An Empirical Study of UK Living labs

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This paper presents a comparative analysis of fifteen UK living labs registered as members of European Network of Living labs (ENOLL). It features two case studies of prominent living labs (LLs) to reinterpret a successful LL as a catalyst and an actor of social innovation to meet the challenge of knowledge and digital economy. This contrasts to the traditional definition of a living lab being purely an experimental environment or open platform for technological or service innovation. A number of interviews together with abundant secondary research and multi-case studies contributed to this study. The findings suggest three modes of LL operation; (1) government-led partnership for digital inclusion, (2) university-driven research centre for new ICT services, and (3) open network for innovative business opportunities. As to the level of entity's involvement, it ranges from community level to city or region level, and are all covered by the cohesion of European level. The study concludes that among these three types of LLs, the government-led mode is more mature than others and its impact for transforming citizens' lifestyles can be huge when local government commits to building up an intelligent city environment via a living lab approach directed at social well-being. However, for this to be effective well-coordinated management, an agreed set of mutual benefits and goals among actors, as well as continuously available financial sources from public and private sectors is essential. Perhaps the greatest danger to a fledgling LL is the ambiguity of the purpose and mechanism which may confound the LL users and stakeholders, and make it difficult to find long-term financial support and to implement viable business models, especially in the case where the public sector works with the private sector. More can be done by other country scope comparative analysis via a set of LL case studies in the future.

Keywords: business incubation, ICT policy, intelligent environment, living lab, service innovation, social innovation

1. Introduction

Living Labs methodology, as a way of sensing, prototyping, validating, and refining complex solutions in real-life environment, its emphasis on 'user involvement' and the 'co-creation' process makes it different from other testing and evaluation methods. It has been implemented as regional policy to improve Information and Communication Technology (ICT) industry and services in cities, regions and countries. Especially in Europe, the potential and opportunities generated by the collaborations of public-private-people partnerships (PPPP) from European Network of Living Labs (ENOLL) expand the scope of Living Labs from pure academic experiments to regional or national innovation systems. The number of ENOLL (European Network of Living Labs) members increased from 19 to more than 200 since 2006. As of 2010 more than 200 Living Labs have joined the ENOLL and contribute to building up new European innovation systems with Living Lab methodology (ENOLL 2010). The phenomenon of creating new prosperous Living Lab activities around the Europe seems alive and well. Well-known cases can be found in projects like Corelabs[1], Collaboration@ Rural[2], CoSpaces[3] and ECOSPACE[4] in the cities, based in countries all over the world, such as in South Africa, Italy, Spain, Finland, Hungary, Czech, Germany, Sweden, and Holland etc.

During the time, a considerable number of studies about Living Labs are mainly surrounding technology applications, user involvement, and innovation policy, aiming to merge technology push and market pull for innovation (Pallot 2009). Topics include ambient assisted living, mobile technologies/services, mobile networking testbeds, online community services, cognitive systems engineering, integrated collaborative spaces, wireless city applications, wireless LANs, broadband innovation, user-centric ICT innovation, eLearning, user needs, user involvement, multi-stakeholder approaches to user integration, user as co-creators, open user-driven research, lead users, open innovation, instruments for business, social innovation in rural areas, social theories of networks, networking in open innovation environment, service oriented architecture. A few papers more recently are discussing about the collaborative SMME incubation, business models for open innovation in rural living labs, rural development, and regional innovation.

Though some professionals argue that social and service innovation is the biggest benefits that arise from adopting a Living Labs approach, not so many literatures address this issue. Even though user involvement and methods are discussed widely there has not been much reported on stakeholder engagement. There is much propaganda about how great the Living Labs model is for

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[1] CoreLabs http://www.ami-communities.eu/wiki/CORELABS
[2] Collaboration@ Rural http://www.ami-communities.eu/wiki/C@R
[3] CoSpaces http://www.ami-communities.eu/wiki/CoSpaces
[4] ECOSPACE http://www.ami-communities.eu/wiki/ECOSPACE

creating values and opportunities in society but almost nothing is said about the drawbacks and bottlenecks. Too many discussions try to rephrase the Living Labs concept and to compliment its contribution rather than trying to understand the methods and synthesis the lessons learnt. As there is a large diversity of methods and tools used in Living Labs (Mulder et al. 2008), it is argued that more case studies are needed to better understand how Living Labs are developed and practiced in different places and different contexts. While some Living Labs are run by university based researchers, some are initiated by government authorities, such as city councils, and others were collaborations between companies and institutions. Given this diversity it would be beneficial to those considering harnessing the Living Lab concept to understand how different forms of Living Labs, initiated by different stakeholders such as authorities, academia, or enterprises, differ from the viewpoint of the various stockholders. Therefore the paper is to draw a picture of real LL cases from the view of practitioners and stakeholders to understand how the collaboration is formed and the issues and benefits that accrue.

