

# State-of-the-art in utilizing Living Labs approach to user-centric ICT innovation - a European approach.

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## Abstract

Europe (and the rest of the western world) faces many challenges in the future: integration of the new member states, continued competition in important business sectors, solving the healthcare issues of an ageing population, to name but a few.

Probably the most important challenge is increasing the overall productivity and job creation in the society in general. It is well-known that developing the ability to be creative and innovative in a society influenced by stress, lack of time, and other factors, is perhaps the most important key towards increasing the overall productivity of a future European society. Rather than the ability to produce low cost products or creating new knowledge more efficient, innovation and creativity is the key to the future.

Mathijs van Zupthen [1] outlines some of the new paradigms in a society more focused on innovation. This includes changing some of the underlying fundamentals of the overall economic system of today, which is based on that knowledge is scarce, owning properties and controlling rights is the means of controlling the economical system of today's society.

Technology enables new value-chains, often without its chain attributes, becoming more network-like and the user/citizen/consumer is given new tools and relations to participate in those value networks thereby becoming as much producer as consumer.

This paper examines the state-of-the art in involving the user and organisations into the

innovation process in various initiatives ongoing, examines the key practices that needs to be in place and gives examples on how those have been deployed.

The proposed systemic innovation approach presented under the name of Living Labs contributes to the coming challenges of mass-deployment of ICT solutions as a mean to further develop the society involving the citizens. It brings the users/consumers/citizens into the system of innovation, thereby leveraging on a larger mass of ideas, knowledge and experiences etc and substantially boosting the innovation capability.

## Introduction

It is well-known that investments and use of ICT boosts the overall productivity of the society. Europe lags behind in the level of ICT investments being made. This has been pointed out by many EC reports, such as the i2010 policy statement [2].

Heavy investments have been made during the last decade into new technologies, such as 3G, DVB-T and various fixed Internet access systems. The industry is now waiting for the services to be deployed, but success seems not always evident. It is more and more obvious that technology will not be a success just because of technical excellence.

If previous years were devoted to explore the possibilities given by technology, the coming decades must be devoted to mass-deployment making full benefit of opportunities. This puts completely new requirements on the agenda for activities to be conducted by the research and

development community at large. It does not mean mass-produced standardized products for everyone, but rather a greater focus on customization and personalisation of products and services. Humans are complex, governed by not only logics, but fears, worries, attitudes etc. There is no standard user!

In order to achieve mass-deployment and stay competitive, the ability to innovate and create the applications of value for the humans will become more and more in focus. This move will evidently make specific technologies what they really are, namely enablers for creating the value for humans (applications) and not the value in itself.

The ability to innovate is then the key aspect. So what is innovation? Per Eriksson, Director at the Swedish Agency for Innovation systems once said; *Research is making knowledge out of money – innovation is making money out of knowledge.* This implies a relation between research and innovation. The problem is of course that the processes of research and innovation just don't appear automatically. The question is how to best stimulate the process of innovation (and how that relates to research)?

The well-established approach to innovation is science parks. With the idea of establishing parks in the vicinity of universities (where research and knowledge can be assumed to be easily accessible), a good foundation is created. Many science parks have been successful in creating new business in high-tech areas, with sometimes great commercial success. A coming focus of ICT application mass-deployment opens up new opportunities for innovation beyond core technologies.

We have argued that the knowledge is an important component in the innovation process, but what knowledge is then important when putting applications, usability and usefulness aspects of ICT more in focus? And how can important knowledge be created? Which are the important areas?

One basic ingredient in all innovation systems is the ability to cross-fertilise. Ballon et al gives a good overview [7] of various problems in the complex innovation systems. Ballon mention three innovation system failures related to the ability to interact.

1. The first failure is suboptimal degree of interaction, e.g. insufficient interaction between firms and public knowledge

institutes. Too much interaction might on the other hand lead to habit formation.

2. The second problem is missing or inadequate institutions whereby the chain of innovation is broken. Typically in the area of user centricity, user knowledge etc these institutions are scarce.
3. The third problem area is the path dependency & lock-in. This is related to the tendency of firms to stay with the existing paradigm of operation as it is so difficult to break into new grounds. This altogether calls for co-operation arenas in where stake-holders from a variety of organisations co-operate.

For innovation to happen, the creative process of humans involved is crucial. Innovation is created by humans, not by systems. Here we find the birth of new ideas that can be turned into applications and bring value through use. So what are the factors to consider when increasing creativity? Often it is claimed that the ability to collaborate between people

- a) of different backgrounds,
- b) with different perspectives, and
- c) possessing different knowledge has a large influence on the creativity process within a group.

It is obvious to anyone that has experience with systematic innovation methods, like TRIZ (<http://www.triz-journal.com/>), that the ability to break the patterns of thoughts is key to brilliant innovation.

