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THE LIVING LABS HARMONIZATION CUBE: COMMUNICATING LIVING LABS' ESSENTIALS

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ABSTRACT

Although Living Labs have been acknowledged in Europe as an open innovation instrument and mature Living Labs have organized themselves in a European Network of Living Labs (ENoLL), common available methods and tools used in Living Labs differ widely. The current article reports on the Living Lab Harmonization Cube, a useful technique that enables the definition of a shared reference of methods and tools. The harmonization cube not only represents the most important perspectives of a Living Lab, but also enables specifying bridges between existing Living Labs. More specifically, it helps to learn from each other, benchmark the validation of user behavior studies, exchange best practices, and interconnect existing Living Labs. Next to facilitating a common ground for sharing, the cube model recognizes the degree of harmonization of used methods and tools in Living Labs. This article elaborates upon the validation approach of the harmonization cube aiming to be used in multiple domains and across several Living Labs, facilitating a common ground for sharing the essentials to keep (the network of) Living Labs *living*.

Keywords: Community-driven innovation, Living Labs, Standardization, Methods

1 INTRODUCTION

The Living Lab concept moves research and development out of laboratories into real-life contexts, and seems therefore appropriate to get a better understanding in what triggers innovations and which innovations proof to be successful in different environmental, social, and cultural contexts. A Living Lab is not just a network of infrastructure and services, but much more a network of real people with rich experiences; it is a new way to deal with community-driven innovation. The Living Lab approach represents a research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real- life contexts. However, methodologies that relate to the measurement of the dynamics of behaviour on a large scale in relation to innovation are still in their infancy. Understanding those social and cultural experiences are the very thing making a Living Lab 'living' (Mulder, Velthausz, & Kriens, 2008).

Europe has accepted the Living Labs concept with open arms as the way to deal with user-driven open innovation. In fact, several initiatives joined forces into a European Network of Living Labs (ENoLL). The ENoLL envisions applying new methodologies for co-creative research and innovation, including new means of open source, open architecture developments, IPR, management of research and innovation as well as new forms for direct user involvement in the innovation process. In the Helsinki manifesto, which has been communicated during the launch event of the first wave of Living Labs (November 2006), it has been stated that "The European Network of Living Labs establishes a European platform for collaborative and co-creative innovation, where the users are involved in and contribute to the innovation process. This approach should ensure that common methodologies and tools are developed across Europe that support, stimulate and accelerate the innovation process. The European Network of Living Labs also has a strong regional growth and development impact by facilitating and fostering regional innovation as interlinked with a European innovation system with a global reach." Notwithstanding, it can be said that harmonization of Living Labs methods and tools is key.

However, practice appears not so straightforward; methods and tools used in Living Labs differ widely. The problem of bridging methods and tools from one Living Lab to another becomes considerably simpler if the two Living Labs in question share a common model, thus whether the methods and tools used are harmonized. In the remainder, we elaborate upon the Living Labs Harmonization Cube which enables the harmonization of methods and tools to be used in multiple domains and across several Living Labs, and therefore facilitates a common ground for sharing.

2 SIX VIEWS ON A LIVING LAB

Although the Living Lab concept seems to be largely accepted as a way to deal with innovation in products and services that have social aspects and/or location based aspects,

there is not one commonly used definition of what a Living Lab is. In facilitating the harmonization of Living Labs several workshops were organised in close collaboration with ENoLL and the European Commission. Reading through all definitions, discussions and visions on open innovation that were provided in the workshops, six prominent perspectives were defined that typify a Living Lab (see also Mulder, Fahy, Hribernik, Velthausz, Feurstein et al., 2007; Living Lab Roadmap). It was concluded that the following six views upon a Living Lab communicate the essentials: User involvement, Service creation, Infrastructure, Governance, Innovation outcomes, and Methods & tools.

