

The Living Labs Approach to a Virtual Lab Environment

Miguel Ponce de Leon

Waterford Institute of Technology, Ireland

Karl A. Hribernik

Bremen Institute of Industrial Technology and Applied Work Science, Germany

Mats Eriksson

TietoEnator, Luleå, Sweden

VIRTUAL LABORATORIES ENVIRONMENT: THROUGH THE LIVING LABS APPROACH

Today, new ways of constructing and delivering complex voice and data communication services require more elaborate and distributed design, prototyping, testing, and validation facilities. The idea of a test bed which is remotely accessible (De, Raniwala, Sharma, & Chiueh Tzi-cker, 2005), can provide an open and integrated test site infrastructure, and has associated development and testing environment for validating research (OPIUM 2002), is not new and has been used in many research projects.

However, as communication networks continue to evolve to encompass very large numbers of nodes, involving networks of networks (with more operators, equipment vendors and owners) and with larger technological diversity and heterogeneity of network elements, the insular, private approach to test bed infrastructures with restricted access, cannot continue.

There are also derivatives of this type of test and experimentation platforms in the usability and human computer interface domain (Ballon, Pierson, & Delaere, 2005), such as usability labs which are typically used for observing users as they work through a set of tasks to identify weaknesses and positive aspects of the communication service (Blom, Chipchase, Lehtikoinen, 2005), experience prototyping, in which researchers, users, and clients gain appreciation of existing or future conditions through active engagement with prototypes (Koskinen, Kuusela, Battarbee et al., 2006), and commercial/social pilots, all of which are private test and experimentation platforms.

In the process of designing and developing groundbreaking communication services, the need for multiple prototype labs, pre-integration demonstration labs and developer labs with organizational hardware and software infrastructure which all culminate to a virtual laboratory environment in which specific instantiation of the entire service architecture can be enabled is widely accepted to be the way forward (DAIDALOS 2005).

Of note, as technology in itself is no longer valid or marketable, the benefits and usefulness for people in their daily lives must be proven before the technology or service can be said to be a success. Whilst technology enables new value-chains, product and service development increasingly need to focus on true user needs in order to be successful in today's increasingly global and competitive market (Vlek, & Cvetkovich, 1989). New R&D and innovation methodologies need to be developed to meet the challenge of addressing those needs.

The living labs (Markopoulos, 2001) network approach is an attempt to meet that challenge by superseding the existing prevalence of isolated private test beds with restricted access, with a model of providing open design, prototyping, testing and validation support to any research or product and service development project, and removes the need for projects to attempt to replicate testing environments for research results. From a European perspective, a network of living labs is a collaboration of public private partnership (PPP) in which private enterprises, public authorities, and citizens work together to create, prototype, validate and test new services, businesses, markets and technologies in real-life contexts, such as cities, city regions, rural areas and collaborative virtual networks between public and private players. The real-life and everyday

life contexts both stimulate and challenge research and development as public authorities and citizens will not only participate in, but also contribute to the whole innovation process (Finnish Government, 2006).

The infrastructure level of this vision is being brought into reality by the establishment of a number of wireless test beds in different countries (DAIDALOS, 2005; WHYNET, 2004), and interconnecting these through an IPv6 communication network. Provision of open testing facilities is seamlessly integrated through security, quality of service and mobility management modules, with open access to R&D institutions and research projects.

Participating test beds exist independently of this collaboration, leveraging additional national and test bed partner funds as well as the local partnership, and involve many stakeholders from various parts of digital value chain. It is the living labs environments that will support the creation of new services and emerging mobile and wireless concepts.

Each interconnected test bed has independent end users, ordinary “people on the street” as test pilots both as a critical research verification element as well as an active ideation partner in this trusted and secure environment (Palen, Salzman, & Youngs, 2001). Placing wireless research and development into the daily life situations of society, enable researchers and product and service developers to interact with all stakeholders present in a specific scenario, situation or context, and is a well-suited method for accomplishing a high degree of relevance and thus consumer take-up.

