Learning Spaces as Accelerators of Innovation Ecosystem Development

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This article examines learning spaces as a broad concept, addressing them both as an abstraction and as venues and facilities supporting learning on individual, organisational and regional levels. Our two simultaneous perspectives are top-down (Europe 2020 strategy) and bottom-up (learning and innovativeness of individuals). As an abstract concept, learning space refers especially to the mental dimension of the space emerging when individual experts collaborate. It draws from the culture of modernising the Triple Helix collaboration coloring the learning environment, and the quality of interaction between the classroom and industry agents, either hindering or supporting better synergy between research, education and innovation, as well as different initiatives focusing on creativity and entrepreneurial discovery.

In order to boost competitiveness in a global economy, one of the key success factors is creating effective and inspiring regional innovation ecosystems. These need to be embedded both through involvement in global innovation grids and through creation and adoption of local mental, physical and virtual platforms, the innovation gardens and challenge platform as described in this article.

In the current economy and globalized surroundings, this means that education no longer focuses on memorization and passive reception; instead, it strives to promote entrepreneurial discovery and societal impact. To integrate theories into real life practices, this article also reviews Aalto University experiences within the Helsinki Region. Our cases focus on Aalto Innovation Garden experiments within the frame of a research programme Energizing Urban Ecosystems and a new innovation hotspot, the Urban Mill.

1. Introduction

This article shows that innovativeness can considerably be increased as challenged by the Europe 2020 strategy and the flagship initiative Innovation Union. This article is based on one hand on the EU Committee of the Regions opinion “Closing the Innovation Divide” (Rapporteur Markku Markkula) upon request of the Irish presidency in drawing up proposals on ways to increase innovativeness and close innovation gaps. On the other hand, we draw on the different roles and responsibilities of the authors within the Aalto University.

The following statements provide a solid basis for our message and allow us to focus on ways of accomplishing the desired operational and mental changes in creating innovative learning spaces (CoR, 2013):

1. Societal challenges cannot be met merely through minor adjustments and conventional management methods. Boosting renewal capital is critical to success: creativity, innovation and the confidence to innovate and reform are also instrumental for local and regional decision-makers.
2. The focused translation of research into practice requires a good understanding by researchers, practitioners and policy-makers of what type of research is being conducted, what issues are being raised, and how relevant research can impact local and regional issues. A new kind of knowledge triangle is needed for this, linking the world of research and science with the world of business and government through a two-way mediating service. This requires further development and active implementation of the EU Knowledge Triangle concept in strengthening the societal role of universities.
3. Regions need new arenas as hotspots for innovation co-creation. These could be described as "innovation gardens" and "challenge platforms", which together form prototype workspaces for inventing the future. Such venues have proved pivotal in addressing challenges of all scales, from small local challenges to major societal ones at the global level. Research, development and innovation activities are therefore required to allow piloting and creating prototypes of (a) spatial configurations with physical, intellectual and virtual dimensions, and (b) orchestration and knowledge management toolkits needed to address challenges.

In sum, we are operating on fruitful ground as many societal actors have begun to understand the immensity of the societal challenges and also the fact that tackling them requires more fundamental measures through research, innovation and structural changes than taken before. As one, research needs to be harnessed more effectively than ever to serve society with outcomes yielding practical value on local, regional as well as global scales. So-called innovation gardens could then provide the facilities for increasing innovativeness and verifying the concrete value. The following chapters describe the cornerstones in making this innovation garden a reality.

Knowledge Triangle and Learning

The EU through the Council decisions and policy programmes has stressed the importance of applying Knowledge Triangle throughout the university sector, EIT European Institute of Innovation and Technology being the forerunner initiator. However, the target results can be achieved only if the universities on a large scale create new operations increasing the synergy between research, education and innovation.

The Aalto Teaching and Education Evaluation TEE brought up interesting aspects with respect to implementing the Knowledge Triangle throughout universities. TEE brought a strong message to encourage developing innovative learning spaces on the Aalto implementation agenda (Aalto 2011):

- Aalto should target more development activities in its curriculum and learning environment initiatives, especially for the first-year studies which are essential to learning-to-learn;
- Aalto should take advantage of situations in which studies are focused on solving real life cases and many study teams include also professionals to apply lessons from the classroom to their work environment. Further, they include projects that require students to work across traditional boundaries;
- Aalto should motivate university students to effective and target-oriented studies by developing teaching methods and support systems, such as students' personal study plans, multidisciplinary study teams and virtual learning environments.

Universities must be determined in developing their academic culture, as well as operational processes and structures, if they are to meet the challenges related to their societal role. They must be able to let go of the traditional methods based on sectorization and silos. Instead, they ought to create a culture of networks and co-creation that crosses through the entire university. (Markkula, 2013)

New innovative learning spaces can be the drivers of this cultural change. Strong evidence for this can be found in the 12 university cases analysed in the "Education in the Knowledge Triangle" study. This rich collection of information from the different universities brings together a number of potential ideas and lessons on how to more effectively integrate the Knowledge Triangle with education activities. In terms of innovative spaces, the list includes the following ones (DC EAC, 2012):

- Creating rich learning environments for talent development;
- Taking an interdisciplinary approach;
- Embedding the entrepreneurial culture throughout the higher education institution;
- Transforming working environments and widening access;

- Embedding evaluation and monitoring of the impact of activities related to the Knowledge Triangle in the university strategy.

