest hosted by the International Association Science Parks and Areas of Innovation.

***Sabancı University (SUCool)* [15]**

SUCool is a pre-incubation and acceleration centre for early-stage start-ups. It was founded in 2013 by Sabanci University, which the Turkish government has recognised as Turkey's most entrepreneurial and innovative university. Since 2014 SUCool's 6-month programme has supported a total of 38 start-ups through training courses, mentoring, business development, working spaces, investor relations and legal services. SUCool also organises 1-week 'international acceleration tours'. These were held in 2014 in Silicon Valley, in 2015 in Boston and in 2016 in London. During each tour, five start-ups take part in a demo night and spend the week meeting with investors, local entrepreneurs and managers of other acceleration programmes.

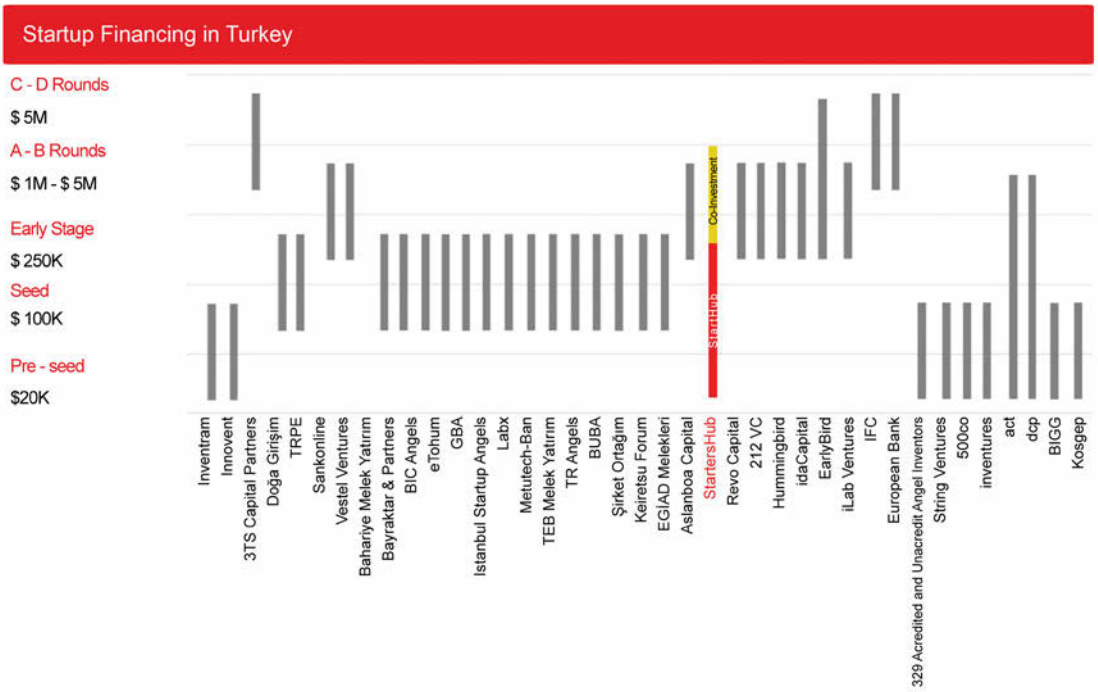
Aslanoba Capital [16] (private sector support)

Aslanoba Capital is part of the backbone of Turkey's start-up ecosystem. To date the company has invested EUR 70 million in 78 start-ups, a record amount in Turkey. In the last 3 years Aslanoba Capital has invested EUR 12 million in unsuccessful start-ups, while the value of its other investments has increased to EUR 80 million. Thirty-five of Aslanoba Capital's investments are based abroad, totalling around EUR 7 million. In 2015 Aslanoba Capital alone accounted for 44 % of investments in Turkey's start-up ecosystem. As for other angel investors, their active investments accounted for 2 % of the investments in 2016.

StartersHub: a regional entrepreneurship platform [17] (private sector support)

StartersHub was founded to provide start-ups with holistic support and with the goal of making Turkey a hub for entrepreneurship in the EEMENA region

Graph 3: StartersHub financing compared to other investment funds in Turkey [3]



(eastern Europe, the Middle East and north Africa). Indeed, StartersHub acts as a catalyst in the region's entrepreneurial ecosystem. With a 1 000-m² office space at the heart of Istanbul's Levent business district, StartersHub offers start-ups free workspace funding, mentorship, networking and strategic partnership support.

Investments made by StartersHub are provided by a private fund totalling USD 10 million. The fund was founded by one of the largest holding companies in Turkey, MV Holding; Gedik Investment, a prominent Turkish finance company; South Korean Netmarble Turkey, one of the prominent game publishers for programmes targeting the gaming sector; and Bahçeşehir University.

StartersHub invests between EUR 15 000 and EUR 250 000 into each start-up, though this number can be tripled if co-investors are involved. Every start-up accepted into the acceleration programmes receives EUR 15 000 of support with additional financial support up to EUR 250 000 provided through its post-acceleration programme and follow-on investments. Over the past 2.5 years StartersHub has invested in 41 start-ups, and the programme expects 1 000 + applications for its 2017 accelerator programme.

StartersHub Accelerator Program (Startupbootcamp Istanbul)

As a member of the United Kingdom based Startupbootcamp network, StartersHub's acceleration programme is one of the most successful acceleration programmes not only in the region but also within the Startupbootcamp family. The acceleration programme starts with 'scouting' and lasts up until 'demoday'. Scouting starts when applications open and scouters collaborate with other acceleration programmes and ecosystem players in the region. StartersHub staff participate in regional entrepreneurship events and organise interviews with entrepreneurs.

Due to its success and scouting activities, Startupbootcamp Istanbul [18] received over 500 applications from 63 countries in 2015 and 830 applications from 91 countries in 2016. Indeed, Startupbootcamp Istanbul's 2016 cohort has an exceedingly international profile, with seven of the 10 start-ups accepted into the programme from countries other than Turkey.

Game Garage [19]

Game Garage operates under the umbrella of StartersHub and is an acceleration programme organised in collaboration with South Korean Netmarble, one of the biggest game publishers in the world. Two of the six gaming start-ups accepted into the acceleration programme received follow-up investments.

StartersHub XO [20]

StartersHub XO, another programme that arose out of StartersHub, is a venture-building programme with global business associates in the fields of the Internet of Things, big data and fintech. The programme was launched for the first time in 2017 and teams that are accepted will develop their companies and be ready for exit within 6 months.

Global events

StartersHub has contributed substantially to Istanbul's start-up ecosystem by hosting events organised by non-profit entrepreneurship and innovation groups, along with global entrepreneurship organisations, free of charge. One of these events was the Swiss-based entrepreneurship contest Seed Stars [21].

StartersHub Portfolio Highlights [22]

- Sixa (Sixa.io) (Ukraine): your computer in the cloud. Sixa is a full computer that operates right from the cloud via a client app. It includes your choice of hardware and software and is capable of running most applications. Graduated from Y-Combinator with a valuation of USD 20 million +.
- Monument (getmonument.com) (Turkey). This is a smart storage device that collects personal photos and videos from smartphones and cameras and provides a simple way to store, organise, share and view them. Raised USD 900 000 on Kickstarter + Indiegogo (best in Turkey) with a valuation of USD 8 million.
- Zeplin (zeplin.io) (Turkey). Zeplin is a working platform for designers and developers. It is a collaboration software platform to enable developers and designers to work together on projects in a more effective way. Graduated from Y-Combinator with a valuation of USD 20 million +.
- Smart Moderation (smartmoderation.com) (Turkey). Smart Moderation protects you by automatically removing hate speech, spam and troll attacks with artificial intelligence. Initiated operations in California with a valuation of USD 10 million +.
- Eventbaxx (eventbaxx.com) (Germany). This is a company that provides a perfect solution for marketing campaign or content strategy by using digital swag bags. Opened a new office in Berlin with a valuation of USD 4 million +.
- Segmentify (segmentify.com) (Turkey). Segmentify is a conversion optimisation suite that helps online retailers to convert visitors into customers by personalised product

recommendations. Already operating in Dubai, Germany and France with a valuation of USD 7 million +.
- Promising projects. Thread in motion (threadinmotion.com); Poltio (poltio.com); Eyedius (eyedius.com); Kimola (kimola.com).

Mentor Effect

In March 2017 StartersHub embarked on a new initiative to train mentors and link them with entrepreneurs via an open collaboration platform. 'Mentor Effect' aims to increase the impact of mentorship in Turkey by training 'lead' mentors in Turkey who commit long term to working with a number of entrepreneurs. Trained lead mentors in turn agree to train new mentors following a train-the-trainer model. StartersHub welcomes mentors who have either started their own successful companies or who have track records in managing and leading within companies. Mentor Effect is just one of many initiatives StartersHub is pursuing to strengthen the Turkish start-up ecosystem [23].

Conclusion

Marking the 100th anniversary of the country's founding as a republic, Turkey's 2023 vision aims to increase Turkish exports provided by start-ups to 20 % of all exports. The 2023 vision envisages that in 6 years Turkey will have produced at least five global-scale enterprises valued at USD 1 billion. In order to achieve these goals Turkish start-ups need to be able to attract investment and scale globally. Fortunately, resources available to start-ups have increased in recent years, both in quality and in number. This accelerating trend of increased resources in the Turkish start-up ecosystem has put Turkey's ecosystem ahead of those of many countries in the region in terms of available resources.

However, much remains to be done to create a network of actors capable of producing global success stories. In speaking with other entrepreneurs and start-up mentors a common refrain is the lack of a comprehensive open portal. Such a portal would link the various sectors and entities within the ecosystem and provide a platform to find and exchange information and to collaborate. There also seems to be a prevailing but counterproductive mindset among individual ecosystem actors, one in which every player tries to become the one 'key' and dominant player. Instead, entities should direct more of their efforts towards connecting with others within the ecosystem. StartersHub's Mentor Effect platform is a step towards stronger collaboration and interaction between sectors.

During the World Business Angels Investment Forum held in February of 2017 in Istanbul, Turkey's weak points such as technology transfer centres and private sectors were discussed. The forum brought together key players from the equity market to focus on how corporate businesses can foster open innovation and deliver more business value through partnerships with angel investors, start-ups and SMEs. During the forum, angel investment networks overseeing EUR 50 billion worth of investment capital announced a new roadmap. The roadmap aims to facilitate start-ups in exiting within their own countries without moving to places like Silicon Valley, and in supporting countries in creating their own start-up ecosystems.

In addition, five arrangements were signed between the London Stock Exchange Group, the European Business Angel Network, the African Business Angel Network, the MENA Business Angels Network, the World Association of Investment Promotion Agencies and the International Chamber of Commerce. The five agreements aim to grow business by changing the ways that (1) start-ups work with angel investors, (2) angel investors work with global investors and (3) global investors work through the stock markets. Another outcome of the forum was an agreement to create a fund in Turkey similar to the angel investor fund created in Luxembourg by the European Investment Fund. Such a fund may help close the funding gap mentioned above.

Despite the barriers we can expect the Turkish start-up ecosystem to continue to flourish, considering the increasing support made available to start-ups. This is mostly thanks to Turkey's young and talented entrepreneurs, who are one of the country's greatest assets.

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PART IV

Industry and transformation

Article 13
Open innovation: the transition from OI to OI2 [1]

Abstract

Several approaches have been implemented by companies to elaborate open innovation (OI) 2.0 strategies. In this contribution we focus on the factors and the conditions of success that lead companies to formulate OI2 strategies starting from OI. Specifically in this study we note that three key factors enable the transition from OI to OI2 strategies: (1) technological pivot as a result of OI; (2) the presence of a clear appropriation strategy; and (3) the ability to orchestrate a rich ecosystem. Additionally, we observe four key managerial approaches, relevant for OI strategy, that are also important in the transition to an OI2 strategy: (1) carefully balancing internal and external resources; (2) leveraging organisational culture; (3) developing a sound business model; and (4) human resources management.

Introduction

The rise of the OI paradigm in the last decade has encouraged the emergence of cross-organisational innovation networks and ecosystems involving a variety of partners: universities, governments, users, citizens, suppliers, customers, start-ups and large firms [1].

In recent years, the interests of scholars, managers and policymakers have been increasingly converging upon the centrality of communities and ecosystems innovating together as a new emerging innovation mode. The OI2 paradigm is based on principles of wide networking and co-creative collaboration among all the actors of modern society, in generating and enabling innovation and creating 'shared' competitive advantages [2].

Ecosystem-centric, cross-organisational innovation involves both technical and societal aspects: actors involved in OI2 ecosystems collaborate and innovate based on common purposes, aligned efforts, shared vision and shared value co-creation. As a result, organisations evolving from OI towards OI2 business models are experiencing a shift from delivering products and services towards the development of distributed product/service systems [3].