User Involvement

User involvement is one of the key elements of a Living Lab. As such it should be a focal point of mature Living Labs. For this, there are two aspects relevant. On the one hand, it is important to perform the measurements of user activity as un-obtrusive as possible; after all, we want to get a better insight in normal day use of involved users. On the other hand, for the acceptance of measuring and collecting data as well as interpreting the data and the iterative design process involvement of users is important. *Organisational* issues involve aspects like motivating users to participate in the measurements and the design process. An important aspect of this is the privacy of the users and the individual advantages they achieve by being part of a Living Lab. *Contextual* issues deal with the social networking aspects, the impact of the measurement tools on the user and all kinds of cultural and legal differences between settings. *Technological* issues involve the use of tools to be used by individuals and other forms of data collection.

Service Creation

Service creation deals with the process of developing new ideas, testing these in the Living Labs and the use of the real-life user-data in the design processes. Due to the nature of Living Labs this involves setting up an ecosystem of involved parties: from cities, universities to commercial companies and other organisations. As such a Living Lab can be seen as a sustainable implementation of open innovation for its stakeholders. Three types of horizontal services structure the service matrix (Ballon, Pierson, & Delaere, 2005): 1) *technical services* – communication, collaboration, demonstration, prototyping, validation, product deployment etc., 2) *customer services* – innovation, idea generation, community services, training, specific service needs, business support, market customisation, and 3) *intra-network services* (within ENoLL) – governance, management, training. *Organisational* issues involve the operation of the service creation process like the collaboration and co-creation processes. *Contextual issues* deal with new idea generation to be tested in the Living Lab, market strategies for the resulting products and all kinds of legal (e.g., IPR) and business models. *Technological issues* deal with the supporting technologies to enable cooperation between all parties involved.

Infrastructure

The infrastructure perspective deals with the services and technologies needed to perform measurements and analyse the collected data. Examples of these are networks, servers, statistical tools, and end user applications performing the measurements. Infrastructure does not refer to the services and technologies under control of the Living Lab. Examples that do illustrate infrastructure are open networks that users are connected to and the sensors in a telephone. However, knowledge on the specifics of these networks and how they relate to the measurements is important. *Organisational* issues surrounding infrastructure involve the processes to operate the networks, sensors, data collection processes and analytical processes to be able to acquire user data of sufficient quality and timeliness. *Contextual* issues deal with all aspects surrounding the used technologies and services, like service levels, legal frameworks around the processing of user data and other aspects surrounding technologies. *Technological* issues deals with aspects like interoperability, scalability of technologies and services and the technical aspects that may influence the measurements.

Governance

The governance perspective deals with the organisation of the Living Lab as a whole and the interaction between its members. Examples are commitments and responsibilities of the members, financial arrangements for the joint infrastructures as well as mutual arrangement in respect to using each other's technologies and services. Also, aspects surrounding priorities for the Living Lab as a whole and future directions are part of this perspective. Other areas are the openness or closeness of the Living Lab to other parties and the amount of public and private funding. *Organisational* issues are the responsibility and authority structure, contractual arrangements and such. *Contextual* issues deals with the overall management structures and the goals of the involved organisations, like research driven, innovation driven or business driven. Also the legal framework surrounding innovation like IPR laws are an important issue. For the governance perspective *technological* issues are of minor importance.

Innovation Outcomes

The innovation outcomes are the results of the Living Lab. These outcomes can be knowledge, new products and services and/or IPR. Outcomes can be in the form of finished end-user applications but also in the form of prototypes or mere knowledge about usage patterns. The *organisational* issues deal with the process of selecting the best results and building upon those. Also issues regarding collaboration of involved parties in relation to IPR are important to be taken into account. *Contextual* issues deal with the surrounding framework of agreement of the involved parties how to work together and share results.

Methods & Tools

A Living Lab approach requires specific methods and tools in order to acquire relevant user data on a large scale. The analysis and interpretation of large quantities of real time user data

has its own peculiarities. The methods and tools deal with how to organise and operate the tools in order to achieve knowledge about the use and experience of users. Moreover, methods and tools to analyses the collected data should not be forgotten. The *organisational* issues deal with the design and development processes of these methods and tools and the standardization across several Living Labs. One of the advantages of this standardization is to make results comparable over several Living Labs. Also the search for best practices in the overall Living Lab community, the method of sharing (e.g. open source) is part of this perspective. *Contextual* issues deal with the selection of appropriate methods and tools for in-situ evaluation. *Technological* issues deal with the tools themselves and the development process around them (development, testing and, acceptance) to ensure appropriate assessments in the Living Lab context.