In result, certain principles call our attention, involving both learners in degree programmes and working life professionals with extensive experience. Motivated people lie at the centre of innovation policy. People create innovations and therefore innovation is, above all, a human and social process. The factors that affect innovation are not confined to within organisations: the most significant drivers of the innovation process at different stages often emerge through human interaction at various interfaces. These motivational factors are so crucial that a deeper review of theories and knowledge of human interaction and motivation are needed.

3. Human Interaction as a Learning Space

Besides the regional and societal structures presented above, innovation activities also require a healthy and supportive socio-cultural environment that nourishes new-creating activities and individuals' motivation. On the organisational level, innovations rest on education and lifelong learning that allow people to live up to their full potential, and on networks which provide the so¬cial capital necessary for research and development. Networks present themselves as organisational structures but also as resources promoting communication, trust and understanding, thereby facilitating innovation activities. Networks also serve as a means to learn, individually and organisationally, by offering forums for sharing information, exchanging best practices, and learning from one another. (Arhio, 2007)

Therefore, in order to optimize creativity, agility and efficiency, organisations are to sustain and foster the intellectual and mental capacity of their personnel to encour¬age them to constantly give their utmost best. Unfortunately, it is too often ignored that the build-up of organisational capability calls for trust and communality, and employee autonomy. (Kultanen, 2009) Trust allows group members to tolerate mistakes, which is an important stepping stone in securing organisational growth, renewal, and innovation activities. A climate that does not accept errors and imperfec¬tion cannot be creative. (Åhman, 2004)

Innovativeness in work communities builds largely on group diversity where the members are highly oriented towards common goals. Appreciation of diversity and criticism are instrumental in reducing unnecessary group conformity or groupthink and in giving a boost to group performance and especially creative thinking. (Korho¬nen-Yrjänheikki, 2011)

At times organisations unintentionally jeopardize or hinder creativity by allowing or setting barriers to innovation activity. These barriers stem from excessive control, too frequent or inappropriately targeted assessment, a patronizing atmosphere, or con¬stant rush. Too much control and monitoring tends to restrain new-creating activities by instigating fear of failure or mistakes. Anticipation of negative outcomes paralyzes productive action, whereas feelings of safety unleash potential and promote learning. (Goleman et al., 2001)

Motivation constitutes a key factor in learning. It stems from various factors: the student's interest and ability, the timeliness and stimulation of the learning content, the inventiveness and utility of the pedagogy, and the safety and positivity of the environment. We examine ways in which universities can elicit students' intrinsic and extrinsic motivation by paying particular focus on learning spaces. (Korpelainen, 2011)

Affecting an individual's motivations is important since adults learn what they want to learn, and because they have different learner styles. Ideally, education facilitates a permanent capacity change that comprehensively alters individuals' action, habits and competences but also emotions and aspirations. To bridge the gap between the students' starting level and the envisioned, individually-targeted level of ability, we advocate learning that increases ownership, empowerment and freedom to experiment and learn through trial and error. The new types of learning spaces described in this article also promote self-actualization and self-management techniques. (Cagiltay, 2008)

The investment in experiments on novel approaches to learning facilities serves aims that are two-fold. On the one hand, universities are concerned with the holistic development of students' professional skills and identity, directing pedagogic attention to abilities such as entrepreneurship. On the other, higher education institutions are to meet challenges related to societal development. The two aims are intertwined as societal impact can only be achieved by individuals with certain professional qualifications.

Universities need to set ambitious targets to change. As an example to bolster new approaches to learning and pedagogy through strong student motivation, Aalto has defined values

that allow individuals to thrive and succeed, also through trial and error:

> Aalto University Values (Aalto, 2013):
>
> - Passion for exploration
> - Freedom to be creative and critical
> - Courage to influence and excel
> - Responsibility to accept, care and inspire
> - Integrity, openness and equality

4. The Impact of Digitalisation

Everyday life practices within the last twenty years have changed dramatically, especially with respect to information and knowledge. Digitalisation drives change in all global business, and convergence towards digital services is speeding up. This phenomenon has already had a huge impact on education systems. The bases of learning have changed, with only part of the learning resulting from teacher-led lecturing. Pedagogy is moving away from teacher-centred and teacher-led practices accentuating memorization, towards learner-centricity and innovative learning environments – both physical, mental and virtual. However, this by no means undermines the role of the pedagogue; rather, it morphs the teacher into a facilitator and a mentor, posing new types of demands. (Lu, 1997) Similarly, learning facilities are striving to keep up with the changing requirements, with their role remaining important in the learning process.