### **The user in the innovation system**

The need to conduct research and development with the user in mind is obvious and has over the years rendered in a variety of concepts, such as participatory design to name one. These are development processes and not innovation systems. The basic ideas might be similar, but they do not cater for the systematic foundation of an innovation system.

As argued by von Hippel and Thomke [3, 4] the users are actually more often than the manufacturers of technology the source of innovations. Several descriptions of the mechanisms exist, ranging from creation (e.g. open source) over information (lead-user-

method) to decision (surveys, panels) as described by Reichwald et.al. [14].

von Hippel and Thomke also highlights that one of the basic problems in product development is that the needs residing at the user/customer has to be understood by the developer, which in turn understands the possibilities given by enabling technology. The process of conveying the needs to the developer is a complex, often trial and error like, process were the developer responds with concept models or prototypes to solve the needs until the user is sufficiently satisfied.

The process then becomes increasingly difficult if the product or service to be developed is to be combined with other products or services in a complex value-chain in the end solving the real need of the user.

An increasing trend is then, as Thomke and von Hippel outlines in [4] that the user/customer is provided tools to allow them to configure, combine and invent the exact product to fit their needs. The product development problem is then transferred from the process of capturing needs, to the process of conveying the limitations and characteristics of the product concept towards the user and also to the process of producing the product. This concept then gives the user or customer a much larger freedom to innovate and provides valuable feedback to the supplier.

The approach has so far mainly been used by the B2B sector, but numerous signs are that it is spreading into the B2C area, with examples coming from Dell, automobile industry, etc but are often limited in the freedom given to the users. Another strong example is the open source movement. This phenomenon lets the user contribute to the evolving sum of products in a growing network. Maybe the most interesting examples comes from 1) Lego that now invites for contributions to their virtual Lego designer and 2) Neuros Audio that have created a media player with an open source environment for users to create their own media players.

The area of mass-customization is studying the values that can emerge when combining user contribution with ICT enabled production, services and logistics.

The argument that the user/consumer is maybe the most important component has up until now been completely neglected when

modelling innovation systems. By utilizing new technologies, the user can be brought into the innovation process as demonstrated by the mass-customization approach. The basic idea is not about using the users as “ginny pigs” for experiments, it’s about getting access to their ideas and knowledge.

ISTAG (Information Society Technology Advisory Group – a set of influential individuals to give advices to the European Commission on the future of IST) recommends in their report [3] a set of measures to enhance the usability of technology and inclusion into the everyday life. The approach is named Experience and Application Research (EAR). In that report ISTAG shapes four different concepts in this area namely:

- 1) Science and Technology Centres
- 2) Feasibility and Usability Centres
- 3) Demonstration and Evaluation Centres
- 4) Field Trials.

In these centres users are supposed to contribute to technology becoming more user friendly.

The concepts proposed by ISTAG include four stages of involvement of the users. Its major drawback is that it does not cater for the “users as innovators” approach sufficiently. This is due to that the ISTAG concepts takes a technology centric view in that it assumes a technological innovation, then stepwise adoption of that technology by testing with users and towards the end a field trial. Furthermore the description uses terms like testing centres instead of modelling an innovation process.

The European telecoms industry, through its eMobility initiative [5] argues that it still is important to continue the R&D efforts related to mobile communications technology as the innovation cycle for basic technology is far longer than that of corresponding applications. It also includes the field test approach, but completely lacks the user/customer contribution in the innovation cycle. This lead to a risk in inventing things that user’s might not request and furthermore limit the contribution to those already in the industry. On the other hand; How do we know what users request if we cannot convey the possibilities? The eMobility report argues that efforts must be put in making the service creation greatly simplified. As this is obviously true it also requires a model for improving innovation – most efficiently done by

actively and interactively involving the users and their needs. This aspect is today missing in the eMobility proposal.

The proposed Living lab model combines the basic arguments from ISTAG on “why?” with the “users as innovators and mass-customization” approach from von Hippel et al, whereby the user is given a central role in the innovation process.

The broader involvement of users far beyond focus groups or mass surveys then becomes crucial, and also the various ways by how to involve users in those collaborative innovation processes.

*“Technologies and applications that allow for new and effective forms of collaboration will not only foster creativity and harness European diversity, but will also boost levels of innovation in Europe”. Cordis News (2003)*

*“If I can tap into a million minds simultaneously, I may run into one that’s uniquely equipped”. Business Week (2005)*

*“Crowds can go mad, of course, but by and large, it turns out, they’re smarter at solving many problems than even the brightest individuals” Business Week (2005)*

If tailored right, such user-centric environments could become very important in increasing the attractiveness of Europe and the western world for young researchers as they want to pursue their careers, thereby attracting the most talented individuals.