3 THE LIVING LABS HARMONIZATION CUBE

In our attempt to harmonize Living Lab practices we derive from the assumption that focusing on those elements that Living Labs want to exchange is an appropriate basis for harmonization of methods and tools. The harmonization cube identifies these exchange possibilities and explicitly defines interoperability elements from organizational, technological, and contextual perspectives in which different standards are relevant. The cube for harmonizing Living Labs is a 6x3x3 model that enables the definition of a shared reference of methods and tools used in the ENoLL. The six sides of the cube correspond with the six views described in the previous section: *user involvement* (coloured orange), *service creation* (coloured green), *infrastructure* (coloured blue), *governance* (coloured red), *innovation outcomes* (coloured yellow), and *methods & tools* (coloured white). Each topic (sides of the cube) facilitates interoperability between both development phases of a Living Lab. Hereto, three development phases, i.e., setup, sustainability, and scalability have been distinguished. These phases are represented in the cube by the three rows. The three columns of each cube side reflect three common aspects of a Living Lab, i.e., the organizational, technological, and contextual issues of the Living Lab. Figure 1 displays the Living Lab Harmonization Cube. Figure 2 portrays the first attempt to communicate the Living Lab essentials including applications, as has been reported by Mulder and colleagues (2007).

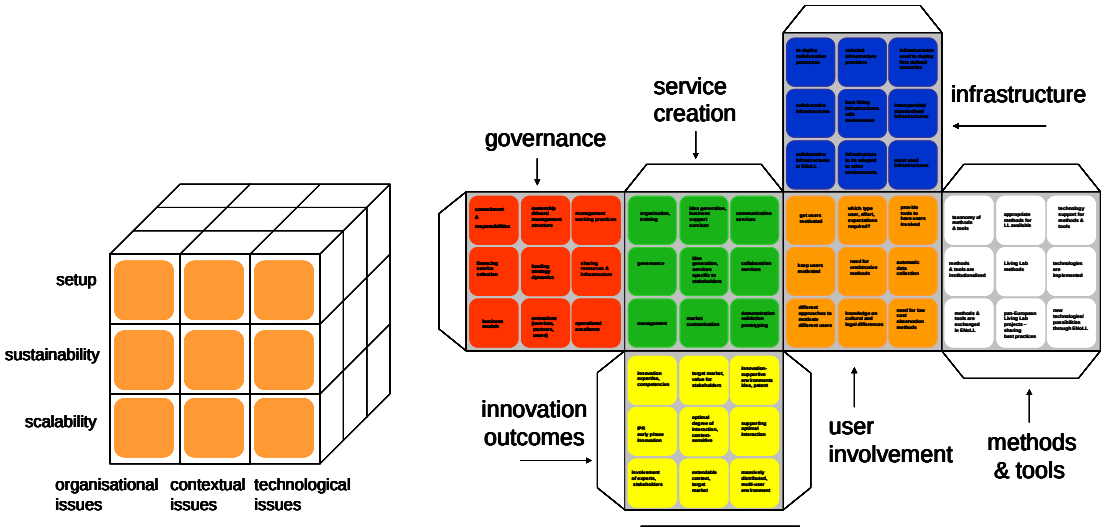


Figure 1: The Living Labs Harmonization Cube.