Research environments have been defined across the world as arenas for this kind of investigation. Different concepts of user involvement can be seen from examples of PlaceLab (Intille, Larson, Beaudin et al., 2005) at MIT, and the Future Computing Environments at Georgia Tech (Abowd, Atkeson, Bobick et al., 2000). These environments have the common characteristic of being in a single-context. This means that users take part in experiments with one single task that normally has nothing to do with the rest of their life.

The living labs concept refers to an R&D methodology where innovations, such as new services, products, product extensions or application enhancements, are created and validated in collaborative multi-contextual empirical real-world environments, within national and international regions. The individual is in focus in the role of a citizen, user, consumer, or worker. The user

experience focus ranges from user interface design and ergonomics as well as assessment of user acceptance and behavior, to user co-design process, finally leading to service or product creation. The benefits of deploying tests on distributed test beds, for service development research are not only limited to analyzing end user requirements, but also analyzing the performance and capacity of networks to support service quality. This analysis is crucial towards service development as well as meeting the business goals.

Value is captured on an individual level as well on the organization level. Emerging value distribution and changes of existing value chains and business models are analyzed. Culture and site-specific features are identified and international markets accessed when innovative applications are transferred across borders to different diverse contexts and cultures.

The challenge of the methodology lies in its design, the inclusion of core local stakeholders from user groups, public and civic sector participation, in parallel with private sector technology and service providers.

In order to conduct such R&D experiments as described above, an extensive technology platform (Test bed or e-infrastructure) must be made available. It is assumed that no such region or test bed can facilitate all emerging service platforms or technologies, so a networking approach must be considered in order to enable the most suitable technology to a specific experiment.

Augmenting these environments with a multi-agent testbed (Abu-Hakima, Liscano, & Impey, 1998) which is a virtualized mobile network, geographically distributed across international test beds (Peterson & Roscoe, 2004) is a key concept of the living labs approach.

This overall approach, with its infrastructure, will go some way to setting a future trend where all stakeholders, and specifically the general public, become developers of innovation and will allow the public to increasingly set the agenda and use of research in ways it has not been used before.

In conclusion, the living labs approach extends existing traditional test bed infrastructures and takes a user-centered approach which places a special emphasis on the need to develop mobile services that are usable, that is effective, efficient and satisfying to use, and has full end user integration in the creation and validation process. This will result in a virtual laboratory environment where:



2 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/living-labs-approach-virtual-lab/17694

Related Content

Spatial Design and Physical Interface in Virtual Worlds

Hidenori Watanabe (2011). *Metaplasticity in Virtual Worlds: Aesthetics and Semantic Concepts* (pp. 240-250).

www.irma-international.org/chapter/spatial-design-physical-interface-virtual/50389

Collaborative Work Training in Higher Education

María Dolores Olvera-Lobo, Rosa María Castro-Prieto, Enrique Quero-Gervilla, Ricardo Muñoz-Martín, Eva Muñoz-Raya, Miguel Murillo-Melero, Bryan Robinson and José Antonio Senso-Ruiz (2008). *Encyclopedia of Networked and Virtual Organizations* (pp. 261-268).

www.irma-international.org/chapter/collaborative-work-training-higher-education/17621

Virtual Worlds and Well-Being: Meditating with Sanctuarium

Laura L. Downey and Maxine S. Cohen (2018). *International Journal of Virtual and Augmented Reality* (pp. 14-31).

www.irma-international.org/article/virtual-worlds-and-well-being/203065

AI and VR-Powered Interventions for Social Anxiety: A Review

Dennis Opoku Boadu, Fredrick Boafo, Lilian Ama Owusu-Ansah and Solomon Mensah (2025). *International Journal of Virtual and Augmented Reality* (pp. 1-27).

www.irma-international.org/article/ai-and-vr-powered-interventions-for-social-anxiety/367871

Semantic Approach to Knowledge Representation and Processing

Mladen Stanojevic and Sanja Vraneš (2011). *Virtual Communities: Concepts, Methodologies, Tools and Applications* (pp. 558-580).

www.irma-international.org/chapter/semantic-approach-knowledge-representation-processing/48692