These changes follow the trends in working life. More and more companies, as well as the public sector, are facing rapid change: phenomena are coalescing, sectoral boundaries have become blurred and complexity has increased. The importance of responsiveness and innovation has grown hugely over the past few years in all types of business activity and work – including policy-making. In the global and digital age, pioneers and potential trend-setters are more and more often those who succeed, because they pave the way and set the ground rules for action. It is not necessary to be a leader in every sphere, what matters is the state of mind. It is usually enough to build sufficiently confidently on knowledge and practices developed elsewhere. Digitalisation provides enormous opportunities – as described in this article.

One of the final obstacles to developing a future based on digital services has been removed by a technology carrying the brand name “the cloud”. Naturally this entails changes in teaching and learning environments. Cloud technologies provide access to the best service and best contents, which are available at any time and in any place. This challenges pedagogues in adopting these new services and the global knowledge flows. This way of developing and producing educational services challenges the traditional type of teaching, i.e. service thinking, where the teacher is viewed as a local agent in all types of education is described as a basic factor in all education. Organisational IT systems are no longer based on local servers, or hardware in every room.

All of this puts service design at the centre of every value proposition. Thus when creating services for truly smart classrooms where learners abandon old memes and old user interfaces, teachers are more than in the past seen as service providers who accelerate the learning process, working alongside learners as their coaches. (Lappalainen, 2013) The competition is severe, and currently many players claim to have created the dominant concept. But the game is not over yet, on the contrary, it has only just begun: learning processes are changing radically as everything that can be digitalised will be digitalised.

Despite all this, most schools, universities and other educational establishments are not the forerunners in updating the spaces and education methods used.

5. Regional Innovation Ecosystem

5.1 The Frame for Creating Innovative Spaces

The planning and construction of facilities is largely driven by building instructions that regulate technical and architectural implementations and costs related to construction and maintenance. Transforming the general alignments promoting innovation activities into concrete practices is challenging, especially in an environment where ongoing operations cannot be interrupted and where no significant funding has been allocated for change. As we aim to demonstrate in this article that even a larger change can be implemented, we start by describing the essential frameworks supporting our examination:

- Characteristics of learning spaces, and
- Enablers of the innovation ecosystem.

Learning spaces meeting the targets described in this article consist of several dimensions and elements. The challenges based on ICT development were reviewed from different perspectives and defined as follows by the Expert Workshop organised by

IPTS in October 2005. Learning spaces put learners at the centre of learning, but, at the same time, conceives learning as a social process. Learners become co-producers in the learning process and not mere consumers of learning content. Learning spaces are comprised of the following dimensions (IPTS, 2006):

- Learning spaces are connected and social spaces;
- Learning spaces are personal digital spaces;
- Learning spaces are trusted spaces;
- Learning spaces are pleasant and emotional spaces;
- Learning spaces are learning spaces;
- Learning spaces are creative/flexible spaces;
- Learning spaces are open and reflexive spaces;
- Learning spaces are certified spaces;
- Learning spaces are knowledge management systems.

The Energizing Urban Ecosystems EUE research programme, as described later in this article, strengthens the already existing innovation hub with the selected forerunner themes on high international level. One of the key questions addresses the shifting of the emphasis of the strong research, education and corporate hub into a living and working hub that is characterized by entrepreneurial discovery and creative industries and that produces significantly more innovations than before. During the first year of the EUE programme, the academic and industrial researchers defined, under the guidance of Professor Pirjo Ståhle, the enablers of the innovation ecosystem. The following are focused on spaces:

- The need for modifiable and flexible spaces: (a) facilitate experimentations, (b) provide experiences in being empowered to act differently, (c) allow to reflect meanings and values of identity, (d) develop and maintain platforms that offer resources for users to select, utilize, modify and create;
- The need of intelligent spaces: (a) prototype technological solutions, (b) create platforms for people on building various meanings;
- The need of attracting spaces: (a) use something inspiring and unique through design, art and ergonomics.

These bring new angles and perspectives compared with traditional space design.

Also architectural competitions have proved to be effective ways of pursuing new approaches and solutions. As an example of this, Aalto University Properties Ltd arranged in 2012-2013 a competition for designing a lively central campus area for Aalto University and its new main building. The amount of floor area to be located in the competition area is between 48,000 – 52,000 m^2 (gross floor area) around the new metro station. In addition to common criteria in these types of architectural assignments, the Competition Programme highlighted the following learning environment criteria:

> A learning environment of the future will integrate public and semi-public facilities, service producers and users. A shift is underway from the traditional, instructor-centric notion of teaching toward a new focus on students as active subjects. One of the tasks of universities is now to support group-based learning activities. Reaching this objective requires comprehensive re-examination of the current learning environment. In addition to lecture halls, studios and laboratories, learning is understood as taking place in various unofficial encounters and situations. The facilities should, therefore, promote and support active collaboration and interaction. The objective is to find new concepts and create a lively and interactive environment for research and learning activities wherein work, studies, leisure and living are interwoven in a natural way and create the foundation for a university city of the future. (Competition Programme, 2012)

The Competition Programme also stressed usability as a learning environment by requesting that the solution:

1. Should promote the culture of the entire innovation community: multidisciplinary international cooperation, joint projects and occasional encounters;
2. Develops a basic solution for connecting indoor and outdoor areas in all weather conditions;
3. Should provide a suitable range of spatial solutions for all members of the Otaniemi community, with smooth and effortless connections between the various components;
4. Represents innovative values that promote international visibility and increase the appeal of the campus.