2. Methodology

A number of interviews together with abundant secondary research and multi-case studies contributed to this study. Firstly, a comprehensive literature review of Living Labs is done. Then the study is focused on the UK area where there are 15 Living Labs registered formally as members of the European Network of Living Labs. Secondly, an invitation of interview was emailed to the contacts of the 15 UK Living Labs listed on the ENOLL website. It includes a brief introduction to the study and the reasons for choosing the objectives to be studied together with a description of how the person could help by answering these research questions. The questionnaire was provided in advance to aid the smoothness of the interview process. This approach helps to attract candidates and be sure that they are both willing and able to take part in the research. The nature of this study was, in part, a consequence of the Living Labs that responded and expressed an interest in participating in this study. Following a positive response, a date and time are arranged for either a telephone interview or face-to face interview. Four contacts responded at this stage. After understanding the interviewees' perception, experience, and involvement of Living Labs activities, Manchester EastServe and the Essex Digital Life Styles Centre are selected to be followed up in detail. While visiting to the directors who initiated the Living Lab, other suitable interviewees/stakeholders were recommended. Finally, the analysis and implications are made from all the materials available. It should be noted that there is a tendency of both published documents and interviews to present the positive aspects. An attempt has been made on presenting and revealing both the positive and negative aspects of the different LL approaches and bottlenecks. I have taken great care to try to substantiate what was told by trying to find more than one source (eg at Essex I interviewed two people independently; I used more

than one source to cross-examine the same event or project). Also, I have visited both of the case study organizations concerned where I had the chance to verify many of the claims made.

3. Living Labs in the UK

During the period 2006 to 2010, fifteen Living Labs around the UK have joined ENOLL as members. Among them, Manchester EastServe now is the only effective member in the UK. It is one of the first 19 Living Labs which joined forces to launch ENOLL in 2006. In the second wave, three UK Living Labs including Digital Lifestyles Centre, TRAIL Living Lab, and Scottish Living Labs also joined ENOLL in 2007. Another eight Living Labs joined in the third wave in 2008. They are ConnectMK – Living Lab for Milton Keynes, Social Informatics Lab (SILab), Sunderland Living Lab, Birmingham Communities Building Capacity, KWest Research, Hull Service Transformation Laboratory, CONNECTED NOTTINGHAM and Cybermoor. In the fourth wave in 2010, MIBON: Multimedia, ICT, Business Organisation Network, THINKlab, and Rural Connect NWLL joined. By comparing the objectives, research areas, and actors of the UK Living Labs shown in Table 1, UK Living Labs can be characterized into three groups based on how they were formed: (1) government-led partnership-type Living Labs for digital inclusion (coloured yellow), (2) university-driven research-type Living Labs (coloured blue), and (3) open network-type Living Labs (coloured green). The following describes these different types of Living Lab.

Government-led partnership-type Living Labs for digital inclusion
There are five Living Labs led by city councils including Manchester's "EastServe", Milton Keynes' "ConnectMK", Sunderland's "Sunderland Living Lab, Birmingham's "Communities Building Capacity", Nottingham's "CONNECTED NOTTINGHAM", and Cumbria Alston's "Cybermoor" which was initially supported by "Wired up Communities Programme" from Department for Education and Skills and, this it is considered to be in the government-led group. These Living Labs follow the experience of Manchester EastServe hereafter identified as 'Manchester Living Labs Model (MLLM)' in our study that aims to create digital inclusion by building up a broadband infrastructure based on a wireless environment that includes providing computer skill training and internet access to local residents. A public-private-people partnership was established at first to provide a forum and means for the stakeholders to collaborate. When the service was mature, an independent enterprise was introduced to sustain the business. Cybermoor is a special case which was initiated by a social enterprise formed within the co-operative. Its board members are all from locals in Alston. These kind of government-led Living Labs are highly controlled and monitored by some digital related development schemes. They are usually project-based with some limited funding period, mostly between two to five years. To sustain the activity or business, they need to create a proper business model or find further government support. In most of the cases, they charge small monthly fee for broadband or wireless connection and in addition to the basic

infrastructure, provide online community services etc.