Zappar Ltd, a company that we had the pleasure to study, provides a fascinating example of an OI2 strategy resulting from this evolution. The company develops augmented reality (AR) applications for digital devices through a proprietary-enabling technology, the Zapcode, an evolved version of the traditional QR code [4] completely developed in-house to maintain the firm's competitive advantage. In its first stages, Zappar used to work on a service-based, closed innovation model, but it soon realised the need to integrate its technology and systems into larger platform-based solutions in order to expand and scale the business. In a second stage of evolution of its innovation strategy, Zappar started to work on its project base, closely co-creating with its partners in an open business model, licensing the services based on its technology and embedding it in third-party AR applications. This led the company to a third evolution of its innovation strategy and business model, which is currently in progress. Zappar is investing in becoming the orchestrator of an external AR ecosystem and community of AR content creators. The company is developing an OI2 strategy, aiming at market leadership in a 'democratised' and distributed AR ecosystem in which its Zapcode represents the technology standard.

This article focuses on the transition from OI to OI2 strategies in European companies. Drawing lessons from five out of 13 case studies collected during previous research we compare and contrast the factors and the conditions of success that appear to be relevant to this shift [4, 5].

[1] Author names are displayed in alphabetical order.

From OI to OI2

We build on the results of a previous study conducted within the European innovation policies for the digital shift (Euripidis) project, a 3-year research programme launched by JRC's Institute for Prospective Technological Studies and DG Communications Networks, Content and Technology in 2013 to advance comprehension of innovation in the ICT sector [4]. We collected 13 case studies of European companies, including large, medium-sized and small enterprises, adopting OI in the ICT sector.

The results of our study revealed an evolution from an OI to an OI2 strategy in five out of the 13 companies in our sample. Analysing the companies' OI strategies throughout their evolution, we noticed that:

- multiple different reasons underlined the shift, ranging from scaling up their business to introducing a new business model or breaking into a new market;
- some of the conditions of success that were significant for OI strategies are also significant for OI2 strategies.

We identified three common features acting as enabling factors and four key managerial approaches (which we call conditions of success) in the shift from OI to OI2. We discuss each of these enabling factors and key conditions of success in the following sections.

Enabling factors

The first factor enabling the transition from OI to OI2 is the presence of a **technological pivot**. Specifically, companies in our sample have anchored their OI2 strategies to a previously developed technology, often resulting from an OI strategy that embraced strategic partnerships, participation in large R & D consortia and/or grants awarded through the small and medium-sized enterprises instrument in the eighth EU framework programme, Horizon 2020.

However, the evolution from an OI to an OI2 setting requires a balance between openness and control (i.e. 'you share what you have better control over'). Hence, the second factor enabling the transition towards a community-centric innovation model was the presence of a **clear appropriation strategy** [6]. We observed that European companies managing the shift towards the creation of distributed ecosystems of partners, users, customers and/or suppliers faced a critical balance between the opportunities and the risks of an OI2 approach (high levels of community engagement vs loss of technological control). These companies had to clearly identify the mechanisms (selective knowledge revealing, formal contracts, effective IP protection mechanisms) that guaranteed the alignment of the community incentives and appropriation of the value created through their technological pivot. Such a balance between appropriation strategies and community involvement represented a critical governance choice that led to adequate returns on R & D investments.

Regarding the development of successful OI2 strategies, companies in our sample contributed to mutually beneficial interactions playing crucial roles: they were able to orchestrate the varied interests of the different involved stakeholders/communities in order to guarantee the creation of a shared vision, a shared value and therefore the success of the OI2 for the entire ecosystem [1]. Being part of an OI2 ecosystem provides significant benefits to the companies: high visibility and good reputation, easy access to complementary assets and the flows of knowledge and information on R & D priority setting that stem from the communities in which they are actively involved. Hence, the third and last factor that characterises the transition from an OI to an OI2 strategy relates to the **ability to orchestrate a rich ecosystem**.

Summing up, analysing the results of our previous study of the OI cases in the ICT sector, we noted that three main factors — (1) technological pivot as a result of OI strategy; (2) the presence of a clear appropriation strategy; and (3) the ability to orchestrate a rich ecosystem — enable the transition from OI to OI2 strategies.

Key conditions of success

Having identified the three factors enabling the shift from an OI to an OI2 strategy, in this section we discuss the key managerial approaches that were relevant in the transition, acting as conditions of success. Drawing on the results of the study conducted within the Euripidis research project, we identify four key conditions guiding the successful transition from OI to OI2. As such, these factors appear to be relevant in both types of settings (see Table 1): (1) carefully balancing internal and external resources; (2) leveraging organisational culture; (3) developing a sound business model; and (4) managing human resources.

First, one of the conditions driving OI effectiveness is the **balance between external and internal resources**. Successfully managing strategic inflows and outflows of knowledge in an OI setting requires the ability to select and nurture relevant and synergic internal capabilities to benefit from a joint development with external partners. Companies that fail to pay attention to the development of internal know-how may lack the relevant absorptive capacity to engage in fruitful OI strategies. In the transition towards an OI2 setting this balancing acquires a crucial role for the success of the strategy because companies need to adequately allocate their assets.

When OI2 strategies are approached companies need to effectively distribute their resources between their traditional business and the activities openly conducted, and in collaboration with the different communities of stakeholders. An appropriate balance of internal and external resources allows companies to avoid the risk of failing and losing control over core competencies and to pursue the evolution and adaptability of their business model.

Second, **leveraging organisational culture** is one of the most important managerial tasks when companies implement OI. To begin with, the diffusion of an 'open innovation culture' within the organisational boundaries (e.g. shared vision, shared values, common language) is essential to set out the incentives to collaborate beyond 'business as usual' and, therefore, guarantees the success of the open strategy. Furthermore, the culture of openness needs to be disseminated among the actors involved in open projects. Indeed, selecting complementary and compatible partners and sharing with them the companies' values, languages and organisational routines is fundamental. This condition of success becomes increasingly meaningful in the transition towards OI2, a setting in which the number of the actors and, subsequently, the interests multiply and diverge even more than in other collaborative strategies. A shared culture and the definition of clear measurements of success remain vital between partner institutions for the fruitful implementation of OI2. Trust building becomes a crucial issue in dynamic OI2 environments, enabling fast and frictionless knowledge flows among partners and, therefore, fast scalability of the business model.

Third, **developing a sound business model** is a well-known condition for success in the implementation of OI strategies [7]. The evolution from a closed to an open business model strongly supports OI effectiveness, allowing the alignment between the company's own objectives and those of the partners in the value network in the long term. The evolution of the business model is even more important for companies managing the transition from an OI to an OI2 setting, in which collaborative communities and competitive markets co-exist [8]. We observed that companies managing the transition towards an OI2 business model have stretched their focus beyond the needs and interests of single partnerships; OI2 business models aim at aligning the incentives and the interests of communities involving several actors ranging from their industrial and research partners, to other sector stakeholders, to their users.

Finally, yet importantly, **human resources management** is a recognised crucial factor driving the successful implementation of OI. Companies that have implemented OI have paid great attention to setting up a system of incentives that could align the interests of their partners and human resources involved in OI projects. In cases in which we observe a transition from OI to OI2, the active participation of citizens and users as communities of external innovators is relevant. Specifically, we observe that these companies have increasingly boosted their offer and developed new and scalable business models by setting up a system of incentives that could work not only for their partners but also for the community of users. Promoting crowdsourcing mechanisms and rewarding users' contributions are two key initiatives that support the notable efforts of engaging with communities of external innovators. Large companies implementing OI2 are also developing new interaction channels. For example, intraorganisational knowledge-sharing platforms are increasingly used in order to map skills and share experiences. Moreover, several companies are investing in training human resources to interact with other actors in the ecosystem that often possess different types of knowledges. Moreover, they are increasingly involving 'external innovators' (e.g. clients and/or suppliers) in seminars and workshops

Table 1: A comparison between OI strategy and the transition from OI to OI2

Key Conditions Of Success	Reasoning
	OI Strategy
1) Carefully balancing internal and external resources	Balancing outsourcing of R&D processes and development of internal knowhow
2) Leveraging on organisational culture	Sharing companies' values, languages and organisational routines to complementary and compatible partners
3) Developing a sound business model	Setting up a business model that takes into consideration the partenrs+ needs and interests
4) managing human resources	Setting up a system of incentives that could work for partners and collaborators

aimed at shaping future scenarios. Finally, they interact with universities and public institutions in human resources training programmes (e.g. through the development of industrial PhDs).

Implications

First, drawing on our study conducted within the Euripidis project we have identified three key factors that enable the transition from OI to OI2: (1) technological pivot as a result of OI; (2) the presence of a clear appropriation strategy; and (3) the ability to orchestrate a rich ecosystem. Further analysis is necessary to explore other factors that may characterise this transition. However, to what extent can we generalise that these three factors characterise this transition? Could we maybe argue that these three enabling factors may not exist?

Second, we have also recognised four conditions of success that are relevant in the transition from OI to OI2: (1) carefully balancing internal and external resources; (2) leveraging organisational culture; (3) developing a sound business model; and (4) human resources management. Interestingly, we have noted that these four conditions of success are usually relevant in the implementation of OI2. Hence, the main message we ought to communicate in this article is that companies that evolve their innovation strategy from OI to OI2 should take into account that the conditions of success that were relevant in OI are also important in an OI2 strategy. However, their mind frame is different: it shifts from partnerships to community of partners and users. Companies clearly need to be well aware of the elements that are critical in securing them a strategic advantage in their OI strategy. Nonetheless, our contribution suggests that when companies shift to an OI2 they need to re-elaborate their entire approach to innovation, reconfiguring their strategy. This implies further issues to be explored: did companies develop the right approach to internally face this reconfiguration debate? Could industrial policy facilitate such a debate?

Third, the cases that we have analysed show an evolution of company strategy towards more competitive implementation of the business model.

Having identified these factors, policymakers and managers should keep these in mind as impeding aspects or favourable elements in order to facilitate the implementation of OI2.

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Article 14

The future focus for open innovation

Abstract

Open innovation has matured into a major innovation process during the past decade. Digitalisation has enabled more sophisticated collaboration and value creation models that, along with the accumulated learning and knowledge base, have encouraged companies of all sorts to start with open innovation initiatives. Recent research has expanded the focus of open innovation to the spatial and structural perspectives, technological enablers and platforms, along with the networked and systemic nature of the practice. This broad scope has led to the convergence of different innovation, technology and business research streams. While this is a very positive development, multiple overlapping terminologies and definitions cause confusion and raise the question of what the essence of open innovation is these days. With data collected similarly from people, machines and objects, the definitions of open innovation, big data and Internet of Things (IoT) innovation become somewhat blurred. In this paper we present a framework for the key characteristics of open innovation and with the main management questions for the digitalised era. This framework will contribute to a better understanding of open innovation opportunities and valuation of knowledge inputs.

Introduction

The open innovation paradigm has evolved from a modest activity to a mainstream innovation concept, following very similar development and diffusion paths to those of open-source software technologies, which are also considered among the key enablers for the scalability of innovations [1]. These days, all major companies include open innovation in their processes and build communities with users, customers and developers. The public sector has various open innovation and citizen engagement initiatives, and all major academic conferences feature open innovation tracks. Among the key players, the European Commission has demonstrated long-term support and commitment to open innovation both in political statements and in research and development instruments.

However, the most impressive development can be witnessed from users and the public in general. People have embraced the possibility to participate in and engage with the supply side of innovations and to become active contributors for product and service design and development, public decision-making, social media evolution and even economic development, through start-up activities and developer communities. This has led to a whole new culture and paradigm in the way companies interact with their customers and partners, and can be considered a great success story and proof of concept for open innovation.

Digitalisation has opened up new opportunities for open innovation and makes it more accessible for new actors. Ever more complex product and service configurations have challenged the existing value chains and strategies, and companies are increasingly looking for competences and collaborations from outside of the company. The new collaboration models build on two-sided technology platforms and application programming interface-based development, systemic approaches to innovation and increased use of digitalised data [2]. Products are increasingly smart and connected, and offer improved information on customer processes and preferences, along with the operation and management of products and services [3]. This has led to multimodal data-collection channels whereby companies can derive data from their customers both as voluntarily offered verbal and qualitative data and as quantitative data collected from transactions and IP profiles over the internet. This increases transparency, customisation of offering and operational efficiency, and opens up new opportunities for value creation.