5.2 Ecosystem Thinking

Grand societal challenges are typically extremely complex by nature. Therefore, the related solutions call for unprejudiced learning, that is, reflection of new opportunities and research in multi-dimensional co-creation teams and networks. Significant learning takes place as part of large innovation ecosystems.

Professor Martin Curley, Director of Intel Labs Europe, challenged the readers of the EU Open Innovation Yearbook 2012: “Open Innovation 2.0 could be defined as the fusion

of Henry Chesbrough's open innovation concept and Henry Etzkowitz's triple helix innovation concept. Triple Helix is about achieving structural innovation improvements through proactive collaborations between industry, academia, and government. The impact of this collaborative innovation goes well beyond the scope of what any organisation could achieve on their own." (Curley, 2012)

Ecosystem is a buzzword we see often in today's media. A natural ecosystem is defined as a biological community of interacting organisms together with their physical environment. In the same way, a business ecosystem is "the network of buyers, suppliers and makers of related products or services" together with the socio-economic environment, including the institutional and regulatory framework. A digital ecosystem is a self-organising digital infrastructure aimed at creating a digital environment for networked organisations that supports the cooperation, the knowledge sharing, the development of open and adaptive technologies and evolutionary business models. (European Commission, 2012)

Professor C.K. Prahalad gave a clear message to universities by defining three critical aspects of innovation and value creation: 1) Value will increasingly be co-created with customers. 2) No single firm has the knowledge, skills, and resources it needs to co-create value with customers. 3) The emerging markets can be a source of innovation. One of his main conclusions should be taken into particularly thorough consideration in creating the new role for universities: The competitive arena is shifting from a product-centric paradigm of value creation to a personalized experience-centric view of value creation. (Prahalad, 2008)

The ecosystem thinking sets new guidelines for learning environments. An effective learning environment incorporates operative methods that elicit new insights and stimulate individuals to exceed their own limits. Typically coincidental encounters and interactive processes fostering surprising innovative angles elicit curiosity and inspiration. A successful learning environment is characterized by myriad events that could be described as creative tension.

Uncertainty factors, doubts and tensions are present in all interpersonal activities. The point is to modify tensions, in particular, so that they serve as a source of creativity and innovation, and so that the principles of the learning organisation are followed. The creative process itself becomes a clearly creative tension that can be applied to change activities in systems and to change systems as a whole. It is important to adopt methods and concepts that increase the amount of learning, raise its quality and enhance sustainable social development.

Universities with all their stakeholders should thoroughly explore regional innovation ecosystems and the role, importance, activity, spatial solutions and success enablers of communities and institutions that spur new and dynamic innovation activity in such ecosystems. Especially the educational institutions should focus on the new mind-set and environment required for user-centric design, co-creation and rapid piloting.

The recent development has throughout the world led to new operational units with flexible entities characterized by a strong collaborative approach in all their activities. The examples include: Incubators and Accelerators, Living Labs, Entrepreneurial Hubs, Development Labs, Social Innovation Labs, Fab Labs, Societal Innovation Learning Camps and Future Centers. They usually operate as associated entities of universities, municipalities and businesses. They combine new and open operating practices, use of social media, new intellectual property rights and funding practices, a broad stakeholder network and entrepreneurship.

5.3 Aalto Pioneering the European University Reform

The explosive increase in the amount of available information, continuously tightening competition, and the European economic crisis have also forced universities to rethink their operations, structures and management cultures. Today's university operations are generally characterized by fragmentation: units are too small and efficiency measurements guide them too much towards independent scientific publications and projects accentuating their own operations. New significance can only be created, first and foremost, by drawing on solid research expertise and both cross-disciplinary and international collaboration envisioning innovative research initiatives.

An essential principle in the EU programme period 2014-2020 is Smart Specialisation and it should be visible also in university activities. One should know and dare specialize and collaborate openly, much more than before. The desired change requires a new attitude also from financiers and university management. Our eyes must open to the huge global opportunities, and all the parties involved should be both bold and capable enough to

create a system of mega-endeavours. With this term we refer to entities comprised of several projects, an orchestrated portfolio of projects operating on the basis of strategic partnerships. This system is built both on the in-depth research activities within diverse disciplines, and multi- and inter-disciplinary collaboration between diverse disciplines. This preferred development also calls for a new university culture capable of challenging the traditional ways of working and thinking. Universities need to begin recognizing new innovative landscapes as immense opportunities, now more than ever.