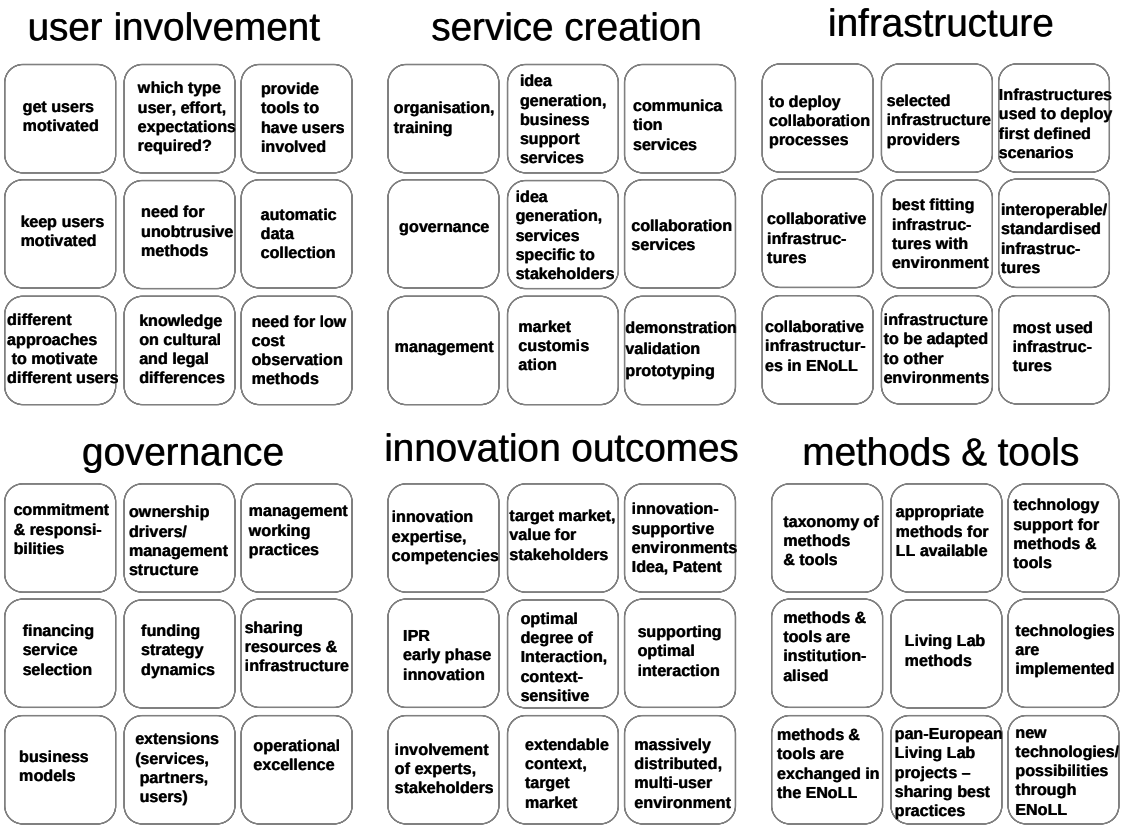


Figure 2: First Attempt to Complete the Harmonization Cube.

In conclusion, the cube contributes to the harmonization of methods and tools in the European Network of Living Labs and proved to be helpful in various Living Lab activities.. The cube model has been used to structure the ENOLL's Living Lab repository as well as the taxonomy and repository for methods and tools as developed in the CoreLabs project (IST035065).

4 DEALING WITH THE DYNAMICS OF USER-DRIVEN INNOVATION

The harmonization cube not only represents the most important elements of a Living Lab, but also enables specifying bridges between existing Living Labs, i.e., to learn from each other, benchmark the validation of user behavior studies, exchange best practices, and interconnect the Living Labs. Next to facilitating a common ground for sharing, the cube enables recognizing the degree of harmonization of used methods and tools in Living labs. The more values (elements on the cube) can be defined in a Living Lab, the more bridges a Living Lab has to exchange knowledge, experiences, and lab facilities with other Living Labs. In order to exploit the dynamic character of a Living Lab, we mapped the cube model onto a physical Rubik's Cube, as it not only provides a physical instance of the harmonization cube, it also recalls certain associations people are well familiar with.

Figure 3: Initial Prototype of the Harmonization Cube.