This development in customer engagement and digital data collection raises the question of what exactly represents open innovation in this process. By the classical definition, open innovation is ‘the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation’ [4]. Do we understand this as the voluntary contributions by users and communities through formally set-up feedback channels, or would we also consider digital user data collection by search engines and algorithms in automated format as open innovation? It also raises a discussion on what data are and when they become knowledge. This question highlights the importance of

the interpretation and context of the data application, which can only be done through a company's internal processes. Considering the second part of the definition on the use and impact of the collected data, we could argue that the collection of digital user data has led to a more significant societal and business impact than the traditional user contributions and has expanded the market for innovations through network externalities and diffusion.

Further questions are raised by innovation definitions. We talk about systemic innovation, innovation for co-creation, innovation networks, innovation tools, policy innovation, service innovation, etc., to name only a few. While we can claim that this is just semantics, there are separate research communities on each different stream of innovation, and their research builds on completely different theoretical foundations. Let us take an example of supply chain innovation, which these days builds heavily on integrated supply chains and the use of digital technologies for process optimisation and real-time tracking. Would this integration of activities with suppliers and value-chain partners represent systemic, networked or open innovation? It would fit the definition for each category, and the research question and the applied research approach finally define the focus.

While it can be argued that the applied terms and labels do not really matter, we claim that in order for open innovation to be recognised as a real research area, and to generate a sustainable knowledge base, we would need to set a few parameters for open innovation and regularly update the definitions. On top of this foundation, we can — and should — embrace the plethora of different approaches to and applications of the paradigm. This call for more specific definitions is not new. Esteemed scholars like Gassmann, Enkel and Chesbrough [5] present nine perspectives for the future of open innovation, namely the spatial, structural, user, supplier, leveraging, process, tool, institutional and cultural perspectives. This very comprehensive list of perspectives covers all the major dimensions of open innovation, though the focus is on development of new products and services rather than process and business-model innovations, which are increasingly the innovation focus in companies. They also looked for the type of partnerships for different market conditions, and estimated the importance of the different knowledge inputs from customers and partners in the different market environments.

Lafarotti and Manchini [6] propose a typology for corporate strategies on open innovation depending on their partner variety and innovation funnel openness, while Bahemia and Square [7] focus on the objectives of the innovation projects in terms of novelty, product complexity and the appropriability regime. Tidd [8] has called for more discussion on the dichotomy of open versus closed innovation, which he considers false, and highlights instead the importance of application, context and contingency. The innovation paths vary by industry, sector and strategy. Open innovation research has also been criticised for the lack of critical analysis of its limitations [9].

Building on the earlier work on open innovation definitions and experiences on recent large-scale European Commission technology innovation projects, we propose a life-cycle view on open innovation as a paradigm. Interestingly, the growth and evolution paths for open innovation follow the recognised life cycle and diffusion patterns for products, industries and business models.

The evolution of open innovation

During the early introduction stage of open innovation the community and researchers struggled to be recognised as a discipline and to gain visibility within developer communities [10]. The early adapters started experimenting with the concept, and the practice gradually expanded to broader communities. A number of focal actors played a key role in the development, namely Henry Chesbrough and Eric von Hippel from the academic side and, in Europe, the European Commission as a mediator for collaborations like the Open Innovation Strategy and Policy Group (OISPG) and the European Network of Living Labs, which created and mobilised the community around open innovation. There were sceptics, and the diffusion of the paradigm required significant investment by forward-looking companies and public funding agencies.

During the growth phase the early majority adopted the concept, and challenges were faced with the scalability of the concept, and partly also with the business logic and return on innovation investments. Questions were raised on the quality of user inputs, the feasibility of implementation and the cost of open innovation projects. The collected data were mainly qualitative, which raised concerns regarding validity and reliability. The tools for open innovation were underdeveloped and severe skill shortages still existed, and thus the projects typically remained labour intensive and costly. Different approaches were experimented with,

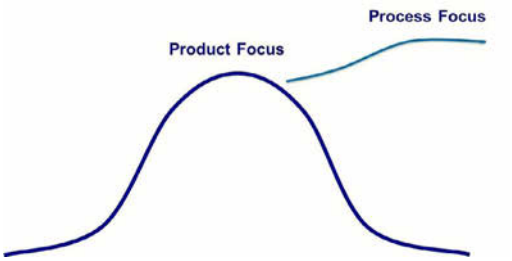
including sectorial focus, regional ecosystem focus and cross-border experimentation. Several projects featured community platform development, handbooks and integration with other research communities. Gradually, open innovation communities gained momentum, and large companies also joined the efforts.

Open innovation could now be considered to have reached the maturity phase. The late majority has found the paradigm and accelerated the diffusion of the practice though network effects and investments in tools and knowledge sharing. Networked product creation has become an industry norm, and a culture of openness and sharing has been established. The attitudes regarding soft standards and open interfaces have become less critical as major hurdles related to privacy, data confidentiality and owner rights have been partially clarified. Joint industry-level open innovation initiatives are generally attended by all major parties, since the case for openness and scalability has been validated. Companies have typically specified various strategies for their approach to openness and ecosystem collaboration for various product categories and markets. The questions mentioned earlier regarding open versus closed models are gradually becoming obsolete.

With this we could consider open innovation to be at a crossroads. The inevitable decline in the growth of adaptation is looming ahead, and the life cycle for the concept as it is today is starting to come to an end. According to the classical life-cycle theories [11], at this point the alternative strategies for a methodology would be to introduce something new to the value proposition or to let the concept gradually be replaced by a new one. On the other hand, the application focus typically shifts at the maturity stage from the product or service to the process [12]. While open innovation in the early stages was considered to be a process for new product development, and related articles featured mostly in R & D journals, the process and business-model focus provides significant opportunities for optimisation, new revenue creation and improved customer experience. This is the direction towards which we envisage open innovation developing, mirroring the evolution of the innovation paradigm in general, whereby the most profit and value is created in the business model and process rather than in product innovations [13].

With advanced digital technologies the optimisation of processes has been the main focus, especially in business-to-business operations where the most profitable and well-known IoT and big-data applications have arisen. The research questions shift from the collection of data to the intelligent application of

Figure 1: Open innovation life-cycle view



that data to the use context. Different actors are finding their position in the data value chain and specialise in selected strategies. In the digital ecosystem, companies like BMW, GE and ABB have announced collaborations with software companies rather than trying to own the whole ecosystem themselves; they let the others deal with the data, while these anchor firms focus on building value on it. The same development takes place in the smart city context, where the public sector takes an active role in facilitating the development of services, acting as the nodal point in collaboration. This has opened niche opportunities for new actors and has created completely new categories of work and products. In such ecosystems collaboration between companies, end users and developers is automated, and the objective is to develop scalable service blueprints that can easily be customised for different application contexts.

The main characteristics of open innovation 2.0

The term 'open innovation 2.0' was introduced a few years ago to highlight the difference between the early attempts at open innovation and the new wave of professionally managed open innovation initiatives [14]. Open innovation 2.0 focused increasingly on sustainability in terms of environment, societies and industries, as well as on the role of governments and regulators. Entrepreneurship and diversification of economic base also received increased emphasis. This was a clever and much-needed update for open innovation, and also helped the community and practitioners to see that the paradigm change in open innovation had indeed taken place, and had elevated the practice to a whole new level. However, the new paradigm was only partially defined and was used mostly for communications purposes. More detailed discussion on the definitions of the new model of open innovation is still missing.

Innovation research in general is increasingly focused on technology innovations or technology-enabled new processes. This is logical, with the role of technology as a driver and enabler for new business and as a game changer in our society of late. The gradual evolution in internet development brings

significant societal and economic opportunities for reducing various costs for societies, creating efficiencies, increasing services for citizens in a vast number of areas and fostering sustainable economic growth with notable productivity gains. However, the focus on technology continues to raise concerns regarding the lack of focus on managerial, societal and human considerations. Critical voices have already been raised concerning the focus on technology in research funding and the development paths that this focus dictates for our societies. Further questions are raised regarding the accumulation of power and wealth in a few organisations and the polarisation of societies.

In this development, open innovation and related communities have been positioned as the representatives of the end users to balance the technology push with the market [1]. Another major definition was the focus on quadruple helix collaboration involving the public sector, people, small and medium-sized enterprises and academia, and thus democratising the innovation process [15]. This focus is still relevant for open innovation, even though the approaches need to be adjusted with the new market dynamics. The concept of a user in today's ecosystems becomes blurred as the actors have several roles and modes of interaction. The different user groups and segments still remain, and thus more specific strategies for reaching each segment are needed. The level of coordination in collaborative solution creation has shifted increasingly from the single company level to the ecosystem level.

With this, the proposed focus for open innovation could be on orchestration at the ecosystem level. This would involve processes that cannot be automated, including the identification of different ecosystems, actor roles, relevant collaboration methods and value capture. The underlying questions would include methodologies pertaining shared objective setting, scope of collaboration and the models for sharing a jointly developed foreground. The application areas would typically be cross-sectorial, and thus more relevant approaches would be discussions on macro, meso and micro layers.

With increased focus on value capture and application of knowledge, the management of knowledge that flows across and within the companies becomes of greater importance. It has been established that collaboration with external parties leads to higher revenues [16], and companies that apply more external knowledge inputs also release more of their own data and intelligence to external parties. The key management dilemmas in this process become the companies' absorptive capabilities and ability to anchor and diffuse relevant data and knowledge to their processes. This process requires tacit knowledge of the corporate internal processes, opportunity identification and management incentives for innovation. In order to be successful in this process companies should maintain their R & D capabilities and build on their exclusive knowledge. Knowledge-mature companies identify opportunities from the new combinations and configurations of data and services, internalise new knowledge fast and are able to act in an agile manner on emergent opportunities. Complex combinations of technical knowledge and business processes provide the necessary protection from emulation.

Process and business-model innovations are a third dimension in which open innovation has a lot of untapped potential. With decreasing product margins management's focus shifts to services, processes and business models. Insights into customers' value drivers, use patterns and unserviced needs offer new opportunities for better servicing the customers and jointly developing new value. Business-model innovation is an under-studied area in ecosystem-based value creation, especially in digital ecosystems [17]. The principles and processes from open-source software communities can be applied to better understand this dynamic. Open-source software business models rely on approximation and complementarity to other resources such as human capital or proprietary products and services. This can include the supply of support personnel, user toolkits, coordination functions or virtual communities [18]. Open innovation business models typically follow similar paths with indirect and subscription-based models rather than direct product sales.

With this we propose that ecosystem orchestration, knowledge management and business process be redesigned as the key application areas for open innovation in the future. The product- and service-development focus would be replaced by an emphasis on process development and value capture. Companies' positions in value chains and networks would need to be reconsidered, with the new technologies overriding the traditional platform-based 'winner-takes-all' models. New opportunities for niche providers would be generated. In these loosely coupled ecosystems open innovation principles and models would apply to ecosystem orchestration.

The concept of a user would become more complex and multi-sided, resulting in various engagement models and contractual terms for different user and developer groups. Data and knowledge flows would become complicated, and the key managerial challenges would focus on filtering and interpreting data for renewal of the company's offering and processes. Further questions related to the quality and valuation of data still need to be answered before data-driven business models can be developed.

Table 1: The dimensions of open innovation in the digital era

Managerial Focus	Open Innovation Dimension	Focus Area
Growth	Ecosystem Orchestration	Orchestration Models
		Contractual Terms
		IP Management
Renewal	Knowledge Management	Absorptive Capability
		Business Intelligence
		Big Data Management
Profitability	Business Process Management	Proces Optimisation
		Business Models
		Customer Experience

Paralleling open innovation with open-source software applications, the roles of the user and provider are typically reversed, with the software communities and companies providing technologies for the use of users. In today's data-driven markets we can consider companies that apply open innovation to be customers of user data. Data become the currency of exchange, where both parties seek to create value. In this, the end user of services becomes a trader of their data, and the service-providing companies become their customers. This reversal of roles in the open innovation process is intriguing, and opens questions regarding the valuation of knowledge and data inputs. Challenges in the business sense are caused by the definition of the value of data, which is asymmetrical and often subjective.

We have learned from the dynamics of these relationships in open-source software markets, and thus can apply them partly in the area of open innovation. The main challenges identified from the open-source software adopter's viewpoint are:

- reliability: the lack of documentation and the inability to negotiate contracts and service-level agreements [18];
- standardisation: the market is still missing dominant standards for open interfaces, which has led to challenges relating to quality, interoperability and versioning [20];
- usability: the challenges related to integration into heritage systems and interoperability with supply network partners' systems [21].

Reliability challenges in open innovation can be caused by the users' selection of ecosystems and processes they choose to contribute to. There are no contractual relationships, which leads to an increased risk if the company builds its strategy on external knowledge inputs. Standardisation and regulations regarding privacy, data security and consumer protection are expected to change, and their impacts on companies remain unclear. The challenge of usability is discussed widely in the big-data management community, and the same challenges of volume, velocity and variance can be identified in open-source projects.