### **Regional issues to innovation**

Although one can argue that the world becomes more global with the support of ICT it is still to a large extent local. We, as human beings, live in a local society. We eat, study, sleep, work and entertain ourselves in that local society. The content we consume is to a large extent still the local one.

This means that services still requires local tailoring. Many of the public services that can be useful are only valid locally, whether it has to do with schools, healthcare or taxes. News is another example where the locality is valid. Furthermore we have the language issue which further enhances locality.

The world of services and innovation should be looked upon in the light of outsourcing more and more to low-cost countries. Some things are

produced in those countries with as good quality, but services and concepts requiring good knowledge of the local market can hardly be moved. The implication of this is that innovations related to the deployment of ICT based applications in certain segments then becomes sustainable over a longer period of time.

Furthermore, the regions especially in Europe are beginning to understand that they need to profile themselves in order to be attractive. Aspects such as quality of life, environments, safety and security, future prosperity become even more interesting. In this context many regions today are launching or thinking about programs to support the region with new and innovative ICT usage. This can be competitive basic access networks, public services etc. Not only does that improve the image of the region, it often improves the overall productivity of public services as argued before.

In executing those programs, the role of the citizen becomes increasingly important and various concepts has been invented, some of them excellent foundations for a richer innovation system.

## **The emerging concept of Living Labs**

The Living Lab concept originates from MIT, Boston, Prof William Mitchell, MediaLab and School of Architecture and city planning. Living Labs represents a user-centric research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts.

The first Living Labs created from the initial ideas were in the area of smart/future homes. In those settings real people (visitors) was observed in their usage of emerging technologies in the setting of a real home. In many of the implementations people stayed in these homes for several days or weeks.

As these initiatives were multi-contextual in the sense that the experiments were conducted in a real home environment, they did not cater for the much wider contextual difficulties from the larger society including work, entertainment and social life at large. The basic idea to include the users in the value-creation process has then been adopted by several initiatives. Some examples are given later in this paper.

There is now an emerging movement to tailor a Living Lab concept for the more general ICT enabled application sector. The purpose of such Living Lab concept in a wider use is to enhance innovation, inclusion, usefulness and usability of ICT and its applications in the society. The development of Living Labs is supported by the belief that the full potential of ICT today is not in the continued innovation of new technical products with superior technical performance, but rather the understanding of the user situation and innovation of solutions to match those in a changing society.

The implementation of the Living Labs is based on the involvement of the user (firms, organisations and consumers) in the innovation process, thereby making the innovation system user-centric, as opposed to technology centric.

The Living Labs Concept refers to an R&D methodology where innovations, such as services, products or application enhancements, are **created** and **validated** in collaborative multi-contextual empirical real-world environments. The individual is in focus in the role of a citizen, user, consumer, or worker. The user experience focus involves areas of user interface design and ergonomics as well as user acceptance, extending to user co-design process, finally leading to service or product creation. The human-centric approach in Living Labs conceives of human beings, citizens and the civic society as a source of innovation and not just as users or consumers in a narrow sense being an object for R&D activities. Many other so called user-centric methods still has the user as an object for R&D, whilst the Living Lab approach then strives to break the trial and error process of product development previously described, and change that into a co-design process where users and developers actively work together creating the new solutions.

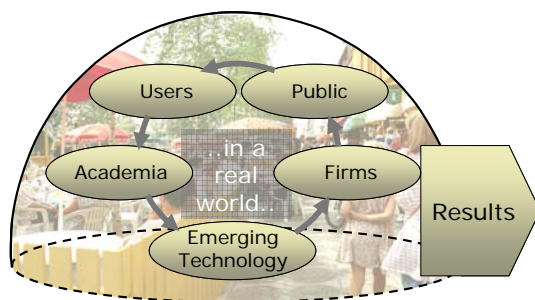


Figure 1. Basic "Living Labs" concept

By involving the entire value chain from technology suppliers, through firms that utilize technology and content providers on to the end-users in the full complexity of the real-world setting, all aspects of ICT applications in a specific field can be analyzed and experimented upon. Through open collaboration between a large variety of stake-holders (as outlined above) the Living Lab does not favour any specific technology or business model, but rather focus on capturing the values of technology based on the usefulness that it bring.

Value is captured on an individual level as well as on the organisation level. Emerging value distribution and changes of existing value chains are analysed including the emerging concepts of mass-customization. Culture and site specific features are identified when innovative applications are transferred across borders to different diverse contexts and cultures.

The challenge of the methodology lies in its design, including core local partners from user groups, public or civic sector participation parallel with private sector technology and service providers. It requires a wider understanding of the process of innovation, especially in the context of the fundamentally changing society (as outlined by van Zupthen in [1]).