Although six views on a Living Lab can be distinguished, these are not 'stand-alone' perspectives. Each view is connected with the others; each decision on one side affects the other sides as well. Differently put, the harmonization cube stresses the dynamics of user-driven open innovation (Mulder et al., 2008). The dynamics of the cube correspond with the dynamic nature and reflect the challenges Living Labs face. The easiness of making a mess, its difficulty of getting it right revealing its complexity. It also illustrates the difficulty of harmonizing two Living Labs, e.g., trying to align the same planes of two different physical instances (Rubik's cubes) each representing a different Living Lab, has severe implications for the alignment on the other planes.

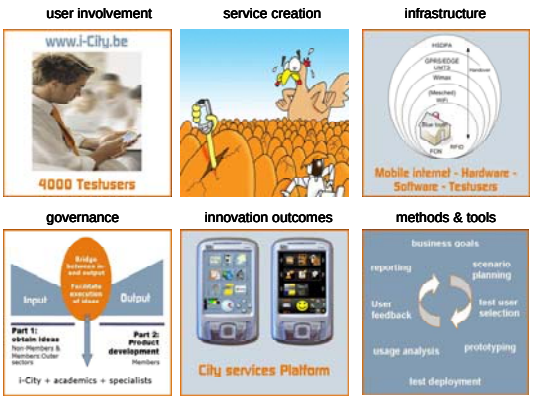
In addition, the harmonization cube has great potential to understand the essentials of a Living Lab in the different development phases. It provides a method to identify areas to be further developed given the phase of their Living Lab. The cube also stresses evaluation possibilities and appeared helpful in uncovering the added value of the Living Lab as an open innovation instrument. The cube, therefore, can be used as a discussion facilitator both within a certain Living Lab as well among Living Labs. This is certainly not a trivial issue; the paradigm of Living Labs gains ground, however, exchange of methods, tools, experiences and best practices often remain on a strategic level.

5 UNCOVERING THE LIVING LAB ESSENTIALS

During a Living Labs workshop organized by ENoLL in Munich held on June 20-21, 2007, the harmonization cube started to show its communication value. The cube not only provided a common ground for discussion, it also inspired the European Commission representatives (DG Information Society and Media) to use it in Living Labs strategy discussions to illustrate effectively the multifaceted Living Labs research, development and innovation challenges as well as opportunities. Consequently, it was decided to use the physical instance of the harmonization cube during the launch of the second wave of the European Network of Living Labs, which was held in mid-October 2007 in Brussels managed by the Portuguese Presidency. Already in the preparation phase the cube model guided the discussions within the Living Lab Portfolio Group and workshop facilitators, consequently the harmonization cube guided the Living Labs Roadmap, the Interactive Events as well the application form for the second wave of ENoLL. Some illustrating examples of the gained insights are portrayed below.

Photo Cubes

All members of the ENoLL as well the second wave applicants were invited to create their own photo cube. Each Living Lab representative was asked to promote his Living Lab by six different photographs, each reflecting one side of the cube model and accompanied with a short explanation. The photos, pictures or images should reflect the Living Lab's best practices, things they were proud of, or should be just an illustrative example. The photo cubes were used to enhance interactivity and creativity during the workshop sessions on the October 16th 2007, and were also published on the ENoLL blog. Figure 4 explains how a representative of the i-City Living Lab of Hasselt (Belgium) completed this creative exercise. Figure 5 shows a selection of photo cubes explaining Living Labs values and best practices, presented for all six views.



User Involvement: i-City is a living lab with 4000 test users, testing all kinds of mobile applications for mobile devices in true-to-life situations.
Service Creation: Will applications be successful? Are they user-friendly enough? Do they answer to the needs of users? i-City allows the ultimate real-life test, where test users produce masses of valuable feedback. It allows i-City to place the results obtained directly at the disposal of manufacturers, who in turn are able to perfect and/or commercialize the applications.
Infrastructure: For testing mobile applications i-City uses different types of connections for mobile internet. hardware software and test users makes the infrastructure complete.
Governance: Different types of technological and non-technological, small and big companies meet at i-City, This cross-fertilization of knowledge leads to practical and original mobile applications. (universities provide academic back up)
Innovation outcomes: Community Services Platform (CSP) is a software implementation or a managed service that provides an end-to-end solution to deliver applications and services to a mobile subscriber. It encompasses the functionality of a Software Delivery Platform, Services Catalogue, Provisioning System, Service Runtime Environment, Service Creation Environment, Service Monitoring System, Service Deployment System, Customer Care Management and a Graphical User Interface. It also contains a basic set of applications that help you monetize the network right away.
Methodes & tools: Project Based management

Figure 4: Photo Cube Example Illustrating the Value of i-City Living Lab (Hasselt Belgium).