Conclusion

The brief history of open innovation in Europe is marked by intensive growth and evolution, which can be attributed to strong industry support by groups like OISPG, along with the European Commission. With such strong institutional support the movement gained credibility and momentum, which led to fast-paced diffusion of the practice in local communities. It has since developed from a hobbyist's activity to a mainstream business practice at an unprecedented pace. However, with parallel market and business developments it is important to revise the positioning and principles of open innovation in order to separate it from the numerous emergent collaboration concepts. This would sustain the original principles of the European open innovation model, which differs from the international models through its specific focus on democracy, equality and well-being. In this paper the authors proposed that open innovation has come to a life-cycle stage in which its value proposition and scope need to be redefined in order for the paradigm to remain relevant and for the application areas to be defined. The authors propose an increased focus on the blurred and even reserved roles of service providers and users in the digital ecosystem, where consumers and customers can be considered to be traders of their data and knowledge and the service providers or suppliers their customers. In this perspective the value of open innovation can be better quantified and can lead to the emergence of the paradigm of data-driven markets.

The authors propose three dimensions in which the traditional principles and processes of open innovation could provide a significant contribution in the future. With digital development, open ecosystems in which the companies have no formal contractual

relationships and data can bypass the digital platform owners are an emerging research area, and solid models for ecosystem orchestration would be needed. The open innovation community has a broad knowledge base on orchestration and IP distribution models that could be modified for digital ecosystems, collaborative service creation and IoT application.

Knowledge management remains another important and under-studied area in digital ecosystems. The processes of translating data into knowledge and intelligence has been among the focus areas for open innovation, but is still underdeveloped for big-data applications. Company processes for using data and user inputs for tangible business benefits still requires more research, and could benefit from open innovation processes. The third area identified for open innovation applications is collaborative processes and business models. Increasingly complex and integrated solutions offer opportunities for new business models, customer experience and efficiency gains. However, building on that capacity requires a broad understanding of the industry on a system level, which has been the focus in open innovation projects from the beginning.

The article contributes to the new definition of open innovation in anticipation of the era in which knowledge assets are fluid and data become the new currency. The authors suggest that the niche for open innovation in this era lies in the management of knowledge flows and translation of the data into intelligence.

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Article 15

Is it time for full open innovation? Reflecting on roots and renewal

Introduction

Why is open innovation thinking so important for Europe and its cities and regions? Is technological innovation not enough? Are there not sufficient 'new things' to help us out of the present crisis and let us cash in on the prosperity potential so long promised to us? Is there not an app for everything today?

But what 'crisis' are we referring to? Crises abound; these days in the media it often seems that every setback or challenge is labelled a 'crisis', as if the resilience of 21st-century European society is so low that sometimes even simple problems seem insurmountable. There are problems enough that should be addressed, many quite complicated, complex or even chaotic; but the present 'crisis mentality' is not the most effective way to marshal our intellectual capital and collective intelligence to deal with them. We need a 'challenge mentality' which allows us to reframe problems and threats as opportunities, and open solution-seeking perspectives to leverage the thinking and doing power of diverse organisations and people. It requires making better use of our strengths. This is the promise of open innovation 2.0 in actual practice.

There is a big difference between innovation (in traditional terms), open innovation (as first postulated in the early 2000s) and the emerging possibilities of open innovation 2.0 in full operation. The promise of open co-creative collaboration is great; but unfortunately, for the moment, this kind of thinking and acting is not yet widespread in Europe. Our society is changing, and with it some fundamental aspects of innovation are changing as well. Issues like access to knowledge on a minute-by-minute basis, big changes in education, migration, demographics, disruptive technologies and the use of interactive media are major factors that shape the new landscape for open innovation. As new situations emerge our capacity to leverage our resources of thinking power and good practice need renewal as well.

There are new challenges emerging that were not anticipated even a few years ago: no one would have believed 5 years ago that Europe would have an exponential influx of migrants from the Middle East and Africa; or that fact-free politics would spread rapidly across Europe and North America; or that people would explicitly cast doubt on the current political and intellectual elite through referenda or elections. Do the present discussions around open innovation 2.0 offer people enough perspective to think and act in the collaborative solution-seeking ways society needs? Unfortunately it does not seem to be so. Open innovation 2.0 has clear principles and inspiring concepts, set out in earlier editions of the yearbook and presented at international conferences. But practice makes perfect, and the question is: is there enough practice? There are some excellent examples of working with open innovation 2.0 in society, but many texts about open innovation 2.0 are still written for academics and the already initiated. Are we preaching too much to the converted? Are the stories compelling enough to inspire new action by those not yet initiated? Are we actively inviting 'new' people to join, and at a more fundamental level do we accept that, if they join, we must change and adapt too?

Outside the realm of business and universities we need to attract more non-governmental organisations and engage more citizens in open innovation 2.0 practice, and to actively join the initiatives that citizens are already engaged in. We need to report on their practice, sharing good examples of social and societal innovation, ecosystem orchestration and citizen-driven innovation. Their stories need to be told, and told in the language appropriate to the audience addressed. We argue that open innovation 2.0 theory is already in place, but is not yet adequately translated to the language of the diverse practitioners who need to put it into practice. We especially need translation into the language of the end users — citizens of diverse ages and backgrounds — because it is our citizens (be they government officials, industrial leaders, entrepreneurs and artists, working professionals and factory workers, consumers, teenagers and grandmothers or all the ordinary people in the streets) who must benefit from the services, buy the products and adopt the mentality. As the Dublin declaration (described on the following page) tells us, there is no innovation without adoption. Beyond that we need to engage these citizens directly in processes of co-creating innovation. We need more attention to social — and societal —

innovation and the issues that matter to people. We must focus on what works and where, with good descriptions of why — in that specific situation — things went well. And we must stop with what did not work, remaining curious about why it did not.

This article intends to make open innovation 2.0 more accessible to the curious and uninitiated. It will relate OI2 concepts to some of the challenges facing European regions, and give a few examples of good practice or breakthroughs. It also offers some reflection on what has been accomplished, what is emerging and what is needed to move on. In this article we argue that it is both timely and necessary to work with a framework for open innovation that fits tomorrow's challenges and today's societal developments — hence the framing of 'next steps' that we would like to call full open innovation 2.0 in practice.

Take it from the top

Before we deal with where open innovation 2.0 is going we think it is important to reflect on where it has come from. Originally, open innovation was intended to stimulate innovation within the framework of the time (the 1990s). This stimulated some surprising collaborations between companies, sharing intellectual property rights to create unexpected new products. In Henry Chesbrough's breakthrough book *Open innovation: the new imperative for creating and profiting from technology* (2003), open innovation referred to 'a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology.' More recently it has been defined as 'a distributed innovation process based on purposively managed knowledge flows across organisational boundaries' [1].

Open innovation 2.0 widens the scope, and extends it to include the diverse stakeholders of the quadruple helix and the innovation ecosystem. One of its original objectives is 'the recognition of a new innovation paradigm, i.e. open user-centric innovation, as well as to get it into European policies' [3]. As a thought leader, Martin Curley writes, 'Today, the concept is evolving fast. Driven by plummeting communication costs and the ever-increasing numbers of connected people and devices, it has never been so easy to exchange information and ideas' [2]. Between 2010 and 2017 we have seen the steady development of strong open innovation 2.0 concepts and practices.

Figure 1: Open innovation 2.0 in 20 snapshots [3]

Figure 2: Dublin declaration [4]

Dublin Declaration – Open Innovation 2.0 May 20 & 21 2013

Mission: Develop a widespread innovation literacy in Europe

Vision: Open Innovation 2.0 – The next new Official Language of the European Union

- Action No 1: Develop a new business model for the European Union
- Action No 2: Design for a new end state
- Action No 3: Create an EU Innovation Strategy
- Action No 4: Move from European Research Area to European Innovation Ecosystem
- Action No 5: Create a European Innovation System and Capability
- Action No 6: Quadruple Helix Innovation
- Action No 7: Focus on Innovation – *Adoption Matters*
- Action No 8: Create incentives to encourage Openness to Innovation and Experimentation
- Action No 9: Stimulate High Expectation Entrepreneurship
- Action No 10: Drive Intersectional Innovation
- Action No 11: Promote Successful Innovators and entrepreneurs as Hero's

- The OISPG (Open Innovation Strategy and Policy Group), now with around 35 members, was created in 2010 to share knowledge about and disseminate the lessons of open innovation 2.0. It unites industrial groups, academia, governments and private individuals to support policies for open innovation at the European Commission. The achievements of the OISPG include its six yearbooks and five international conferences. These are excellent sources of knowledge and inspiration, and resources for knowledge networking.
- In diverse articles, many open innovation 2.0 concepts have been described and visualised, most notably open innovation 2.0 in 20 snapshots (see Figure 1). Short descriptions of the snapshots are available [3], and the snapshots image has been presented at conferences around the world. Strong visual images for each item, based on practical examples, would make it even more accessible to a wider audience.
- The first International Open Innovation 2.0 Conference in 2013 gave us the Dublin declaration, a set of clear and inspiring principles for anchoring open innovation 2.0 in modern organisational practice (see Figure 2). It remains an excellent common theme for thinking about how to turn common sense into disruptive practice.
- At the third International Open Innovation 2.0 Conference in Espoo (2015) people set about describing how to anchor this in actual practice. One of the results was the Espoo action process,

inspired by how the city of Espoo orchestrates its innovation processes. Some ingredients of this were formulated as the Espoo action process: 'Eight action fronts for realising open innovation 2.0 in practice' (Figure 3).

- At the fourth International Open Innovation 2.0 Conference in Amsterdam (2016) a further step was taken to develop 'innovation literacy' in Europe: the initiative to develop a pattern language for open innovation 2.0. Curley's article in Nature [2] describes the first patterns, along with several recent OI2 examples from the world of business and industry.

Figure 3: Espoo action process [5]

Some important open innovation 2.0 concepts, such as ecosystem thinking and the quadruple helix, are already entering the mainstream of Brussels discourse, and their use has started to spread throughout the pioneering regions and cities of Europe. Open innovation 2.0 ideas may be on the verge of breaking through to a wider public, especially in the realm of business and universities. But this is only part of the picture.

What is needed now is more attention to social and societal innovation and to citizen-driven initiatives. Citizens of all kinds, and especially young people, seniors and migrants, need to enter the mix as equal partners in the innovation ecosystem in order to effectively address the challenge of creating better public goods. This requires definition of the skills, competencies and literacies of innovation and how we can best learn them. It can be supported through open dialogue with citizens, including a multigenerational innovation dialogue, and the renewal of educational institutions. Some of this is already taking place, and to further encourage these processes we propose a next-step framework for thinking about and working with open innovation in practice.

Drivers of open innovation in practice

When it comes to the modern development of open innovation concepts we believe that two of the most important cornerstones are the changing role of citizens (and the growing importance of putting the citizens first) and the changing role of government. These relate directly to the Espoo action process.

We focus below on the importance of engaging the citizen and the crucial role government can play in creating an innovation ecosystem that fits the needs of society.

The growing importance of putting citizens first

People throughout Europe are seeking a new balance between the responsibilities of government and an active society. Government can no longer take the sole responsibility for dealing with societal problems; citizens can no longer simply question or complain about what their governments do or do not do. The role of new technology, social media and social entrepreneurship, the empowerment of stakeholders and the changing set of competencies for government professionals to be responsive and appreciative to citizens' initiatives are vital issues.

What is the role of citizens in open innovation 2.0? We think that citizens will transform from being merely consumers of policy to becoming co-producers of public goods, using processes supported by technological development, social media and face-to-face generosity. A real transition is needed, and we can see it happening already when we look at energy cooperatives, neighbourhood banking, Airbnb, crowdfunding platforms and the sharing economy. But this also requires that public services be redesigned to mobilise and enable people to help each other, working alongside paid professionals. That is a challenging task. It requires some significant shifts: from managing resources to mobilising them; from delivering to facilitating; from mid- and long-term policy planning to resilient, agile activities; from thinking about what a specific service can provide to exploring how to tap into resources out of the public sector's direct control [6]. 'In short, we need to put the public back into the heart of public services' [7].

The 2013 working conference Borders to Cross, in Amsterdam, let us see that there is a vibrant culture of citizen-driven innovation across Europe and beyond. The world is full of examples of democratic innovation and social change. Citizens have been taking public matters into their own hands, driving change through efforts to improve the neighbourhoods and cities in which they live. And government officials are experimenting with new forms of practical deliberation, which reshape relationships with the public and other stakeholders. New forms of co-creation and cooperation are necessary to address social and democratic challenges — the ongoing current financial crises, the influx of migrants, the growing distrust in

political representation — and these are evolving all the time. At the same time they are also transforming the roles and responsibilities of everyone concerned.