University-driven research-type Living Labs

Four UK living labs are founded as part of university research, namely; the Essex Digital Lifestyles Centre, The Newtown Abbey TRAIL Living Lab, the Newcastle Social Informatics Lab and the Salford THINKlab. These research entities have adopted the Living Labs concept since they found some similarity and opportunity from the ENOLL organisation and concept. Some of them, such as Digital Lifestyles Centre and TRAIL Living Lab have worked previously on research involving users. Some of them are new initiatives like Social Informatics Lab and THINKlab which have gained new funding recently to start up a Living Lab. For this type of LL, they basically survive by winning funded projects from the UK government or the European Commission. To further leverage their research capability and high-tech facilities they, on one hand, keep working on internal multi-disciplinary research, but on the other hand, try to seek external collaboration or contracted service from industry. In addition, based on their resources, some of them provide facilities, space and consulting. For example, in the Salford THINKlab, people can rent meeting rooms or social space for events wheras in the Essex Digital Lifestyles Centre researchers and companies need to pay for using their iSpace. However, the diverse nature of basic University research means that projects going on in University Living Labs tend to be very 'ad-hoc'. The funding is equally "ad-hoc" which means they face ongoing difficulties in maintaining their organisation and facilities.

Open network-type Living Labs

Examples of the Open Network Living lab include the Scottish Living Lab, Bristol's KWest Research, and Birmingham's MIBON. They can be founded by a multiplicity of entities, such as university, social enterprises or, indeed, any other kind of organisation. Basically, their principle is to act as a forum to bring people together with the intention of encouraging collaborations. Each case differ from one another. For example, the Scottish Living Lab exploits the geography and politics of Scotland to bring together the universities, agencies, and city councils within Scotland aiming to encourage collaborations on new services that benefit the region. KWest is a social enterprise that provides media-related skill training or educational activities to local residents. Their strategy is to empower people with creativity with the idea these people are more likely to spearhead enterprises that will benefit the community. MIBON is also a social enterprise formed by some industry experts who try to disseminate innovative ideas and cutting-edge technologies to people who have interests in multimedia, ICT, and innovation, with the aspiration to create new collaborations and services. This kind of open network has very low overheads and is frequently supported from the membership. Generally they find presenting themselves as a Living Lab as beneficial because it enables them to join ENOLL and expand and strengthen their network.

Table 1. UK Living Labs

Title	Headquarter Location	Objective	Research area	Key actors	Initiated by
Manchester EastServe[5]	Manchester	To provide broadband and wireless environment and to empower people with internet skills in the emerging information society	Digital inclusion[6]	New East Manchester[7]	Manchester City Council
Digital Lifestyles Centre[8]	Colchester	To optimize the design and development of pervasive computing technologies in inhabited environments	Ubiquitous	Intelligent Inhabited Environment Group[9], The Institute for Social and Technical Research, Natural Language Engineering and Web Application[10], Pervasive Networks and Services Research Group[11] at University of Essex	University of Essex
TRAIL Living Lab[12]	Newtown-Abbey	To study the unmet needs of ageing citizens in rural locations in the region of the North of Ireland	Health. Ambient Assisted Living	School of Health Sciences, School of Computing and Mathematics and the Department of Management at University of Ulster	University of Ulster
Scottish Living Lab[13]	Edinburgh	To develop an open collaboration and infrastructure to evaluate and develop new services	Wireless, Open network	University of Edinburgh, University of Glasgow, Napier University the Edinburgh College of Art, Glasgow School of Art, Dundee University,	ISSTI[14], University of Edinburgh

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[5] http://www.eastserve.com/ and http://www.eastservebroadband.com/

[6] "E-Inclusion, or digital inclusion, is about mobilising information and communication technologies (ICT) to combat such social or economic exclusion. It is also about the usability of ICT for all or e-accessibility." (European Commission Information Society 2008)

[7] New East Manchester (NEM) Ltd. (http://www.neweastmanchester.com/) is a partnership between national (Homes and Communities Agency), regional (North West Development Agency) and local government (Manchester City Council), with local communities playing a full part. It was the second Urban Regeneration Company (URC) created in 1999. URCs (http://www.urcs-online.co.uk/) are private companies in the UK that seek to achieve a radical physical transformation of their areas through masterplanning and co-ordinating financial assistance to developers from both the public. There are now 18 URCs established in England, one in Wales and one in Northern Ireland. Additional URCs have been created in the West of Scotland.