The interaction needed for innovation can be modelled according to the figure below.

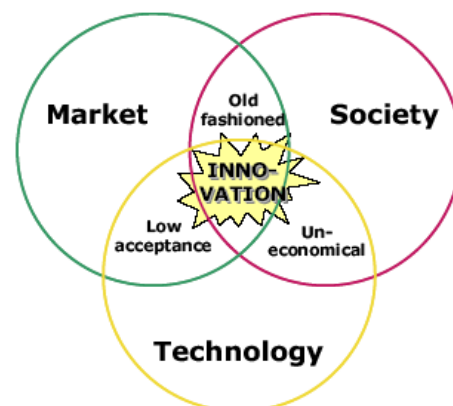


Figure 2. Society, Market and enabling Technology in Co-design Process

Generally speaking, innovation generated with only two out of the three components above would lack serious constraints. If only Society and Technology is involved, the results risk being un-economical, if only Society and Market

is involved the result might be old-fashioned and if only Market and Technology is involved the result risk being of low acceptance from the users. By securing all three dimensions improved innovation is enabled.

In several regions of Europe, local user-centric “Living Labs-like” innovation environments exist independently of each other, for example Arabianranta in Helsinki, Crossroads Copenhagen in Denmark, Mobile City Bremen in Germany, Philips HomeLab or Testbed Botnia in Sweden just to name a few. Furthermore, the regions are beginning to network between themselves (e.g. LivingLabs Europe or SIG LivingLabs@Work). Although with similar objectives, the implementations of the individual sites vary immensely, and should to some extent probably do so due to regional differences. There are however some critical aspects that needs to be implemented.

In these environments, technology evaluation and market validation infrastructure is provided in an open manner to actors within the targeted sectors. The concept directly involves end users into development of new applications and services by providing bilateral access, on the one hand, of the consumer to the new and emerging services, and on the other of the developing enterprises to their feedback and contribution.

Living Labs integrates the consumer into the development process, ensuring highly reliable market evaluation, resulting in a significant reduction of technology and business risks. In combination with scientific evaluation methods developed by academia, the approach is particularly attractive to SMEs, micro-organisations and start-ups, who typically have problems acquiring venture capital unless the market attractiveness of ideas, concepts, products and services can be reasonably demonstrated.

Although large enterprises have the economic power to conduct similar activities inside the company operations, and of course have done so, the value for large as well as small can be argued for. In the case of SME’s this is an issue of economy and also knowledge that they seldom possess. In the case of larger enterprises, the lack of unbiased judgement of technology

and services as well as a broader base of idea generation are often factors that in the long run threatens the future prosperity of large enterprises. Compare the path dependency and lock-in problem explained previously.

### **Comparison of test and experimentation concepts**

As outlined in the paper on “*Test and Experimentation Platforms – examining European practice*” [7], Ballon et al outlines several different concepts that addresses several issues of bringing technology to the market in what they call Test & Experimentation Platforms.

A division in six different concepts, namely prototyping platforms, testbeds, field trials, living labs, market pilots and societal pilots is made in [7]. A model to compare these concepts has been developed by which the main differences can be summarized to be:

1. The commercial maturity of what is tested is normally higher in the societal and market pilots compared to in the Living Labs.
2. The level of design focus (as opposed to testing something already made) is higher in the Living Lab as compared to testbeds and field trials.

Also the open nature of the Living Labs is highlighted as opposed to what are sometimes purely in-house activities.

Ballon examines a number of initiatives in all six categories, in three European countries. The initiatives are examined with respect to openness, public involvement, commercial maturity, vertical scope, scale and duration. Although giving a good overview, the models proposed by Ballon et al gives little room for the major difference in modelling the user contribution as feedback only or co-creation. The model does not cater for any vertical focus (application domain, e.g. eHealth).

Mapping the various methodological aspects in comparison to the Living Lab approach is described by Prof Otto Scharmer (MIT, CKIR) as in figure 3.

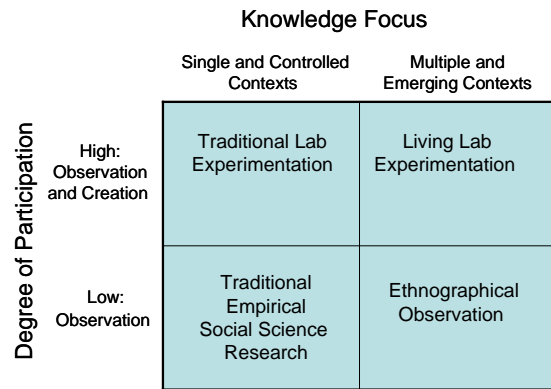


Figure 3. Participation and context of innovations

### The various practices applied in a Living Lab

There are many practices and characteristics of Living Labs that needs to be put in place in order to operate sufficiently.