The changing role of government

From the perspective of government, it is important to acknowledge that during the last decades government has been more of a follower than a leader of innovation and change. Christian Bason describes the need for a government renewal as follows: 'A new vision for the public sector is required, whereby public managers become public entrepreneurs. This can only happen through a pervasive change of mindset, with more experimentation, controlled risk taking, and an agile and personalised response to new constituent challenges. This will help unleash the potential of an innovative public sector, which can be transformed into a much-needed growth engine for the economy' [8]. But what exactly is blocking public sector innovation? A recent study by Nesta [9] indicates five prime reasons:

- no investment models for innovation in organisations;
- lack of dedicated budgets, teams, processes and skills;
- discouraging reward and incentive systems;
- departmental silos blocking the sharing of innovation;
- lack of mature risk management methods for experimentation.

Although government has difficulties innovating itself, the power of the public sector to support innovation in science and businesses should not be underestimated. 'In contrast, over the last century mature innovation systems have taken shape in science and business. In science, both the public and private sector invest billions, and the difficult task of turning scientific insights into useful products was long ago taken away from lone inventors in garden sheds and placed at the heart of great corporations and great public laboratories. We have seen the structured use of experimental methods, evidence gathering and the creation of global networks, peer-reviewed journals and large complex teams. Meanwhile in the business sector, the 20th century brought the creation of in-house labs and research and development (R & D) teams, and in recent years more widespread use of open innovation, user innovation, service innovation, design' [9]. At the same time, we see that the role of cities and city governments is increasingly important [10]. It is time to focus on what makes cities thrive, what makes them open for innovation and how governments can support this development. 'How city administrations programme themselves and the city for innovation is little understood. It is also not always clear what entrepreneurs should ask of their city hall. What is missing is a comprehensive view of the ways in which a city government can mainstream the innovation that underpins a city' [11]. The City Initiatives for Technology, Innovation and Entrepreneurship consortium was founded to fill this gap.

High-performing city governments are built on the foundations of well-established innovation practices and mature entrepreneurial ecosystems, supported by clear policies which do not just concentrate on today's problems, but clearly address the changes of tomorrow as well. They keep on pressing forward, and they are open to redesigning even the most complex systems. They recognise that new ideas and technologies can create big opportunities and make better places to live.

This relates directly to the Espoo action process. Here we propose adding a ninth front for action: 'rapidly scaling experiments into common practice'. This can be practised at the level of cities and regions, but also at the level of streets and neighbourhoods. It is relevant to nations and to transnational organisations. It can be applied to local issues and broad societal challenges. Becoming proficient in this is at the heart of the challenge mentality. We see many sparks across Europe that illustrate good open innovation 2.0 practice. The four cases described below, two in cities and two in regions, each embody a clear lesson. They also address four of the key challenges facing Europe's cities and regions.

1. Amsterdam: a systemic approach to innovation.
2. Espoo: creating conditions for emergence (of ecosystems).
3. Skåne: the importance of political will.
4. Tuscany: the need for speed (rapid realisation).

Amsterdam public sector alignment — a systemic approach

Amsterdam is a city that nurtures innovation in all fields. Amsterdam's successes were never due to a top-down structure; instead they are rooted in the mobilising force of diverse stakeholders, who collaborate and co-create within a loosely coupled innovation ecosystem.

Because innovation is in the city's DNA, Amsterdam has become flexible and creative in dealing with the challenges that have confronted the city. The government is also playing a very active role in creating fertile soil for an innovation ecosystem, for instance through the establishment of the Amsterdam Institute for Advanced Metropolitan Solutions

(which explicitly engages in research to deal with complex urban challenges) through a public tender, and installing a Chief Technology Office — directly linked to the City Manager — to respond quickly with new technologies that make interventions and investments more effective.

The strength of the city of Amsterdam derives from this approach. The most impactful innovation assets that characterise Amsterdam are:

- a vibrant urban society that nurtures innovation, comes up with self-invented solutions and applies them to concrete situations;
- the fast uptake and application of smart technologies that enable city residents to mobilise talent through rapid contacts and meetings;
- a focus on the local context, where urban challenges form a basis for continuous discourse among stakeholders, helping the city to respond faster to challenges;
- a data-driven, evidence-based approach with a high level of adaptive and absorptive capability, leading to a shorter innovation cycle;
- bottom-up innovation helping the city to implement, learn and grow [12].

Since 2013 seven initiatives have been developed, resulting in 28 examples of how Amsterdam innovates. Prior to 2017 this had already led to over EUR 200 million worth of investments in innovative projects and over 300 strategic partners in the city. Over 100 000 people are involved through online platforms and social media. This strategy has been noticed, and in 2016 Amsterdam received the European Capital of Innovation award. As Carlos Moedas, European Commissioner for Research, Science and Innovation, said at the awards ceremony: 'Amsterdam fully deserves to be our European Capital of Innovation for its holistic vision of innovation in and for the city.'

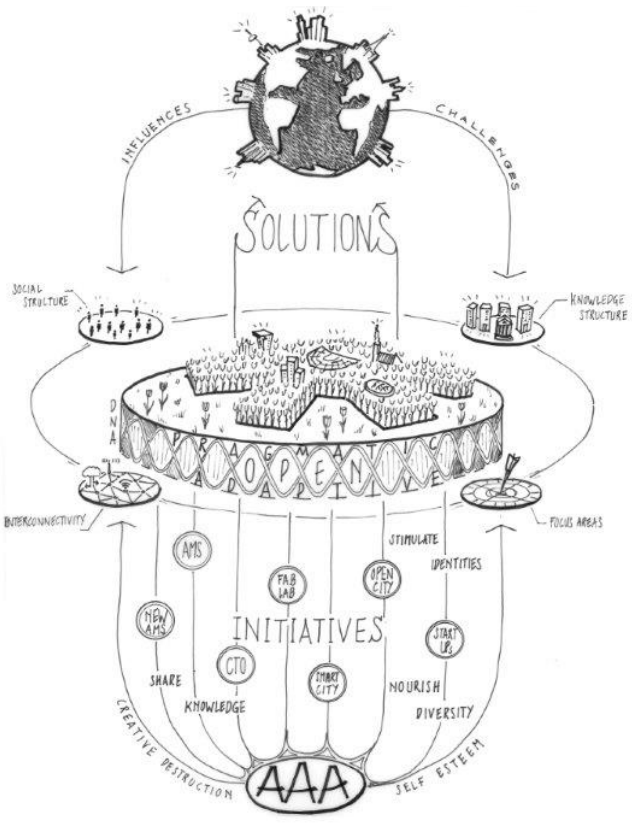
A garden for innovation in Espoo: creating conditions for emergence (of ecosystems)

Espoo, Finland's second-largest city, is active in undertaking initiatives that create value for its citizens and the business community. The Espoo Innovation Garden (EIG) is a concept that Espoo has been using to spread an innovative mindset throughout the city. It refers to common innovative ways of working, a culture of collaboration and co-creation and a communal way of thinking and doing things. Espoo is a city of opportunities, and the innovation garden image is at its dynamic heart. Gardening is a perfect metaphor for this: preparing the soil, sowing seeds, providing nutrients, maintaining the ground through watering and weeding, and harvesting when the time is ripe.

Co-creation and collaboration with universities, companies and residents are key elements of this approach. The number of labs, co-creation spaces, incubators and accelerators in the EIG has grown enormously to include over 30 innovation communities, with a special focus on RDI to address societal challenges. Major elements in the EIG vision are based on answering the question: 'How can we create an inclusive and fully accessible society, in which all citizens are "smart" and can contribute to co-creating quality of life?' [13].

Espoo is a garden for emergence, and, looking at some of the things that have emerged — diverse innovation factories, a vibrant start-up ecology, educational renewal through the school-as-a-service concept, the urban mill (a public–private co-working and co-creation platform for urban innovations) and an active and orchestrated regional innovation ecosystem — we can see that the Espoo story is bearing fruit. Europe's living-labs movement started here, Rovio's Angry Birds started here, Eurasia's largest start-up event Slush was created here, ACSI (the Aalto Camp for Societal Innovation) began here. The EIG is taking on a pioneering role as a hub where ecosystem thinking is fully integrated in practice, and where entrepreneurial discovery and a start-up mentality drive collaboration. Throughout the region, participants experience multiple gains: businesses can develop the scalable product and service

Figure 4: Amsterdam innovation strategy [12]



solutions that users want; the public sector can provide effective and affordable solutions to regional challenges; citizens share ownership of the specific, often highly personalised solutions they need; and universities can actively contribute knowledge and reap new insights in return. The increased synergy helps achieve a far greater impact than ordinary development measures allow [13, 14].

The power of political will in Skåne: Skåne Research and Innovation Council

In Skåne one of the most interesting examples of open innovation is the Research and Innovation Council (Forsknings och Innovationsrådet i Skåne — FIRS), a body with no actual decision-making powers that acts on the perception of common good and its members' will to act on each other's information and joint leadership. Even without formal power, FIRS has endorsed both Skåne's international innovation strategy and the smart specialisation strategy for Skåne, and this has proved to be an important strength. Since there are no binding 'agreements', the possibilities for diverse towns, enterprises, entrepreneurs, the public sector and individuals are endless, and the energy put into action is very real. The joint will to make smart materials, smart sustainable cities and personal health the keys to Skåne's smart specialisation strategy has meant that all players feel comfortable addressing common challenges that nobody can solve by themselves. Open innovation is key to cooperation within the three innovation areas, and many concrete projects aimed at solving both grand challenges and more specific ones — such as building the new infrastructure to support ESS and MAX-Lab IV or how to deal with new green infrastructure in the built environment — have been initiated. In many projects in Malmö the involvement of citizens is key; it has also been noted that activities within the three innovation areas draw attention from companies on that note alone, enabling the development of new ways to interact with citizens and entrepreneurs [15].

What this show of political will — and the importance of open innovation 2.0 — has done is to encourage entrepreneurs and businesses to actively move forward and explore new ways to cooperate within the broad framework of open innovation 2.0. Interesting examples include how the packaging industry cooperates with digital industry and how modern mobile industry cooperates with the health industry. The overall move towards open innovation 2.0 in Skåne's three innovation arenas is just beginning, but the pace and direction is indicative of the power of this approach. The combination of political will and ambition, with entrepreneurs and businesses working together in an open innovation context, has proved essential for the rapid development of Skåne. With even more ambitious goals for 2030 in place, Skåne is well on its way to achieving its ambition of becoming Europe's most innovative region [16].

Open Tuscany … at an astonishing speed

The Tuscany region has adopted an open innovation approach for its organisational development and reform that has gone through a process involving over 3 000 of its employees. Initially this process included an internal climate analysis, in which the employees described their perception of the working climate, communication, trust and process effectiveness. As the emerging results were less than expected, policymakers set up a bottom-up, co-creative participatory process, involving all levels of the organisation, to analyse the critical hotspots and suggest remedial actions. The areas of focus were training, professional development, communication, change management, organisation, evaluation and assessment, working environments and relationships with stakeholders, citizens and territory. The process was called La Mia Regione Toscana (My Tuscany Region) and involved all of the technical and political levels of local government. It was run through a very intense programme over a period of 6 months, ending in 2015, and including a series of workshops, meetings and instant-reporting processes to document and openly make immediate innovative additions to the process.

The first 10 workshops identified visions and guiding principles for the future organisation, as well as 44 ideas for projects that could have an impact on more than 90 areas and organisational processes. All personnel could comment on and improve the ideas through the region's open idea system. The 44 projects were collectively prioritised, leading to the identification of seven integrated strategic actions to address organisational motivation, training, innovation, working environment, assessment, communication and behaviour. Three of these actions were implemented within 4 months of the end of the programme — a rapidity that is quite astonishing for most public organisations — while the remaining ones are being implemented now. The main one that was implemented immediately was a bottom-up assessment system, enacted by law, allowing an internal open dialogue between teams and managers to identify solutions and continuously improve the working climate. Despite difficulties due to the challenging national and European economic climate and large budget reductions, the region is now studying the possibility of transforming My Tuscany Region from a one-off programme into a permanent one, by setting up a future centre to cater for the problem-solving needs of all regional socioeconomic actors.

What is needed next? Twenty-two reflections on full open innovation 2.0 practice

We would like to suggest some gentle provocations to the open innovation community, a few 'modest proposals' and some questions to reflect forward on what is coming next. Here are 22 points for reflection to consider when working on what open innovation can become as we approach 2020.