[8] http://cswww.essex.ac.uk/Research/digital/index.htm

[9] The Intelligent Environments Group (IEG) http://iieg.essex.ac.uk/

[10] Language, Logic and Information (LLI) group http://cswww.essex.ac.uk/Research/nle/

[11] The Pervasive Systems http://www.essex.ac.uk/csee/research/groups/Pervasive/index.aspx

[12] http://trail.ulster.ac.uk/

[13] http://www.issti.ed.ac.uk/research/SLL

[14] The Institute for the Study of Science, Technology and Innovation (ISSTI) http://www.issti.ed.ac.uk/

				Innovation Centres (Scotland) Ltd, MX Alliance	
ConnectMK[15]	Milton Keynes	To develop an open innovation platform, promoting social cohesion through the reduction and ultimate elimination of digital exclusion within the city.	Digital inclusion	ConnectMK Ltd, Milton Keynes Council (owner of ConnectMK Ltd), Freedom4[16] (key trading partner)	Milton Keynes Council
Social Informatics Lab (SILab)	Newcastle	To provide the tools, facilities and the capacity to actively initiate, support and deliver multidisciplinary partnership based working.	unknown	KITE Public Services Innovation group	KITE[17], Newcastle University Business School
Sunderland Living Lab[18]	Sunderland	To promote social inclusion by facilitating the participation of local people in a pro-active role, and to assist the development of Community based ICT provision	Digital inclusion	Sunderland City Council e-Neighbourhoods Programme	Sunderland City Council
Birmingham Communities Building Capacity[19]	Birmingham	To increase communities' capacity for self-help and innovation through the use and development of digital technologies.	Digital inclusion	Digital Birmingham[20]	Birmingham City Council
KWest Research[21]	Bristol	To develop the creative, educational and social potential of people within the surrounding area.	Education, Community activity	Knowle West Media Centre[22]	Knowle West Media Centre
Hull Service Transformation Laboratory	Hull	To develop open innovation approaches to utilise Hull's potential as a Service Transformation Laboratory.	Open network	Broadband Capital Ltd[23] (no longer exist)	Hull City Council
CONNECTED NOTTINGHAM[24]	Nottingham	To promote ICT investment in the conurbation	Digital inclusion	Accelerate Nottingham[25] (partner with East Midlands Development Agency and Greater Nottingham Partnership, Learning & Skills Council and Nottingham Council	Nottingham City Council

[15] http://www.connectmk.com/

[16] Freedom4 is a joint venture between Freedom4 PLC and Intel Capital (The Intel Corporation's technology investment fund). http://www.freedom4.com/

[17] Centre for Knowledge, Innovation, Technology and Enterprise http://www.ncl.ac.uk/kite/

[18] http://www.sunderland.gov.uk/index.aspx?articleid=2769

[19] http://www.digitalbirmingham.co.uk/projects/communities-building-capacity-cbc

[20] Digital Birmingham http://www.digitalbirmingham.co.uk/

[21] http://www.kwmc.org.uk/index.php?project=38

[22] Knowle West Media Centre (KWMC) http://www.kwmc.org.uk/

[23] Broadband Capital Limited http://www.broadbandcapital.co.uk/

[24] http://www.connectednottingham.org.uk/

[25] Accelerate Nottingham http://www.acceleratenottingham.com/

Hsuan-Yi Wu
An Empirical Study of UK Living Labs

				for Voluntary Services, Nottingham City Council and Nottinghamshire County Council, Nottingham Trent University, the University of Nottingham and New College, Nottingham, Nottinghamshire Chamber of Commerce and Industry, Nottinghamshire Police)	
Cybermoor[26]	Alston	To provide broadband and innovative services	Digital inclusion	Cybermoor Services Ltd (initially supported by Wired up Community Programmes, DfES, and)	Cybermoor Services Ltd
MIBON[27]	Birmingham	To provide a 'test bed' for technology and service providers, comprising SME, to pilot leading edge technology developments in new media, ICT and business applications.	Open network	MIBON (Partner with Birminhambition, Laboranova, Clevercherry.com, Centre for Concurrent Enterprise at Nottingham University Business School, Succe&d)	Multimedia ICT Business Organisation Network
THINKlab[28]	Salford	To facilitate innovation, concept development and validation involving multidisciplinary teams.	Virtual prototyping, City planning	A group of 8 researchers led by Prof. Terrence Fernando	University of Salford
Rural Connect NWLL	Unknown	Unknown	Unknown	Unknown	unknown