Figure 5: A Selection of Living Labs Values and Best Practices Explaining the Six Views.

Experience Forms

During the workshop day Living Lab experts were also asked to describe interpretation of what essentials need to be communicated for at least one side of the cube. The form used contains nine elements to be completed with text reflecting their experiences, best practices, things they were proud of, questions they still have or challenges to be addressed. Figure 6 shows an example of a completed form.

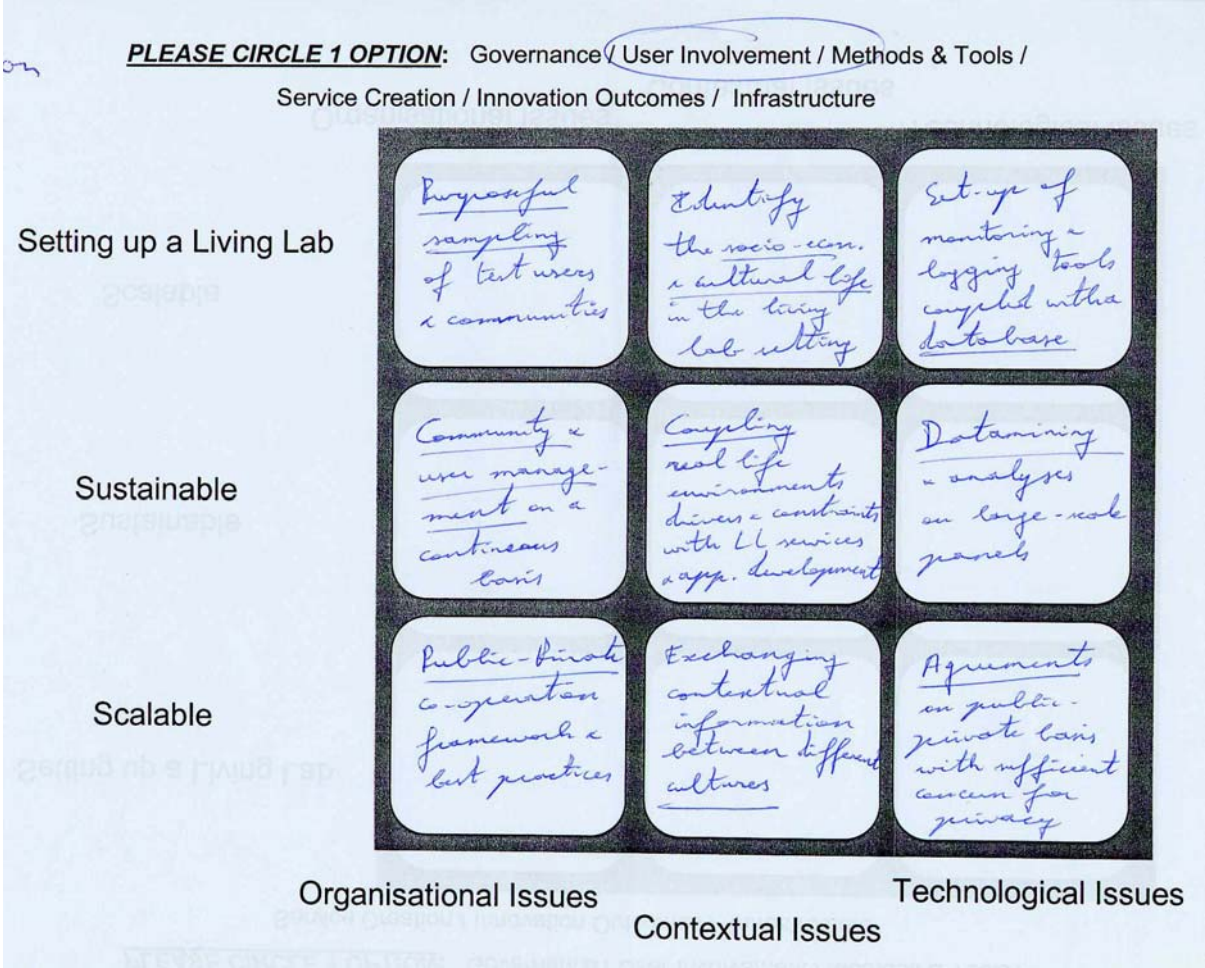


Figure 6: Example of Completed Experience Form.

Twenty-five experts completed the experience forms, some experts filled in multiple forms for different views. The distribution over the different views (N= 43) was: user involvement (N=11); service creation (N=9), infrastructure (N=3); governance (N=7); method & tools (N=9); innovation outcome (N=4). Analysis of the completed forms provided input for the Living Lab Roadmap. The current inquiry indicated that the cube model is suitable to provide a comprehensive overview of most relevant aspects to be included in the different stages of a Living Lab. Some examples of the topics are listed below.

- *User involvement*: motivation of users, user incentives, identifying interests of participants, understanding users' behaviour and roles, selection of users (amount, type, diversity, context, etc.), managing the community, exchanging contextual information between different cultures, how to make sure that the users remain users, ethical issues on trust, informed consent and privacy.
- *Service creation*: common language for stakeholders & long term engagement, efficient communication, strong partnerships between actors, organise the living lab as profit centre, portfolio management, provide R&D links, first success stories, links to business value, visionary leadership, entrepreneurship (both public and private),

leadership and involve creation, local-regional-national backgrounds, cultural backgrounds, tailor made services for sustainable challenges, local answers for national problems, evolving services, start with 'right' services that are easy to implement, local service concept, benefit for local economy, regional, national, global challenges, motivating easy interfaces, strong brand, roaming cross border, share the technical roadmap with other living labs, adaption of innovation by the executives, links with company/society needs, affordable, scalable, open (free) architecture software.

- *Infrastructure*: issues of ownership, selection criteria for platforms, IT architecture, amount of resources, use of private versus public infrastructure.