1. Why are we working in silos when we have proven practice methodologies for collaborative solution seeking?
2. Why do we excel in making the possible impossible? How can we put more effort into making the impossible possible?
3. Why do we need a challenge mentality, and not just a problem-solving mindset? How can we marshal the collaborative capacity of society and work across borders of all kinds to address societal challenges together?
4. How can we replace the dominant hierarchical structures with more open horizontal networking capabilities?
5. How can we directly apply entrepreneurial discovery to issues of real importance to people in society?
6. How do we create a full open innovation 2.0 practice in which thousands of not well-known practitioners — active citizen innovators — are invited to join us in challenging the status quo?
7. How can we experiment with reverse participation and participate in citizens' initiatives? How can we implement our ideals and really take the end user as a starting point?
8. How should we deal with obsolete institutions? How can we repair, reinvent or stop what no longer works? How can we stop doing what is not needed anymore and what is simply not an answer to citizens' needs?
9. How can we scale successful experiments faster, and realise them more rapidly in practice?
10. Who is looking at the generation after next? How do we focus on 'horizon three' innovation?
11. How can we involve children — and especially young children — as co-creators and visionaries?
12. We talk about the power of disruptive technologies; do we not need more disruptive thinking and disruptive doing? Should we accept the role of being disrupted or strive to be disruptors ourselves?
13. Who takes the lead in facilitating the dialogue about the renewal capital of society?
14. Do we see the problems — and the problems behind the problems — clearly enough? And what about the changes behind the change and challenges behind the challenge?
15. How do we increase our resilience with more focus on doing things fast and less focus on planning, compliance and timelines?
16. Is a thinking renaissance more important than an industrial renaissance?
17. Is a systemic overview necessary and, if so, how do we realise it?
18. Who owns the future? (Question from Jaron Lanier.)
19. What does technology want? (Question from Kevin Kelly.)
20. Where are the clear examples and compelling stories about why open innovation 2.0 works?
21. What is the political colour — the taste, feel and smell — of open innovation 2.0?
22. How do we make open innovation 2.0 trustworthy for all parties? Who owns open innovation 2.0 and its results?

What questions are you asking about open innovation and trying to answer in your daily practice?

After reflecting on these questions we propose an open dialogue. Readers can communicate with each other, directly or via the OISPG, the yearbook editors and the authors. This will help each of us to put theory into practice, intention into action and lessons into learning. Many of the lessons we need for actualising open innovation 2.0 in full practice are already known and being put into practice somewhere. We need to leverage this learning. The next steps are not about invention and innovation; they are about seeing, exploring, scaling and implementing. They are about curiosity and courage. And they are about actively supporting those who are struggling to get to the next stage. So, let us become better enablers.

Conclusion

IIf we look critically at the situation in society today — in Europe and all over the world — we can conclude that some societal challenges have been adequately addressed, while others are growing worse. Looking through the macro lens of the United Nations' millennium development goals (2000), or their more recent sustainable development goals (2015), we see that major problems do not go away easily. They need systemic initiatives, not just local or ad hoc actions, however important the underlying intentions are and however valuable the results may be locally. Looking at Europe's grand societal challenges [17] we see many things that have been accomplished, yet even more that must still be addressed, and much that has not yet even been attempted.

Now Europe is moving on, beyond its grand societal challenges, to new lists of goals and priorities. But without a real challenge mentality there will perhaps be too much talk, too many plans, too much fear and not enough experiments. Breakthroughs are needed, and to start, the societal dynamic of paralysis by analysis needs to be broken. The practice of rapid prototyping and rapid realisation need widespread anchoring

throughout Europe. Open innovation 2.0 can supply the thinking and doing power for this.

We propose the promotion of open innovation 2.0 practice on a broad scale, stimulating a process in which the focus is on asking the difficult, uncomfortable, provocative and disturbing questions and, without waiting for definitive 'right' answers, experimenting with actions to test promising ideas in practice. A process of societal prototyping, with the direct and co-creative participation of all our citizens — and especially our youth, our seniors, our immigrants — in creating a positive impact in society. The 'Eight action fronts for realising open innovation 2.0' are a suitable starting point, and by the time we achieve the ninth action front — scaling and implementing broadly — we believe that open innovation 2.0 will have become part of our common European practice. We will have learned how to turn common sense into disruptive practice, and disruptive practice into common sense. It will empower our challenge mentality and kick-start widespread innovation literacy in Europe, building greater civic literacy and the literacies of collaboration and co-creation as well.

Difficult, maybe; but that is why we need to do it. Challenging, improbable? Of course; but we believe it is worth doing, that it is doable, and also fun to do. We owe it to European society to try. As one of our entrepreneurial colleagues likes to say, 'Impossible is only an opinion'.

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Article 16
Things and systems — open innovation in Japan

Abstract

Every industry in Japan started again from scratch after World War II. Endless improvements in quality, costs and delivery (QCD) resulted in Japan becoming a manufacturing superpower with worldwide attention. In 1979 there was even a book published on the phenomenon: Japan as number one. Furthermore, the country's gross national product grew steadily at a rate of between 5 % and 10 % every year for more than 30 years from the 1950s onwards, a growth achievement unsurpassed anywhere else. Every company during this period improved its QCD capabilities through domestic competition within the same industry. The cycle of development and manufacturing that enhances products' competitiveness made Japan the world's most competitive industrial power. This was due to the conventional 'closed innovation' approach, in which companies stretched their limits by using scarce research and development costs across diverse fields. As closed innovation reached its limit, a new architecture, or 'open innovation', as proposed by Henry W. Chesbrough in his book *Open innovation: the new imperative for creating and profiting from technology* (2003), attracted great attention in Japan. However, open innovation has not always functioned effectively in Japan for many reasons, the most profound of which is that everything must be performed internally to differentiate from competitors. The largest factor creating this mechanism is a plentiful supply of engineers, which allows for proprietary R & D; this is enabled by an increase in university entrance rates, particularly in science and engineering subjects. The collapse of Japan's bubble economy forced changes in Japanese industrial policies, but did not change the conventional emphasis on originality and proprietary R & D. When open innovation was proposed in 2000 one well-known Japanese company noted that it had already been implemented among its internal divisions. Japan still uses a unique mechanism in which subcontracting companies are systematically controlled. Japanese small and medium-sized companies still have substantial shares and good positioning in the global high-grade parts industry. However, as this current state is also challenged on an annual basis, the Japanese industrial structure must adapt and deploy open innovation, and then evolve into network-based open innovation 2.0.

Current analysis: a shift in the Japanese industrial structure

The ratio of Japan's gross domestic product to the world economy has shrunk from its peak in 1994 (17.8 %), and decreased to 8.7 % in 2010, when it was ranked third in the world after being overtaken by China. The Japanese government estimates that this share will decrease to 5.8 % by 2030. Japan should not only supply high-quality and high-performance hardware products and parts, but also transform its business model. Customer value is generated here by building an ecosystem that can secure high profitability and develop new products and services. There is not much time left, however, and the Japanese industrial structure, which operates by both function (such as electronics, automobiles, steel, chemicals or materials) and item (such as parts, components or equipment), is still unchanged. Japanese companies hold over half of the global revenue-based shares for many components.

Examples of these shares include:

- *semiconductor materials — silicon wafer: > 60 %*
- *semiconductor manufacturing equipment: ~ 20 %*
- *reverse osmosis membrane equipment: ~ 50 %*
- *ceramic capacitors: > 50 %.*

Many parts and components for smartphones are developed by Japanese manufacturers, but Korea and China manufacture many more smartphones than Japan.

Measures towards open innovation by industry–academia–government collaborative measure

The Things and Systems Association was established in 2014 based on an economic organisation proposal (the author participated as a member and issued a proposal from the Japanese Committee for Economic Development). Its purpose was not only to change the conventional industrial structure — in which Japan supplied parts and components globally while focusing on manufacturing hardware and not on maintaining close relationships with customers — but also to create ecosystems that consider services through open innovation. This relates to the establishment of the Division of Things and Systems in the Research Institute for Science and Technology at the Tokyo University of Science. Things and systems aim to develop products, services and systems through industry–academia–government collaboration, while considering making things and making systems as a pair of axles. The objective is to create customer value, in

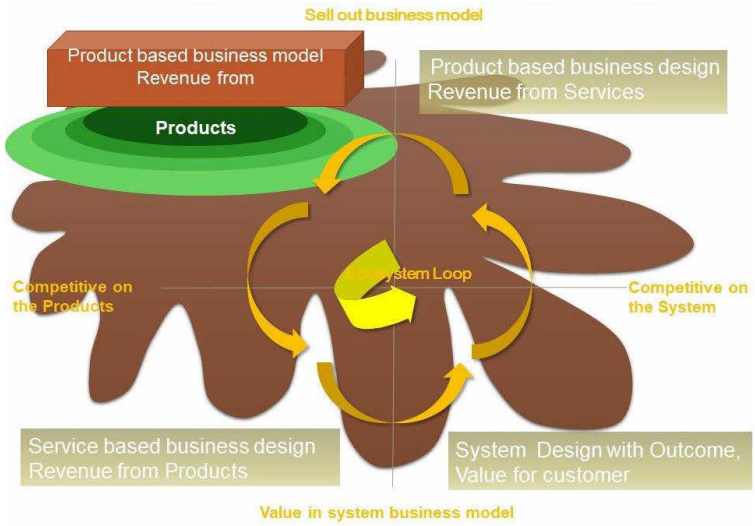
addition to the previous goal of creating the world's highest-quality products.

Many talented people influence the making systems concept, and their innovation arises from diverse ideas. Therefore, one significant goal involves promoting the necessity to implement open innovation across industries.

The 'things and systems' concept

The top-left section of Figure 1 [1] indicates Japanese manufacturing industries' conventional state, which involves strengthening products by the improvement and quality enhancement of existing products, low-cost mass production and global sales. This is expected to shift to a service-based business model that profits from product sales, a product-based model that profits from providing services and ultimately a model that profits from customer value. An ecosystem loop is necessary to evolve this system. One major goal includes innovation, from a compilation of optimisation technology regarding research, development and sales of individual things to providing systems that maximise customer value by considering 'things' and 'systems' as a pair of axles. Nevertheless, this evolution process requires open innovation architecture, namely dialogue and collaboration between competitor companies, different industries, academia, government and customers.

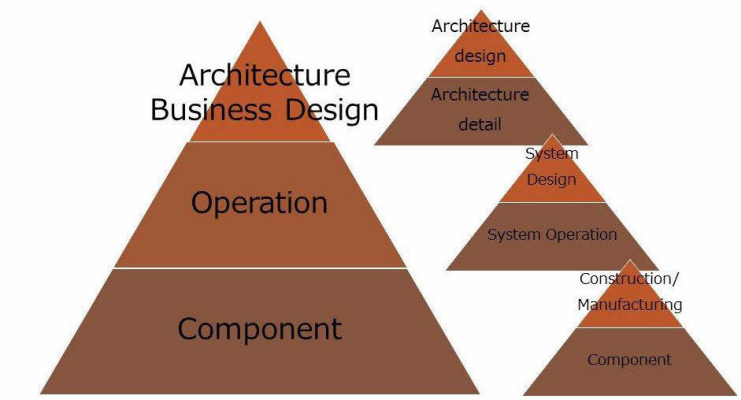
Figure 1: Incorporating new business mechanisms into companies



Business architecture

The architecture of actual businesses (Figure 2) is comprised of an organisation that plans and considers the structure of the entire business; organisations that operate, design and manage their plans; and organisations that either manufacture parts themselves or subcontract production. In most cases parts are purchased from external companies, and the supplier is not guaranteed a permanent contract. For instance, Apple conducts the top two tiers and chooses the best companies worldwide for the third tier. This architecture creates a planning and design ecosystem, and applications self-multiply. Alternatively, the first personal computers from IBM marked the onset of specialised development and open innovation, in which Intel and Microsoft are in the top tier and Lotus and Sony are examples of the second tier. While IBM did not use existing proprietary technology, they instead created a new method that considered development times when starting their personal computer business. Therefore, IBM provided an environment to create business applications. These are examples of open ecosystems through the open innovation 2.0 network.

Figure 2: Business architecture



The Things and Systems Association

The Things and Systems Association began work in 2014. Working groups were established for over a year to research examples of the participating companies' things and systems innovation in Japan. Research subcommittees were organised to conduct research on three topics: business research on making things and systems and the creation of inspiration, leading to a pivot; business research on making things and systems and the change in business and innovation from the change in technology; and human resources and organisations that make things and systems. The first stage of research results indicated many reports on things and systems leading to services (Table 1) [2].