4. Manchester EastServe

To fight the high levels of unemployment, poverty, and social exclusion in the region of East Manchester[29], Manchester City Council identifies ICT and digital media as an important theme in their City-Region Economic Development Strategy and Plan from which the Manchester EastServe project was initiated in 2000 and executed from 2001 to 2007. Since 2003, with the support from Manchester Digital Development Agency,[30] EastServe has moved forward from being just a web portal to becoming a community based Internet wireless network that has

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[26] Cybermoor Ltd http://www.cybermoor.org/

[27] MIBON (Multi-media, ICT and Business organisation network) http://www.mibon.org/

[28] THINKlab http://www.thinklab.salford.ac.uk/

[29] East Manchester is a large working class inner-city area quite close to the city centre. It consists of three local areas; Beswick, Clayton and Openshaw. The area has a population of 11,231 and contains 4,500 households. 80% of residents live in houses and the majority of the remainder are low-rise flats. Almost 40% of the housing stock is council owned. The area suffers from a complex and inter-related range of issues including high crime levels, low educational attainment, poor health and a lack of local facilities and is ranked in the lower quartile in the National Index of Deprivation. (Wired up Communities Evaluation- Case Studies) http://www.intelligentcommunities.org.uk/research/

[30] The Manchester Digital Development Agency (MDDA) http://www.manchesterdda.com/

become financially self-sufficient in two years.

Infrastructure

Creating the EastServe LL has required a great deal of resources. For example, initially, networked computers (with no hard disk) in the form of new/recycled PCs and set-top boxes were provided to residents with dial-up Internet access in Wired up Communities (WuC) projects. However, having embarked on this plan it as found that 25 percent of homes no longer used landlines resulting in the need to change strategy in 2002, to provide wireless broadband connectivity. By 2007, more than 2,000 of the area's homes had wireless broadband Internet connections, as well as 17 local schools, 8 "UKOnline" community access centres, and 10 public access points in libraries and other centres. The wireless network infrastructure consists of a 100Mbps licensed wireless backbone, linking four tower blocks around the East Manchester area with each tower redistributing the connectivity locally to residents. Eastserve has became one of Europes largest community based all-wireless broadband networks and the largest community regeneration initiative (compared with other WuC projects shown in Table 3) using digital technologies in the UK (Carter 2007).

Stakeholder Engagement

Under the coordination of New East Manchester, all the partners were brought together. Besides the key partners, a Steering Group was formed to enable the Wired up Communities bid. Members of the group included all the major organisations operating in the area. Meetings were held approximately every six weeks. The partnership operated at both a strategic level and an operational level with particular attention being paid to the latter where it was recognised it was important to users to deal with issues, even one, quickly (Devins et al. 2003).

Table 4.4 EastServe Stakeholder formation

Key partners	Steering Group
- East Manchester Residents' Forum	- Department for Education and Skills
- New Deal for Communities	- Regional Development Agency (GONW)
- New East Manchester Ltd	- MANCAT (the local technology college)
- East Manchester Education Action Zone (EAZ)	- Manchester Community and Information Network (MCIN)
- Manchester City Council	- English Partnerships
- Network East Manchester	- ITEM (Information Technology East Manchester)
- Key Private Sector Partners (Atlantic Telecom, BT, NTL, Bush Internet, Netgem, OnDigital, NIC Company, Nutshell, Cisco Corporation, Hewlet Packard, Clicks and Links Ltd)	- Private Sector Firms (Clicks and Links, Fujitsu and British Telecom)

User Involvement and Service Creation

By targeting people who may be affected the most by the digital services, users were more motivated to be positive long-term participants. Monthly meetings were held in local community centres and 'Community champions' were formed from computer literate members to encourage and foster the use of IT and to make recommendations to Steering Group (Devins et al. 2003). A series of "user journeys", based on archetypes developed through community engagement and consultations, were undertaken. The vision for the project was to enable everyone in the community, no matter how excluded and disadvantaged, to gain a stake in the knowledge economy and to use it to provide themselves with a better life, particularly in terms of work, skills, and health" (Carter 2007). The user journey started with:

(i)   Engagement with the local digital action centre, with the method chosen being dependent on locality and approach taken to engagement.

(ii) Individual planning to determine a person's needs and current digital capability with the aim of creating a personalized NetStart plan.