Universities are challenged especially by the creation of new learning environments in practice. Our case examples illustrate how theory moulds into practice: Aalto University – the merger of Helsinki University of Technology, Helsinki School of Economics and the University of Art and Design Helsinki – started its operation in January 2010. The period of planning the merger did not extend long; more important was inspiring and creating a foundation for active initiative within the entire university community along with its stakeholder groups. To provide a mental incentive for its community, the university wanted to signal its excellence as a forum of materializing dreams.

Aalto University set a target to create a solid foundation for societal impact by integrating the separate activities of different departments and other units and to develop synergistically connected entities securing prerequisites for close university-industry cooperation in the spirit of the Knowledge Triangle. Such entities were defined as:

1. Aalto University Factories;
2. The Learning Center;
3. Open Innovation Activities;
4. Strategic Partnerships.

Aalto University on a broad scale has developed its activities towards being a real life living lab. On the other hand, several units within Aalto are already running subject-focused living lab operations. The need to create a cross-disciplinary operating culture that examines societal phenomena multi-disciplinarily has been documented in Aalto's strategic alignments. Upon University transformation, we have drawn guidelines depicting, what is meant by networked Aalto Living Labs and other open innovation operations (Figure 1). At the same time, this materializes as intensified collaboration between diverse operators from the different parts of the University with the aim of increasing societal interaction with and impact on society significantly. The concept and its activities are based on university-level research, development and innovation (RDI). Open Innovation integrating research, teaching, learning and different collaborative developments is a feature characterizing all these activities.

These all are new openings based on the existing Aalto strengths and activities, as well as the defined development needs. However, making new organisational structures is not a priority activity. Instead, the first phase of the strategy process has stressed the definition of the Aalto Vision 2020, based on the general aims and objectives set by the Aalto Board and the review and planning process integrating different elements within the University activity spectrum.

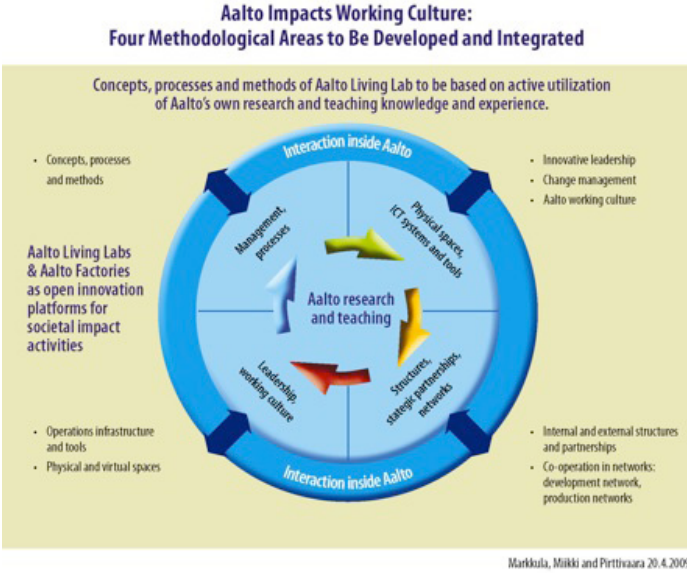

Figure 1: Aalto Impacts Working Culture: Four Methodological Areas to Be Developed and Integrated.

Within the three missions of universities (research, education and societal interaction), the work for the transformation plan has followed the following route: defining (a) vision 2020, (b) concepts and processes, (c) culture and capabilities, (d) structures. In increasing the societal impact of Aalto, the guiding principle has been that research conducted by all Aalto units serves as an essential channel increasing societal impact. In addition, special emphasis is all the time on developing the higher education and innovation theories in parallel with implementation and also rapid prototyping, i.e. making things happen and learning by doing from new experiments.

6 Regional Innovation Ecosystem around the Aalto Campus

6.1 The Research Programme "Energizing Urban Ecosystems"

Energizing Urban Ecosystems, EUE, is a Finnish 4-year research program for 2012-2015, with 20 MEUR funding, with 50 % of the funding coming from industry and the other 50% from public bodies including Tekes, Espoo City and Aalto University. The EUE program has brought together a broad group of researchers, innovators, business interests and civil sector participants to pursue its ambitious objectives. The program is organised through RYM SHOK, the Strategic Centre for Science, Technology and Innovation for the Built Environment.

The special focus of the EUE research is the T3 area (Otaniemi, Keilaniemi, Tapiola) in Espoo, Fin-land's and also northern Europe's most significant concentration of innovation resources and activities (an area of about 5 km2). According to the plans, within the next 10 years, there will be new investments of about 5 BEUR: metro, tunnel construction of ring road, other infra, housing, office and business buildings, public services, university buildings, sports, cultural facilities and others. However, the most important driver of change is the mentality towards innovation and entrepreneurial discovery.

This T3, the innovation triangle, forms an ideal landscape for prototyping potentially valuable innovation methodologies and technologies in real-life test beds. The program will create an internationally recognized and multi-disciplinary hub of excellence for urban development in Finland, working through a globally networked cooperation platform for R&D projects in urban development. EUE will create and apply operational models and solutions to the challenges posed by urbanization. The goal is to create user-centric and competitive urban solution concepts applicable to both existing and new areas. Solutions for smart urbanization, orchestrated innovation activities, energy use and mobility will be integrated into the design of the built environment, land use and ecosystems of service production. This research will create a powerful research-based practice for actively building the pioneering smart city-region.