Table 1: Working group output: first-stage research results

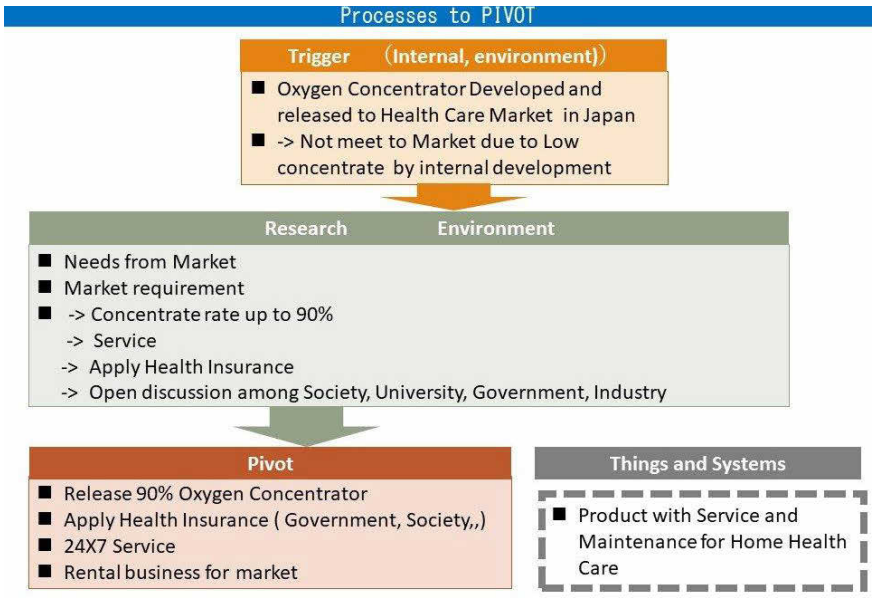
Company	Example	Method
Chemical	Home Care	OXYGEN INHALER + Health Insurance +
Semiconductor	PC	CPU + Software
Construction Vehicle	IOT	Construction Vehicle + IT(Software) + Communication + Operation + Eco + Life Cycle Management
Heavy Industry	Railroad	Railroad Vehicle + IT System Operation + Life Cycle Management
Information	Agriculture	Sensor + IT (Software, Cloud) + Management

Proposal from research in working groups

Turning points occur through long-term strategies for an organisation's executives, organisations that embrace challenges and conversations with customers and those performing the actual work.

Teijin's home-healthcare business is an example of things and systems, as the company invented a propriety oxygen-separation membrane technology in 1979. Air with high oxygen content (40 % compared to the 21 % present in standard air) could be obtained by collecting the gas that penetrated the membrane. This product was commercialised, but was not well accepted in the market. Therefore, the company developed a system to increase patients' quality of life with a new home-healthcare things and systems ecosystem. They entered into a broad collaboration, as long as there was a benefit regarding customer value, with global technologies, academic associations, governments, hospitals and doctors. The home-healthcare system in reality became an ecosystem that various companies have extended; the Japanese government and municipalities have also promoted this ecosystem as a pillar in medical-system reform to address an ageing population (Figure 3) [2].

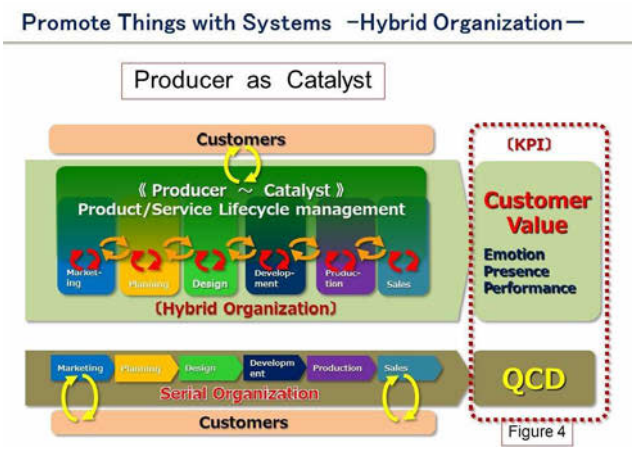
Figure 3: Things and systems example: Teijin home healthcare

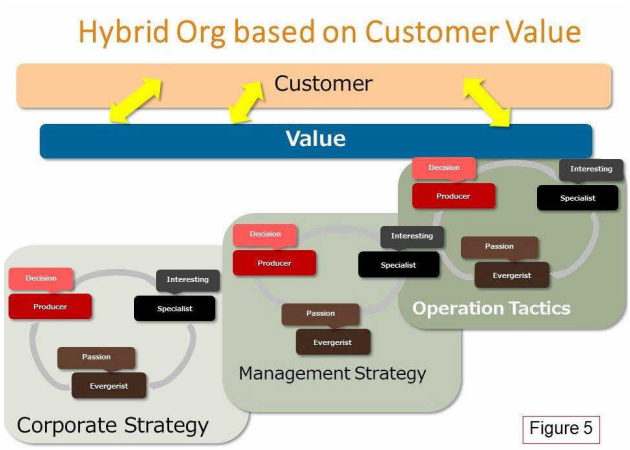


Necessity of changing organisations

As Figures 4 and 5 [4,5] illustrate, organisations will self-transform from a conventional serial system from marketing to sales into a hybrid structure where organisations create products and services designed to generate customer value through interactions with customers, with the producer acting as a catalyst. Many conventional Japanese companies have carried out the optimisation process based on vertical integration of proprietary technologies. However, solution development through organisations with the very latest technology is beginning, especially with the recent rapid advances in technology, particularly in information and technology. This is the proposed transformation from making things to making things and systems, and the key performance indicator of the supplier is changing from conventional QCD to customer value as a mechanism. Needless to say, open innovation must transform into network-based innovation, or open innovation 2.0.

Figures 4 and 5: Hybrid organisations create products and services designed to generate customer value





Research topics in the second stage

The research topics changed in stage two. The three new topics are: (1) things and systems as an enabler; (2) things and systems in virtual companies; and (3) nurturing human resources that can understand and practise things and systems (Table 2).

Table 2: New working group: stage two

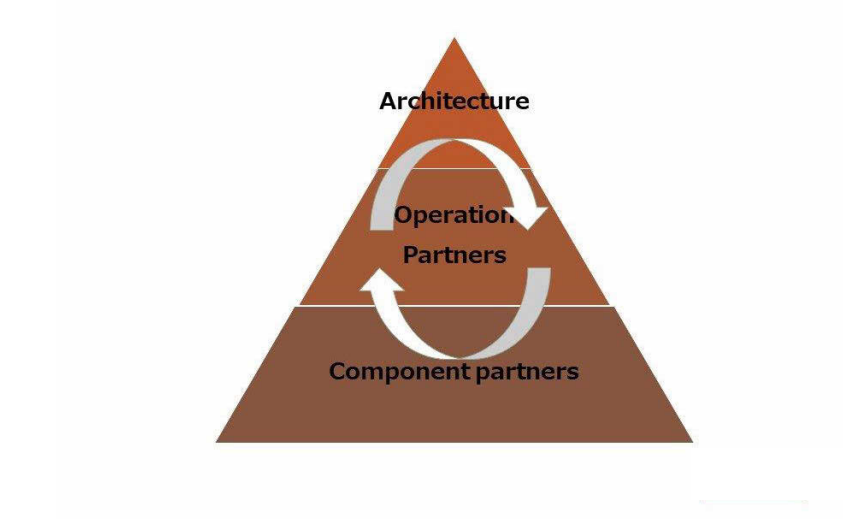
Group	Research
Things and Systems as a Enabler	How to change
Things and Systems in Virtual Company	Design Thinking
Things and Systems Native Person	Education and Fostering

Promote open innovation by OI2

Figure 6 provides a fundamental framework to promote open innovation 2.0 and the things and systems concept.

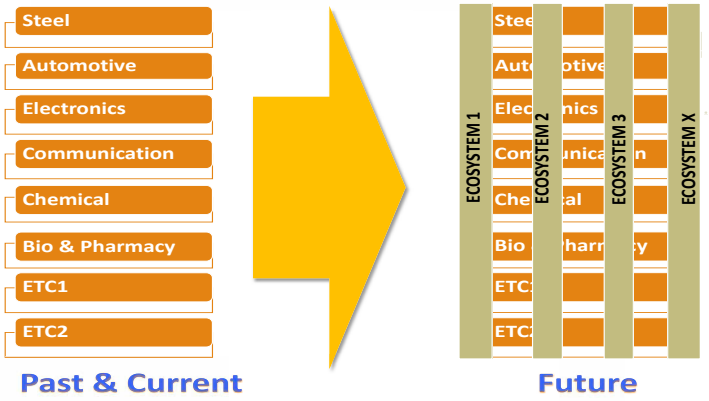
It is necessary not only to build a business architecture with diverse related companies but also to create a new ecosystem with materials and parts partners. This new architecture must have a flexible organisational structure that can adapt to ecosystems; unlike the conventional structure through industry and trade, the values to be evaluated will naturally change.

Figure 6: New architecture with flexible organisational structure



The architecture of network-based ecosystems will accelerate the evolution of industry, academia and government into a new industrial structure. This will lead to the promotion of things and systems and open innovation 2.0, and the creation of new business models (Figure 7).

Figure 7: Industry structure innovation



Conclusion

We will be able to change the industrial structure through implementing OI2 by establishing an architecture of things and systems. Open innovation 2.0 will play a critical role in this change. Moreover, there is a need to transform the traditional industrial architecture from product silos to transversal ecosystems.

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Article 17

The future with big data and digital transformation is disruptive

Abstract

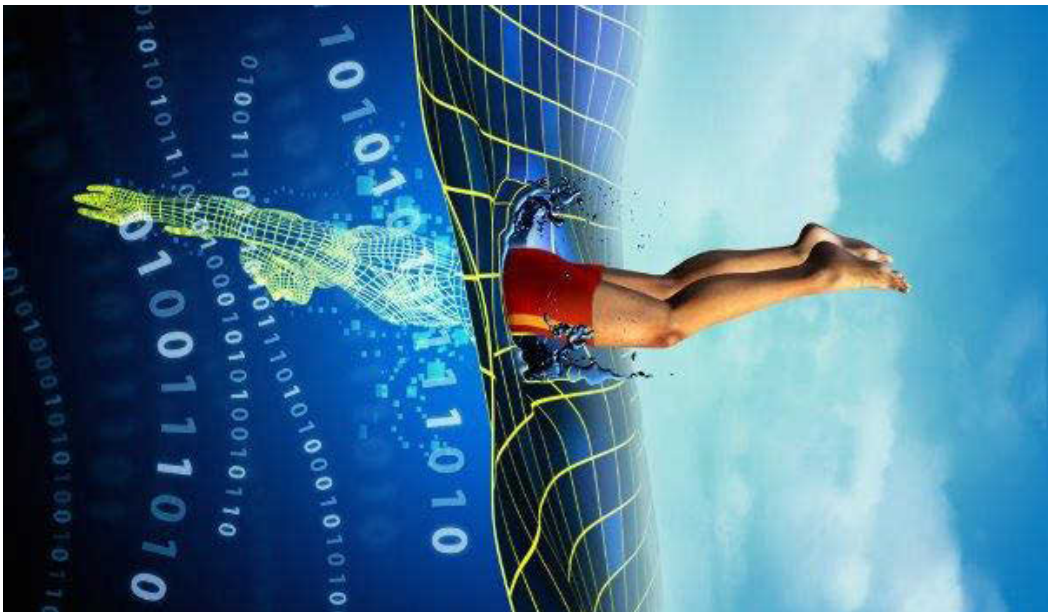
Big data and digital transformation are recent phenomena which offer opportunities for the futurists and visionaries to speculate upon the future, while coming up with more questions, discussing new challenges and trying to offer creative solutions. These topics have also become central for some large corporations, small and medium-sized enterprises, governments, academia and citizens who address them from their respective perspectives. A number of high-level multidisciplinary think tanks, forums and events — which participants use as focal meeting points for collaboration, co-creation and synergies of wonderful ideas — are good places to inspire stakeholders to drive the future and find solutions to upcoming challenges in a more creative and constructive manner. I was motivated to write this article by the current trends and challenges of big data and digital transformation and my participation in the abovementioned think tanks and events.

In this article I elaborate on the emergence of the topic of big data and digital transformation, analysis and synthesis. Then I describe the future as being disruptive, taking into consideration the (r)evolution of big data and digital transformation. Finally I explain the importance of embracing collaboration and a curious mindset and offer a potential solution to overcome the current challenges.