- *Governance*: level of openness, establishment of climate of co-operation, interoperability, design for scalability, IPR and ownership of the experiments/gathered insights/software (open source), role of public funding, balance between public and private involvement, agreement on public private basis with sufficient concern for privacy.
- *Methods & tools*: adaptive innovation methodologies, worldwide applicable, easy in use methods in complex environments, embedded in the organisation, user involvement tools (Wiki's, web2.0), enhancing visibility, knowledge exchange, stimulating environments, collaboration platforms, interoperability, standards, share best practises, IP based logging tools complete with a database, data mining and analysis.
- *Innovation outcomes*: clarity of objectives, shared objectives, clarity of IPR agreements, territorial relevance of objectives, adaptability, ability to continuously respond to needs, organise and design that continuously will generates new products, transferability to other contexts and domains, platform scalability.

Facilitated Workshops

The Living Labs open innovation community organized several workshops during the second wave launch event (October 2007). In this way, they aimed to bring together people interested in Living Labs and open innovation to exchange results from ongoing Living Lab related activities within the European Network of Living Labs; to make these results visible and as concrete as possible; to discuss what's next in the context of the Living Labs as they relate to regional, national and European policy; facilitate knowledge sharing, opportunity creation and partnering amongst Living Labs Open Innovation Community members.

The Living Lab harmonization cube has been used in the workshop to structure the workshop day itself. During this day the physical model of the Living Lab harmonization cube (i.e., the adjusted Rubik's Cube) was handed out to facilitate the discussion on the following topics: issues about infrastructure addressing ICT research & development; user involvement issues addressing users, buyers, citizens as drivers; governance discussed about policy (including European Innovation), business models & sustainability issues; issues about

interoperability in different domains and network synergies addressed issues about methods & tools, innovation outcomes, service creation. The outcomes of the event, including the discussions on the cubes views, have been used to draft the Living Labs Research Roadmap.