Within the EUE program, the Regional Innovation Ecosystem (RIE) work package has brought together diverse technologies and methodologies for new urban design and development. In this inno¬vation-enabling environment, the EUE program demonstrates how to effectively implement the key enabling success factors of the Europe 2020 strategy, and how an updated triple helix model supported by the Knowledge Triangle approach can enhance collaboration between the city, universities, research institutes and diverse enterprises throughout this regional innovation ecosystem.

From the perspective of Horizon 2020, the EUE program is highly relevant for achieving European goals. In the EUE program, we see how value can be co-created with customers and stakeholders, how the orchestration of support infrastructure between participating partners can create synergies in using knowledge, skills, and resources to co-create value with customers, and how experience-centric models of value creation can be applied. Looking at the relevance of the EUE programme to Horizon 2020, we see a number of important aspects, including:

1. Setting the example of a pioneering innovation region: how to create and maintain an effective regional innovation ecosystem;
2. Using Espoo T3 as a test bed for specific innovative practices: developing realistic, close-to-the-street innovations in practice, with measurable effect on the lives of citizens and stakeholders;
3. The potential for applying many of the technologies, methodologies, working processes and collaboration models developed here in other European regions;
4. The possible scaling of relevant concepts, working pro¬cesses, results, and research questions, whereby lessons learned here could become lessons to be learned elsewhere.

6.2 Regional Information Modelling and Virtual Reality

The EUE program was launched in May 2012 and has moved forward in a number of ways, including its scientific research on regional information modelling integrated with virtual reality applications. The EUE research program adopts cutting-edge techniques for spatial data acquisition. These are applied to, and combined with, concepts for a digital ubiquitous ecosystem in Espoo City T3 area. The target application will be a mobile and virtual smart city model with geospatial virtual knowledge elements. Specific attention will be paid to aspects of usability and innovative visualisation for various user needs. By capturing the city's geometry and characteristics through laser scanning, the resulting model can be applied in an information modelling

process to conduct different kinds of analysis. The virtual — pos¬sibly, photorealistic — models used as the basis for the regional information model create a virtual city, geometrically accurate and visually close-to-iden¬tical with the real one. This enables city planning, built environment and real estate management pro¬fessionals, as well as decision-makers and citizens, to use the model for diverse purposes.

As we have described in this article, the impacts of digitalization have been overwhelming in many activities – also in terms of innovation and learning. Universities should be the forerunners in applying latest scientific and technical research and innovation knowledge to real-life practices. An example of opening and testing potential opportunities is the work in the EUE of integrating real and virtual worlds. In practice, this means that university researchers and industrial professionals review physical, mental and virtual environments in parallel, i.e. as operational and learning spaces. An integral part of the ongoing EUE processes is the Meshmoon (a product of a SME called Adminotech) online virtual reality hosting system, which is based on on-demand cloud hosting technology and the open source realXtend Tundra software. The Research Institute of Measuring and Modelling for the Built Environment at Aalto University together with the Finnish Geodetic Institute are developing the concept of Regional Information Modelling, based on an open source virtual world application platform. Traditional Building Information Modelling (BIM) is used in controlling a single construction process in order to record physical and activity-based features in a digital form.

The resulting building information models become shared knowledge resources to support decision-making about a facility from earliest conceptual stages, through design and construction through its operational life and eventual demolition. Regional Information Model can be regarded as a similar presentation of a larger area of built environment, that can be further used e.g. for virtual city planning. The Regional Information Model could provide a reliable and trustworthy basis for lifetime engineering supporting new value-adding activities and decision-making. It could also create a novel platform for urban planning, where designers, civil engineers, city officials and inhabitants will be able to interact, exchange thoughts and study the evolving urban environment in a visual way with the help of accurate spatial data. (Hyyppä & Virtanen, 2013)

The starting point for the regional information modelling is the integration of existing building information models, different spatial information systems, and state-of-the-art measuring techniques such as Mobile Laser Scanning, with virtual environments. This, in effect, creates a combination of the physical and virtual worlds. Within the EUE program, we have used these instruments in creating our virtual collaboration platforms (Figure 2). Online virtual reality hosting systems, like Meshmoon, are still fairly new technologies, but the potential is high. Updateability and availability are some of the major benefits of networked virtual environments, such as Meshmoon: the latest version of the model of the built environment could be in use within a few hours from completion. As the virtual environments can be viewed by several users simultaneously, the customer, contractor, users and decision makers can instantly discuss various aspects of the project online, enabling efficient cooperation. Demonstrations where the physical and virtual worlds meet provide an excellent foundation on which to present research results. Applications can be examined from a user's point of view before beginning the final development work. A demonstration can be used to reify and clarify the possibilities offered by a technology. (Hyyppä & Virtanen, 2013).