Big data

Over the past few years we have heard big data defined in many different ways, and therefore I am not surprised there is so much confusion surrounding the term. I am not going to discuss various definitions of big data in this article. I will only introduce a one-sentence definition-like interpretation of big data to give context: 'Big data is a collection of different data from traditional and digital sources inside and outside your organisation and network that represents a source for ongoing discovery and analysis.' It is a good start for a discussion, which I usually apply. I also strongly believe that data will be a critical part of our future. As described by a team from the Ontario College of Art and Design with a great manifesto: 'We can describe data as one of the remarkable new materials of the 21st century — as important to our future as water. Data are measurements of other things: physical phenomena (such as weather patterns) or virtual phenomena (such as telecommunications packets). Every time we search for an online movie, view a video on our mobile device, tweet a comment about a news article, upload a photo to Instagram or are directed to a new location in Pokemon Go, we are producing and responding to data' [1].

Figure 1: Big data as the new water



The big banks and Silicon Valley are waging an escalating battle over your personal financial data [2]: your dinner bill last night, your monthly mortgage payment, the interest rates you pay. The struggle over these data points to a growing recognition in the world of finance that personal records rank among the most valuable currencies in the increasingly digital economy.

Brian Forde is a senior lecturer in Bitcoin and Blockchain at the MIT Sloan School of Management. He was a senior advisor for mobile and data innovation in the Obama White House administration. In the Harvard Business Review he argues that 'We need open data to keep making important business and policy decisions — and we need to put it back into the hands of the public. Our data problem doesn't have to be a crisis. It can be an opportunity — a chance for our business leaders and policymakers to rebuild a foundation of trust in the critical data we all depend on' [3]. I strongly agree.

Digital transformation

Digital transformation is another term which has become increasingly spoken about over the last few years. Similarly to big data, many different definitions are introduced also for digital transformation. According to Wikipedia, the term stands for 'the change associated with the application of digital technology in all aspects of human society' [4].

From the industry/organisation perspective, digital transformation concerns all aspects of the organisation — business model, funding, culture, human-capital strategy, operating model, technology, talent and more — to create an integrated digital enterprise capable of creating innovative ways to more effectively run, change and grow their business.

Forbes listed the five top talent challenges of today's C-level executives, with 'Need for digital expertise' listed as one of those challenges, stating that few organisations have yet fully realised enterprise-wide digital transformation [5].

Digital transformation is having a huge impact on all types of organisations — large and small, private and public — and on society — old and young.

How to survive the digital disruption?

According to CGI's Craig Wallace, who is the global digital transformation lead, 'competition from new market players, fast-changing consumer and citizen demands, and the proliferation of new business models is disrupting the status quo' [6]. To meet these challenges, organisations are investing in digital technologies to transform their legacy environments and connect them to new digital business models.

Digital technologies are enabling organisations to integrate their lines of business across the enterprise, continuously collect and analyse valuable customer data and turn that data into actionable insight, with the end goal of becoming customer-centric, agile and value-driven enterprises.

But the hard truth is that 8 out of 10 digital transformation initiatives fail to deliver the value that is expected of them. One reason is that, when it comes to digital transformation, technology is only part of the answer.

Realising the promise of digital requires transformation across three areas: organisation, business model and technology. All three areas are inextricably linked, and it is important to include each as part of a holistic, enterprise-wide digital transformation strategy by embracing the collaboration mindset.

Disruptive future with big data and digital transformation

It is quite an exciting journey to try to understand and predict what the future looks like with big data and digital transformation. Whatever way I look into this, the future looks disruptive.

Let us take three different perspectives.

Figure 2: Digital transformation

Figure 3: Surviving the digital disruption

1. The end of privacy. In part one of a three-part series, a Stanford professor discusses a controversial algorithm that knows more about you than your best friend. In just minutes online you leave a rich digital trail behind. Data scientist Michal Kosinski has developed a powerful algorithm that collects all those digital crumbs and creates a profile of you so intimate it might even surprise your spouse [7].

2. The end of jobs. Now let us take the jobs. It is not surprising that with the emergence of big data and digital transformation the job market is also transforming: new jobs arise leaving behind the old. Here is a list of 10 jobs that could be replaced by artificial intelligence in the next decade: surgeons, teachers, police officers, commercial airline pilots, pharmacists, astronauts, bartenders, poker dealers, journalists and lawyers [8].

3. The end of current human social class. In a 2017 article the best-selling author Yuval Noah Harari argued that through continuing technological progress and advances in the field of artificial intelligence, 'by 2050 a new class of people might emerge — the useless class, people who are not just unemployed, but unemployable.' He put forward the case that dealing with this new social class economically, socially and politically will be a central challenge for humanity in the coming decades [9].

The formation of 'The new'

Looking at it from another perspective, the disruptive future has huge potential to create enormous opportunities for organisations to grow and for humans to learn and enjoy the new societal and economic life. In particular, new jobs will appear, such as data scientist and social media analyst as appeared recently; new methods and technologies will replace the old ones to protect data privacy (such as Blockchain); a new social class may be formed (perhaps we could call it 'superhuman') that will deal with the upcoming social challenges. With the optimistic view, I welcome 'The new'!

Embracing open innovation 2.0 and a curious mindset

As defined by the Open Innovation Strategy and Policy Group group, open innovation 2.0 is a new paradigm based on a quadruple helix model in which 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 encompasses also user/citizen/customer-oriented innovation models to take full advantage of ideas' cross-fertilisation leading to experimentation and prototyping in a real-world setting [10,11].

Bringing an industry view on embracing collaboration and a curious mindset [12], in recent years supply-chain discipline has led the way in moving from a supplier mentality to a partner mentality in which organisations share, collaborate and innovate with outside partners to improve overall performance. Traditional value chains are disintegrating as we move to a more networked, collaborative and shared economy. Establishing your place in this kind of ecosystem has become a critical strategic move.

Leading organisations are also investing in creating a culture that values a curious mindset. Such a mindset drives innovation and is prepared for change as the market dictates. It is both informed and driven by

the customer and also focuses on keeping employees motivated and engaged. These organisations are treating employees like customers, so that employees, in turn, are motivated to provide an excellent customer experience.

Applying the same thinking to societies — more specifically, curiosity-driven citizens'/societies' engagement in government decisions — more value can be derived for the benefits to the societies [13]. In the reverse pyramid offered by the OSI consortium [14], people, users and citizens are key drivers for feeding the innovation and co-creation cycle.

To conclude, big data and digital transformation promise a disruptive future, offering new challenges to all stakeholders concerned. Embracing the core values of open innovation 2.0 and a curious mindset, I strongly believe that constructive solutions can be achieved faster and in a more efficient way to make our world a better place to live in terms of creating a secure, intelligent, social, cultural and inclusive world and delivering value to all stakeholders.

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Bonus article

Open innovation 2.0 is a concept that requires a completely different way of thinking about innovation

It has always been a tradition in the open innovation team to give departing members the opportunity to share their experience with our constituency before they start a new professional adventure. After 5 unforgettable years with my OI2 colleagues it is a great privilege for me to share a few thoughts about the new paradigm in innovation in this very special and highly valued publication.

The entire time I have spent with the OI2 team at DG Communications Networks, Content and Technology I have always felt somewhat special to be working for and with one of the European Network of Living Labs' policy pioneers.

The relevance of open innovation

As a communications professional I needed to find the easiest way to explain what open innovation 2.0 actually means: a process that involves all stakeholders (businesses, public institutions, academia and citizens). It can actually translate into smart cities, living labs, fab labs, social media, e-platforms, crowdsourcing platforms, etc.

More and more we have made citizens hear about open innovation. It has become mainstream, not only because it brings different stakeholders together, but also because it has a huge amount of potential in an industry 4.0 and Internet of Things-driven business context. It is also very relevant for one of the more important pillars of the 'digitise European industry' effort, which is the activity to develop a network of digital innovation hubs (DIHs). DIHs are one-stop shops that help companies to become more competitive with regard to their business/production processes, products or services using digital technologies. They are based upon technology infrastructure (competence centres) and provide access to the latest knowledge, expertise and technology to support their customers with piloting, testing and experimenting with digital innovations: 'A DIH is a regional multi-partner cooperation (including organisations like registered training organisations, universities, industry associations, chambers of commerce, incubator/accelerators, regional development agencies and even governments) and can also have strong linkages with service providers outside of their region supporting companies with access to their services' [1]. It is thus crucial to open up and find workable methods that allow for citizens' involvement in innovation, policymaking and decision-making processes.

Therefore, in recent years our team focused much of its effort on open innovation in the context of e-platforms and social media. We reached the conclusion that e-platforms for ideas sharing requires a totally new professional approach; an open communication approach where professionals have full-time involvement in creating trust between the different players!

Open innovation in the context of e-platforms and social media

Looking at a platform as a stand-alone product, apart from the actual web development the platform would need promotion and dissemination. Nowadays we are so overwhelmed with information that we tend to seek out ways to quickly get informed about the world around us, and tend to generally prefer faster services, faster internet and even some more effective and rapid means of information transmission. In that sense an e-platform (which aims at gathering people's opinion, juxtaposing them with other stakeholders' viewpoints and orchestrating them in such a fashion that the output is helpful and beneficial for the greater good) requires a constant external storytelling flow and continuous incentive delivery to all participants in the ideation process. In addition, in order to create acceptance or even enthusiasm for more openness and collaboration, stakeholders need to see concrete benefits.

The various different social media platforms have not only changed the way we interact in our personal relations but also the way in which companies position themselves vis-à-vis their customers. Tools like Facebook or Twitter are easy to use and allow people to share information, discuss a wide range of issues and build relationships. Forward-thinking organisations are online: the use of social media and other online platforms has led to factual improvement on different levels that range from market research to the use of customers' feedback as a source for innovation. The possibility to listen first hand to customer feedback on social media can help a business grow, improve profits and bring in new ideas.

Too many online social networking sites?

Even though digital technology makes interaction and service provision faster and easier, from a user experience standpoint time is becoming more and

more limited. Engaging with citizens is not as challenging as re-engaging with them, making them participate again and again, making them be part of the process. We are talking about creating a new type of participatory culture. Building on this by combining the online networking sites, be they social media spaces or online platforms for information and innovation, might be one effective solution. We are talking about one-stop-shop online spaces for interaction; an online ecosystem enabled by open innovation approaches.

New professionals

Such one-stop-shop platforms for open innovation online need professionals who are directly involved in their management, such as **bridgers** and **curators** (see Bror Salmelin's article, 'New skills and attitudes at the heart of modern innovation policy', above) and professionals who are constantly analysing the information, compiling it and matching it with other relevant chunks of information in a specific context — around a problem area, policy-related decision or new market creation.

We are moving into a world of open innovation and user innovation; a world where the digital and physical are coming together. Launching an open online platform and running a simple communication strategy around it every now and then on Facebook, Twitter and LinkedIn has long been the old-fashioned way of doing it. Achieving innovation online is already shaping the professionals of the future, who will have knowledge in communications, programming, political sciences, regional development and negotiation.

I believe it is obvious that living labs are the right methodology to enable the 'three Os' strategy (open innovation, open science and openness to the world) [2] through the quadruple helix approach — involvement of businesses, researchers, policy-makers and citizens. Living-lab practitioners can actually provide expertise at both the local and the international level on the creation of open innovation national strategies. Living-lab experts can provide full assistance in creating open innovation teams in online innovation sectors.

How? One idea could be to launch living-lab university campuses. Why? In most cases students get hands-on experience through summer (or other types of) traineeships, different initiatives/campaigns, the Erasmus (European region action scheme for the mobility of university students) programme, work and study programmes and so on. It sounds sufficient, but what unites all those opportunities is that they are all looked upon as something in addition to curricula.

The great thing about living labs is that they are actually research facilities, therefore whole university campuses can be converted into living labs, providing hands-on experience to students by default and also making youngsters adopt the abovementioned participatory culture. Being part of an innovation community is a type of interaction that requires time and the physiological adjustment of those that have newly joined. It is the same in every other sphere of life. Every new thing we try feels a little bit unfamiliar and not too comfortable at the beginning, until it becomes part of life, if we let it. In that sense a university living lab will give a lot of room for serendipity innovations — innovations born out of unexpected circumstances and intersections of opinions.

Instead of conclusion

'Words, once they are printed, have a life of their own,' said the American actress and writer Carol Burnett. The same goes for ideas. How many, most probably, great ideas remain unshared — unprinted if you wish? Through open innovation approaches we have always wanted to enable more and more ideas and opinions to be shared and taken into account. And if standard methods are no longer sufficient, then we need to dare to try something new, to dare to think differently about innovation. And to be a little bit conservative at the same time by admitting that innovation cannot be achieved only online: innovation can only be enabled online. Innovation happens where online and offline intersect, and both interactions complement each other in an orchestrated, hopefully by the new professionals, innovation ecosystem.

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