The Living Lab needs to bring access to state-of-the art technology of not only one kind but often competing technologies delivered through different business models. The open cooperation with vendors is therefore crucial including both SME's and larger firms.

The environment must also bring together various organisations that utilize technology, or being candidates to utilize technology in the vertical dimension of a value-chain. The focus is on creating the innovative applications based on existing technologies and on creation of future technologies. This sometimes also encompasses competing business models or interests.

The ability to bring public interests into the environment is important to cater for long-term operation for the systemic innovation. As public organisations are often responsible for the overall innovation system (especially in Europe) these organisations should be involved in the operation of the Living Lab and most probably should be the organisational owner of the concept. Not only should they be involved in the operation, the should also utilize it from an content and application perspective in order to improve the operation of the public sector.

Living Lab is built on the wider co-operation with the user/consumer/citizen (in her role of being citizen, user, consumer, or worker etc) in order to leverage the full creativity of the system which calls for an efficient interaction with a larger population of people. There are two

aspects of this; the ability to capture the ideas and input from a larger population and the ability to understand (evaluate) technology use in a specific situation. These areas require more focused research in order to create methods capable of generating the necessary knowledge.

The ability to interact with the users is what distinguishes the Living Lab approach from other more traditional supplier – customer partnerships, or cross-disciplinary approaches seen previously.

Altogether this calls for focus in several directions while developing the application further.

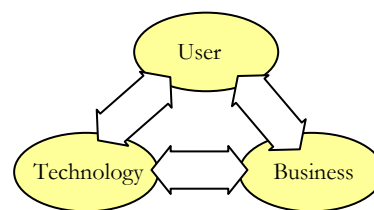


Figure 4. Focus in several dimensions

Comparing the various initiatives in their applications of the practices generates the following key aspects that should be implemented. Note that the authors of this paper have different and sometimes limited knowledge of the various initiatives referred to. Therefore, this comparison should be seen as examples of good practices.

#### A) Cooperation with technology and application providers

This co-operation should cater for co-operation with large players as well as with SMEs as being the suppliers of solutions. It is their products and services that should be influenced and created in the Living Labs.

The Freeband initiative is probably the one that best cater for a broad cooperation with technology providers from different sectors. It includes some very large firms as well as more technically niche companies. Also the setup around Mobile City in Bremen including a large amount of SME's in the area of mobile communication is very well implemented. The Octopus environment includes many companies but mostly around a specific ICT business model.

## B) Technology availability

The Living Lab concept has its foundation in experimenting with technology together with users. Having access to state-of-the-art technology in network access, service platforms, terminal and user interfaces etc is therefore key to be able to optimize the results generated.

The most advanced environment is probably the Fraunhofer FOKUS which has an impressive collection of technology. Other technologically strong sites include Mobile City Bremen, Octopus and the CASST centre in Ireland where emerging technologies for service creation are made available in an open lab setup.

## C) Vertical co-operation in the value chain

The ability to include a large variety of companies and organisations, in many segments of the society, is crucial in order to reach the necessary impact.

The Helsinki Virtual Village in Arabianranta has a strong setup involving the full participation and also including actual service delivery within a part of Helsinki. Testbed Botnia and Crossroads Copenhagen have established co-operation networks in certain application areas.

## D) Openness and neutrality

Avoiding path dependency & lock-in is crucial in order to capture the values created by certain concepts.

Most initiatives claim openness, like Living Lab Västervik, Testbed Botnia, Mobile City Bremen. Openness is difficult and it remains to be seen whether they will stay truly open as there is not that much of competing business models or technology models that have been deployed so far.

One issue to openness is also that if one major player utilizes the Living Lab, it might affect competing players (technology or business model) from being in the same environment.

## E) Public involvement

The basic reason for public involvement reaches far beyond funding. In order to address the full systemic innovation aspects of society, the public organisations needs to utilize the Living Labs to start reforming the basic processes of society.

All of the initiatives listed below, except some of the smart house initiatives like e2home, are based on public funding. The purpose of that

funding varies. In the case of Freeband this is more research focus, whilst most of the others are focused on creating a platform for growth. The level of active involvement in the area of actually utilizing the Living Lab for public services varies. Good examples of this is Living Labs Västervik and Sparknet, where the environment serves the purpose of creating a platform for public services and the public commitment for the initiative is high.

## F) User involvement

The most interesting aspect to Living Labs is the ability to involve the users (citizens/consumers) into the creation process. This encompasses several challenges, but promise incredible opportunities if tailored right.