6 CONCLUSIONS AND DISCUSSION

The results of the Corelabs project mainly manifested in the 'Method & Tool Inventory and Taxonomy' and in the 'Best Practice Report' set the scene for our search for Living Labs standards. In spite of the identification and collection of most effective methods, tools and best practices, the Living Labs approach lacked a standardized reference methodology as a means to support the innovation process in creating new products and services. The same was valid when it comes up to setting up and configuring a Living Lab from scratch. As such with the emergence of the second wave of Living Labs, many organizations and stakeholders appeared which do not yet possess a Living Lab of their own, but intend to establish a Living Lab in near future. Particularly for these candidates, a standardized guideline of how to set up and configure a Living Lab would be a very valuable contribution. Born out of this need, a coherent, mature and transferable suite of methods and tools for Living Labs has been created (and is available through the repository of the Corelabs project). This suite of methods and tools represents guidelines for creating new products and services as well as guidelines for setting up and configuring a new Living Lab.

So far, the harmonization cube has shown its communication value, has structured the discussions constructively, and has been adopted by the Living Lab community. As goes for common standardization, the Living Lab harmonization cube has been used and referred to on a voluntary basis. In the vein of community-driven innovation, the harmonization cube not only has been defined for the Living Labs community, it definitely has been developed with and by the community members themselves. What's more, it was referred to in an ENoLL meeting as best available methodology. However, the question 'what are the essentials of Living Labs that need to be shared?' need to stay on the research agenda. Having some way of standardization does not mean the harmonization of methods and tools has been solved. How and what to share has been agreed upon, however, what these best practices, experiences, methods and tools are still needs to be exchanged. Continue this sharing process is essential in order to have a sustainable network on open innovation; or differently stated this exchange of gained insight is essential to keep the European Network of Living Labs *living*.

Another point of discussion is whether a Living Lab indeed has mastered the requested essentials. In answering this, an (agreed upon) defined set of key indicators is needed that can assess these important elements defined by the nine elements for each side of the cube. A good starting point is the mapping towards performance criteria used by the ENOLL community to evaluate the Living Lab applicants for its Living Lab members (used in the second wave). These criteria deal with leadership, people, partnerships and resources, policy and strategy, processes, people results, society results, customer results, and key

performance results (including cost-efficiency of the Living Lab's services, self-sustainability and maturity of the Living Lab organisation). For example, for each of the nine elements of a cube side an aggregated representation of an underlying model can be developed. In this sense, a third level of aggregation can be achieved without increasing the complexity and usability of the harmonization cube.

Similar as for the Living Labs concept, for standardization processes the engagement of large user groups is increasingly important; not only for the increased power in development and innovation but also as a mechanism to make products and services more market valid, through continuous influence by users in real contexts. Interestingly, current standardisation institutions also stress the importance of user involvement in the standardisation process; see for example the new approach to technical harmonisation (http://www.newapproach.org/). Unfortunately, standardisation processes are too often seen as technology-driven processes. Next to that, a standard is very often a result of a long and tough consulting progress which might lead to compromises and might therefore not point towards exemplary innovation. However, looking beyond the borders of individual Living Labs willing to benefit form the European-wide network efficiency for creativity and innovation, some form of harmonization is inevitable. Aware of this general interest, several Living Labs initiatives already have incorporated the cube approach in their Living Labs activities. Those that serve as an example are the Living Labs in Amsterdam, Barcelona, Scandinavia and South Africa. The growing usage of the cube model opens a wealth of possibilities for true harmonisation of Living Labs methods and tools, however, actively supporting further development, promotion, and usage of the harmonization cube is welcomed. Even though, best practices are over the place, fostering the engagement in our own Living Labs harmonization processes is key; not only striving for harmonization through use, but foremost harmonization *with* and *by* its own community members is the best way to define a user-driven standard.

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