Figure 2: Aalto City Integrating Real and Virtual Worlds.

6.3 Aalto Innovation Garden and Aalto Design Factory

Aalto Innovation Garden is the new focal point of innovation buzz at Aalto Campus. Its core activities pivot around the Aalto Design Factory (ADF), the Startup Sauna (SS) and the Urban Mill (UM). Together these three co-working and co-creation spaces, and their common yards, form a networked physical, virtual and social Knowledge Triangle with its nodes focused on learning (main responsibility ADF), systemic innovation

(main responsibility UM) and new business creation (main responsibility SS). The operators of these spaces work daily and closely together. (ADF & SS & UM, 2013)

Startup Sauna, founded in 2010, is a non-profit organization for startups and aspiring entrepreneurs in Northern and Eastern Europe and Russia. The aim is to implement a blooming startup ecosystem and a pay-it-forward culture into the region in order to make it the best place for startups. The newly renovated Startup Sauna space is the meeting place for aspiring entrepreneurs in Northern Europe. The 1.500-m² co-working space is an old industry hall free for anybody interested to work at. In practice, Startup Sauna consists of three different operations:1) an internship program for aspiring entrepreneurs to work at high-growth companies in Helsinki and in Silicon Valley, 2) an accelerator program for early-stage startups where the companies receive coaching from experienced serial entrepreneurs and investors in an intense one-month program in Helsinki, and 3) The Slush conference, which brings together the early-stage startup ecosystem in the region to meet top-tier venture capitalists and media from around the world.

The activities are mainly self-organised by multi-disciplinary communities of practice and collaboration is facilitated through shared boundary objects. Their human-centered innovation orchestration approaches challenge the traditional institution-centred Knowledge Triangle practices. (Mikkelä & Miikki, 2013) Factories are a strategic part of Aalto University's ecosystem, aiming at deep and sustainable social, cultural and economic impact. Factories provide physical and virtual facilities, coaching and facilitation to increase collaboration between academia, industry, and society (Triple Helix perspective). Factories enable and inspire knowledge co-creation and make Aalto more visible and easily accessible. They create the desired working and learning culture in the Aalto community, including all its stakeholders and customers.

By definition, Aalto Design Factory is an experimental co-creation platform for education, research and application of product design – where 'design' has a broad meaning. Three factories started their operations in the fall 2008: Design Factory, Service Factory and Media Factory. The factories serve as experimental platforms, showrooms and sources of inspiration for all the parties involved.

Aalto Design Factory is defined briefly as "A Passion-Based Co-Creation Platform" and "Expertise Value = hard x (soft)2". The following quotations sum up the opinions of thousands of ADF users describing the multi-dimensional nature of innovative spaces. The Aalto Design Factory has been described as:

- A symbiosis of the state-of-the-art conceptual thinking and cross-disciplinary hands-on doing;
- A platform for experimental problem-based learning to promote better learning outcomes as well as enable experiments in industry-university collaboration;
- A place where students, teachers, researchers and industry partners can interact under the same roof. The place has its architecture and certain enabling and supporting technologies, but perhaps even more important are the soft issues – philosophy, attitudes, our ways of working;
- A second home for having fun, experimenting, failing fast and learning, asking for help from others, being openly curious, inspiring by example, being proactive, and taking initiative. (Aalto Design Factory Stories, 2013)

The following categories have been defined as the characteristic features of interaction within ADF community:

- Potential for Collaboration;
- Close community as a home base;
- Open Interaction;
- Diversity of the ADF community members;
- Importance of integrating with the ADF community;
- Importance of the atmosphere.

Some new developments for Aalto Design Factory's next step ADF 2.0 are already processing with even more ambitious goals, more aspiring people and more focused activities. ADF 2.0 will be building a world-class hub and community for Interdisciplinary Product Design in its widest meaning.

6.4 The Urban Mill

The most visible outcome of the EUE pro¬gramme so far is the Urban Mill (UM). It is a thematic focal point and open innovation platform service for global urban innovators. The UM was established in early 2013.

The UM is also a co-working space, an innovation community, and a change orchestration tool. The UM aims to re-define the way in which people accomplish joint innovation work, and aims to make societal impact in a global urban context. It strives to be a point that people want to visit because it seems natural, special or relevant to them. The space is not only bringing single individuals together but also supporting to engage and energize people. (Mikkelä & Miikki, 2012a)

According to the UM vision, a substantial amount of the co-creative knowledge work of the future is carried out in thematic RDI communities using smart co-working and co-creation spaces which are digitally supported, connected and globally distributed. Space concepts are seen as creative hybrids of physical, virtual and social dimensions. Each hybrid space has its own core working community, thematic properties, specific characteristics and functional role within their own network of other connected thematic spaces and within their respective ecosystems. (Mikkelä & Miikki, 2012b)