Most of the initiatives still look upon the user as an R&D object rather than a source of innovation. The user community of Testbed Botnia is a good example of how to conduct some basic interaction with a large group of users. Arabianranta and Sparknet are other examples where larger communities serve as users of technologies.

## G) Research involvement

It is already known that better knowledge about ICT and usage is needed. The ability to transform knowledge created in Living Labs into new areas of research related to technology as well as the human issues is important.

Freeband has here a strong approach in developing novel methodologies for conducting user evaluations thereby understanding more about the usage of a particular technology. Most initiatives related to smart houses also shows sophisticated methodologies and monitoring equipment.

## Need for further research

The concept of Living Labs applied in the way as described here is novel. Thus, it requires substantial research to optimize its operations and methods although already promising.

Burgelman et.al states in [15] *"The construction of artefacts often builds on rather simplistic assumptions about real situations and conditions of usage"*. This is said to be evident in most of the application areas where ICT is applied. Burgelman states that there is a need for better grounded studies on social changes involved and on the interplay between actors.

The key aspect in Living Labs to differentiate it from other cooperation's, clusters etc is the user involvement. As stated by ISTAG in [3]:

*“The real challenge may lie in involving users in a sociological sense, that is to say, by taking into account the micro-context of their everyday lives”*

Research is needed in order to create the comprehensive models and methods by which experiments can be analysed and values be measured. Examples of new approaches here is e.g. the Experience Clip method as outlined in [8]. The emerging area of ambient intelligence puts increasing focus on the social and user dimension as ambient intelligence represents a blend of the physical and virtual environment.

Furthermore, concepts stimulating the users (individuals) to take a larger role in the future development of the knowledge society is required. This involves several disciplines. The ability to capture business values and transform those into business models without falling into predefined concepts is also requiring further methods development.

Burgelman et.al. [15] recommends a number of areas in which further research is proposed:

- Stronger integration of different schools of thought in the social science fields and with technical research.
- A greater degree of cross-European research.
- Stronger integration of economics oriented schools.

An area of importance when bringing the citizens/consumers into the Living Lab innovation system described is how to handle the ethical and IPR issues. As private persons become a source of ideas and innovations, there should be an appropriate rewarding and incentive system in place that secures pay-back to all the actors involved.

One can say that the Living Lab is a true multi-disciplinary instrument needed to support the mass-deployment phase when ICT moves into affecting everyone's daily life.

### **The governance needed for and impact of Living Labs**

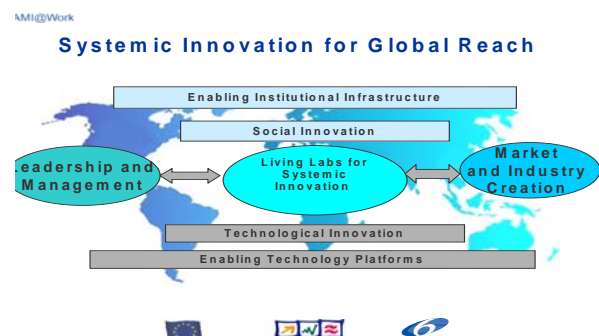
It has been stated already in this paper that the nature of the Living Lab is its openness and neutrality in respect to technology or business models. The reason for this is mainly to enable

maximum innovation, by avoiding the problem of path dependency & lock-in and at the same time optimizing interaction among organisations. The Living Lab then forms the institutionalisation of the very meeting place for all organisations involved in a certain innovation system.

This open, neutral approach calls for public involvement not only in funding, but also in the very operation of the Living Lab. It also calls for new means of governance, leadership, management, and organizing. These should reflect qualities of open source platforms and favour wide knowledge sharing and communication, networking and partnering.

In Living Labs there is a need to combine highly self-organized and self-managed processes with multi-disciplinary R&D and innovation management processes. There must also be in place a communication culture and collaborative social and technological infrastructure for continuous shared vision and mission creation, as well as for learning from experience.

However, the LivingLabs provide an opportunity to ‘compress’, integrate and synthesize the human, social, economic and technological elements and processes of innovation. Through LivingLabs the human-centric systemic innovation may emerge through the process (figure 5.) where technology is created and challenged in interaction with human, social and institutional systems.



**Figure 5. Network of Living Labs are for Human-Centric Systemic Innovation, Market and Industry Creation with Global Reach**

From market and industry creation viewpoint, the LivingLabs offer a research and innovation platform over different social and cultural systems, cross-regionally and cross-nationally. As such this is a good basis for rapid mass customization even with global reach.

On the other hand, the LivingLab as a research approach may deal with social and environmental sustainability as well as other socio-techno-economic impacts that should contribute to the productivity, creativity and innovativeness of Europe.

A regional, national or European-wide network of LivingLabs strengthen the opportunities to integrate social innovations with technological innovations in wider scale that contributes to socio-economic dynamism and end up adding in regional, national or European wide global competitiveness, growth and job creation. European-wide networks of LivingLabs are large-scale experimentation platforms for new service, business, technology, or even market and industry creation within ICT.

A European Network of LivingLabs supports the i2010 policy aiming at a European-wide Information Space being highly effective and inclusive for everybody, anywhere and anytime. Consequently, the LivingLabs may not only be for creation of converged technologies and industries but even more for the convergence of European markets having a positive impact on job creation.

Some initiatives for European co-operation has already been launched such as the Special Interest Group of Living Labs as part of the AMI@Work family of communities <http://www.mosaic-network.org/amiatwork/> and the Living Labs Europe initiative <http://www.livinglabs-europe.com/> stimulating European co-operation in the area.

As a consequence of this identified potential, the Living Lab approach is considered as the natural candidate for the implementation of large scale demonstration and validation as recommended by ISTAG [3]. Furthermore, the capability of involving a large number of end-users already in the technology innovation phase is expected to boost the societal impact of the achieved technical breakthrough, in terms of both broad utilisation and delivered value.

Currently, the existing testbeds throughout Europe do not provide a homogeneous, standardised approach to the Living Labs methodology by employing proprietary methods and environments often tailored to specific regional attributes. Of course there is a need to cater for regional differences but technologies provided at each site represent a small fraction of what is available on the market and the ability

to network together a larger set of technologies is a non-utilized opportunity.

### **Global Players and their Strategies toward Living Labs**

Understanding the market is of course important to all global players, the ICT industry is no exception. As technology develops and new business models emerges, the need to understand the threats and opportunities as well as to stay innovative in this changing landscape is maybe more important now than ever. Global players generally approach public-private partnerships in two ways

- 1) Research-only co-operations with leading universities with the purpose of acquiring new knowledge. As these companies are often involved in complex technology development, the co-operations tend to be very technology oriented. This is also well reflected in the eMobility initiative.
- 2) Co-operations centralized around the business models of those global players. Typically the companies want to push a certain technology or business model, which is understandable as they often invested huge amount of money in development.

The Living Lab concept of actually shaping the technology and the applications in a collaborative setup, thereby creating the understanding of future opportunities, requires a very open approach resulting in applying concepts sometimes contra dictionary to a specific business model of a company.

However, as the Living Lab concept gains momentum as one of the major vehicles for developing future ICT technology and applications global players will have to develop their relation to the Living Labs.

### **International Living Labs and application testbed initiatives - examples**

The following section includes some examples of international initiatives related to the proposed implementation of Living Labs. The order of the examples is not made by any ranking. None of the examples complies fully to the practices described in this paper.

**PlaceLab/House\_n (MIT- US).**

[http://architecture.mit.edu/house\\_n/placelab.html](http://architecture.mit.edu/house_n/placelab.html)

The mission of the Changing Places/House\_n project is to conduct research by designing and building real living environments - "living labs" - that are used to study technology and design strategies in context. The PlaceLab is a joint MIT and TIAX, LLC initiative. It is a residential condominium in Cambridge, Massachusetts, designed to be a highly flexible and multi-disciplinary observational research facility for the scientific study of people and their interaction patterns with new technologies and home environments.

**Philips HomeLab (The Netherlands)**

<http://www.research.philips.com/technologies/misc/homelab>

Philips HomeLab looks and feels like a regular home with modern furniture in every room, Van Gogh prints on the walls, and even a fully stocked kitchen. While no one lives at Philips HomeLab, temporary "residents" can stay at the facility for anywhere from 24 hours to two weeks, depending on the type of research being conducted. During their residence, individuals or families will go about life as usual, while interacting with the new technologies Philips has installed in the facility.

**Telenor Home of the Future (Norway)**

<http://www.fremtidshuset.com>

Telenor's application of the smart home concept outside Oslo, Norway

**Dr. Tong Louie Living Lab (US)**

<http://www.sfu.ca/livinglab/>

The Dr. Tong Louie Living Lab, is a research facility built through the collaborative efforts of Simon Fraser University's Gerontology Research Centre and the British Columbia Institute of Technology's Technology Centre. The Living Lab conducts research and training activities that aim to improve the relationship between people and their living and working environments. Their goal is to create environments and products that facilitate independent living, sensitive to the needs of older adults and persons with disabilities.

**E2Home (Sweden)**

The Electrolux – Ericsson joint venture to provide the future intelligent home solutions. The joint venture provided a setup with a large number of real apartments provided with intelligent solutions to improve the quality of life for its residents. The ability to provide feedback into the design of new products and services was in the objectives. Due to the lack of growth in the telecom sector the joint venture was closed.