UM facilitates re-thinking how sustainable urban innovations can be pursued and how urban transformations are orchestrated. The UM community shares a common challenge, which is how to enhance the quality of urban life and services through ICT and built environment development, and how to orchestrate and energize urban ecosystems development. The UM itself is like a continuous facilitated innovation journey, where the collaborative actions and creative dialogue between different UM actors is boosted and facilitated by using physical, virtual and social boundary objects, like shared concepts, methods, probes, prototypes, demonstrations, test-beds and living labs. (Mikkelä & Miikki, 2013)

The Urban Mill's enabling service provision supports co-learning, co-design and co-effectuation of the user communities. As a connected smart space, the Mill acts also as a two-way interface to thematic creative social networks of its users and as a two-way interface to the relevant macro-context digital open data sources. This extensive connectedness supports space usage experiences and its users' own micro-context transformations before, during and after events held in its physical or virtual premises. (Miikki & Mikkelä 2012)

The core competence of the orchestration team centres on the organization of the right methods, tools and facilitation processes for help¬ing projects and partners achieve their objectives. The methods may range from tools and technologies for creative-problem-solving, user-centred co-creation, building syn¬ergies and breaking silos, dealing with resistance to change and creating breakthroughs in no-progress situations. In addition, a systemic learning infrastructure is needed to ensure effective learning, and to facilitate entrepreneurial learning – the rapid application of lessons learned within the ecosystem so that projects and players within can systematically benefit from each other's experience and expertise. (Markkula & Kune, 2012)

The process of creating something like Urban Mill is a novel example of the public-private partnership. The orchestrating initiator and driver taking also an operative risk of succeeding is a private company Järvelin Design Ltd, while the other main stakeholders involved are Aalto University, City of Espoo and RYM SHOK. This type of a setup has proved to be a dynamic foundation for the initiative and could be applied as a leading principle also in other contexts.

The theoretical background of the UM development is based on theories and concepts such as Nonaka's "Ba", Susan Star and James Griesemer's "Boundary Objects" and Joseph Pine's "Multiverse Framework". Figure 3 explains the context and main building blocks of the Urban Mill approach.

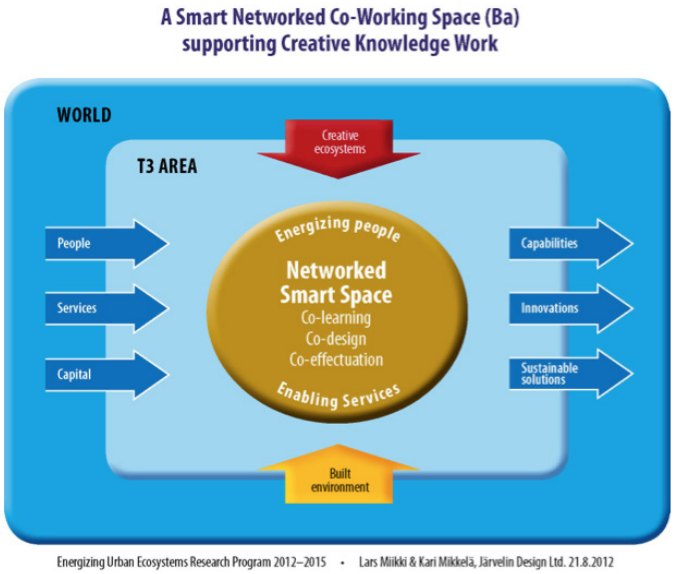

Figure 3: Smart Networked Co-Working Space (Ba) Supporting Creative Knowledge Work.

The development process followed the principles of effectual entrepreneurship and lean start-up methodologies. The funding is mostly from the main users of the facilities, so no venture capital or direct public funding was needed. Sustainability factors are highly respected, the building is a former Technical Research Centre of Finland (VTT) testing laboratory facility in Otaniemi. The building was transformed into a 1300-m² flexible co-working and co-creation space by the pioneering Urban Mill community itself. Space elements and modules are flexible and multi-usable, and open to all regardless of who is hosting the sub space. Most of the furniture, technology and resources are recycled and shared among all users. Also fixed costs are shared

and even some of the basic facility and special support services are co-produced on social exchange basis. (Kakko, 2013)

7. Conclusions

The Smart City concept has been one of the EU focus areas in driving smart and sustainable growth and improving quality of life. The enablers include investments in modern e-infrastructure and e-services, as well as in human and social capital. The driver of change is, above all, learning. Regional renewal capital and the effectiveness of innovation ecosystems lie at the core of this learning – targeted especially at modernising the Triple Helix collaboration culture and thus getting innovation out of research, as well as increasing regional responsiveness through citizen participation.

In the university-industry interface, knowledge exploitation and capacity-building processes are the important concepts, as well as exploration and knowledge co-creation. The innovative learning space tackles these challenges. Its practices are based on bottom-up self-renewing that takes into account the characteristics described in this article.

There is a need to create strong regional innovation ecosystems as platforms for learning and co-creation spaces, as well as test-beds for rapid prototyping of many types of user-driven innovations, based on transformative and scalable systems. They challenge top-down approaches inherited from the old, analogue world. While digitalisation is making service development more global than ever, Europe's position at the moment is not optimal: if we do not wake up, we cannot win the global race.

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