**CDT Testbed Botnia (Sweden)**

<http://www.testplatsbotnia.com>

Testbed Botnia mission is to bring stakeholders together to interact with its several thousand end-users. In the environment of Testbed Botnia researchers and companies conduct experiments on services and applications in a variety of social contexts.

Environments include city centres as well as the more rural settings of northern Sweden. It involves researchers from various fields through the CDT cooperation.

**Crossroads Copenhagen (Denmark)**

<http://www.crossroadscopenhagen.com/index>

Crossroads Copenhagen is a network of research institutions, private enterprises and public organizations. The network strives to strengthen the co-operation between companies and universities within culture, media and communication technology.

**California Institute for Telecommunications and Information Society (US)**

<http://www.calit2.net/research/labs>

Cal-(IT)<sup>2</sup> is moving academic research prototypes and industrial partners' early products into the field for system integration and testing, creating living laboratories. These labs provide a glimpse of future mass markets three to five years before the markets themselves come into being.

**Mobile Forum – Octopus (Finland)**

<http://www.mobileforum.org/>

Octopus is a leading testing, development and business platform for mobile applications and services. Its core is an authentic, technologically

advanced test network, completed with business support and training services. Companies, mobile operators, research and educational entities and universities are among those using Octopus test network and services. The goal of Octopus is to promote creation of new technologies, innovative applications and user-oriented services, and thereby, enhance the growth of mobile business.

#### **Living Lab Västervik (Sweden)**

<http://www.livinglabs.se>

Living Labs Västervik is a catalyst and a driving force in the development process that started in Västerviks municipality and Kalmar County to create a modern society structure. During the next few years the digital society platform will establish a foundation for completely new conditions to develop organisations, stimulate new business and increase the service for citizens and tourists in the entire municipality.

The focus is the power of innovation and renewal concurrent as previous experiences is an important part of the development. The ambition is to create a dynamic environment where citizens, organizations and companies together develop and test new digital services and products.

#### **Sparknet (Finland)**

<http://www.sparknet.fi/>

Sparknet is an open access network initiative consisting of several various access technologies. Its open architecture enables new and emerging services possible.

#### **Helsinki Virtual Village – Arabianranta (Finland)**

<http://www.helsinkivirtualvillage.fi/>

An entire suburb of Helsinki is translated into an example of the future living environment. By integrating architecture, city planning with modern ICT solutions and services a unique environment has been created.

#### **Fraunhofer FOKUS (Germany)**

<http://www.fokus.gmd.de/home/>

The Fraunhofer Institute for Open Communication Systems FOKUS researches and develops mobile communication systems in wireless and wired networks. FOKUS engineers

the modules that enable the complete seamless integration of technology with end devices and the deployment of open flexible communication services and applications. The focus of FOKUS is to provide emerging technologies to be used in service and application experiments.

#### **Mobile City Bremen (Germany)**

<http://www.mobilecity.org>

In cooperation with Bonsai Deutschland Testmarkt Bremen GmbH, a subsidiary of the renowned market research and opinion polling institute TNS Emnid, the existing infrastructure was enhanced to create a test market for mobile applications. The acceptance and functioning of new products, services and solutions are investigated under real conditions. At the same time, Bonsai analyzes the effects of corresponding advertising and marketing measures focused on the Bremen test region.

#### **Livingtomorrow (The Netherlands, Belgium)**

<http://www.livingtomorrow.com>

The project plays an informing and sensitizing role: it aims to fascinate the general public and make them aware of innovations and trends and especially point out what the consequences will be for their lives.

The project involves several disciplines. New software and IT-applications are predominant throughout the House and Office of the Future. But new ecological and energy-saving building techniques and new interior trends also play an important role in the building.

#### **The Communications and Software Services Test (CASST) Centre (Ireland)**

The centre is a nationally unrivalled mobile communications test facility which can provide a “3G & Beyond” test bed for real and rapid development, prototyping, interoperability, conformance testing and validation of wireless and mobile research. The CASST Centre enables industry and research organisations, who would otherwise be unable to acquire sufficient hardware and software resources, to realise their business and strategic goals.

The CASST Centre provides the following services to its clients:

Deployment tools  
 Showcasing facility 'Smartworld'  
 Business Cases Analysis  
 Technological Foresight  
 Promotion & Standardisation

Conference on Human Factors in Computing Systems, Seattle, Washington, 31 March-5 April 2001.

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### Freeband (The Netherlands)

Freeband is a large Dutch research programme on ambient intelligent communication (85 million euro budget over 7 years), which comprises more than 30 organisations, including all-important technology providers, knowledge institutes and many representative end user organisations. The Telematica Instituut manages the Freeband programme, which has a testbed infrastructure and can be seen as a Living lab.

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