(iii) Access to content/services via the matrix digital cooperative, with membership options and the chance to build up and share in a digital dividend (a digital "divi")

In this process Eastserve.com plays an important role by acting as an online community website where users can easily access information such as events, training, courses and workshops, conferences, community services, as well as job and volunteering opportunities. EastServe Broadband provides broadband offerings and a PC repair centre for 'hard to reach people who might otherwise be excluded'. According to Carter (2007), the user coverage in 2007 was about 5,000 households and during that year it was expected to expand to more than 10,000 households and then to more than 50,000 households by 2010 (this year), expanding population coverage from around 20,000 people to more than 250,000 (including family members). Up to 2007, over 40 percent of residents had experienced basic ICT training via the Eastserve initiative which is more than double the rate of most areas in the city, with 20 percent of these people moving on to extended courses that provide opportunities for accreditation.

Impact

During 2001 and 2005, broadband access grew from 2% in 2001 to 25% in 2005 and overall 75% of residents had internet access. PC ownership increased from 19% in 2001 to 52% in 2005%. 57% of residents identified access to online services through Eastserve as beneficial, highlighting improved communication with family and their community. Crucially unemployment in East Manchester is now a third of what it was in 1999 and below the national average (Eastserve 2010).

Key Successful Factors

The EastServe project is an important benchmark for both other LLs and government regeneration efforts and, as such, has been monitors by the government over its 10 years of life. In

analysing the operation of Eastserve, it is important to note that it is not an entirely usual case. Firstly, the nature of building upon national and local frameworks for digital inclusion, as well as being identified and marketed as a "good practice" example has helped the project gain the fortuitous funding from different government agencies such as MDDA, NEM[31], NWDA[32] etc. Secondly, its business model, puts local, user and community needs at it's heart thereby engaging, empowering, and improving people's life. Thirdly, the strong relationship and partnership between public, private, and community sectors in the region has formed a powerful engine for driving the enterprise forward around the laudable goal for a common wealth in the society.

Currently, the Living Labs activities do not end after the success of Manchester EastServe,; MDDA still takes part in ENOLL and Manchester's digital inclusion actively by leveraging its capacity to seek different constitutions of partnership, and collaborate to spread its experience by enlarging the power of innovation. In addition, Manchester City Council has linked up with three neighbouring municipalities, Tameside, Salford and Oldham to create "ONE-Manchester" (Open Network E-Manchester); MDDA, Manchester Knowledge Capital and Manchester Informatics with the University of Manchester have partnered together to create the City Innovation Lab.

5. Digital Lifestyles Centre

The Digital Lifestyles Centre (DLC) at the University of Essex was established in 2006 as part of a collaboration between the school of Computer Science and Electronic Engineering Chimera[33] as a means to manage emerging multi-disciplinary research around the iSpace[34]. It had aims to bridge the gap between social and technological sciences by focusing on the development of innovative applications and technologies through fusing new 'people inspired' methods and tools from the socio-technical centre, Chimera with hardcore science and engineering from the Intelligent Inhabited Environments Group (IIEG), the Natural Language Engineering and Web Applications group (NLWA), and the Pervasive Networks and Services Research Group (PNSR). Despite there being a focus on longer term fundamental research there are a number of near-market technologies being explore, with companies such as BT, Kodak, and more recently with Intel.

Infrastructure
"Essex Intelligent Environment"[35] comprises three facilities iDorm, iSpace and iCampus which

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[31] NEM, New East Manchester Ltd http://www.neweastmanchester.com/
[32] NWDA, North West Development Agency
[33] The Institute for Social and Technical Research (Chimera) http://www.essex.ac.uk/chimera/
[34] iSpace http://cswww.essex.ac.uk/iieg/idorm2/index.htm
[35] The Essex Intelligent Environment is a framework for exploring a multiplicity of living spaces that has the current iSpace at its core but extends beyond it, as mobility is an essential aspect of any future digital living. It is used by

support DLC research activities. The iDorm development was funded by the EU Disappearing Computer programme in 2000, whilst the iSpace was built using SRIF 1 funding (HEFCE 2003) for £300,000 and completed in 2006. It was later equipped under SRIF-3 funding (£250,000) in 2008. All these spaces were built as Living Labs to facilitate work on "intelligent environments"[36]. Living Labs here represent "an environment for exploring the interaction of users and technology in everyday life" (DLC 2010). The iDorm acts as a testbed to perform technical development and testing (a 'dirty environment' where all the technologies and tools are exposed), whereas the iSpace is used for socio-technical evaluation involving members of the public provides (a 'clean environment' where technology is more mature and where the environment is capable of supporting evaluations with long-term occupation). Finally the iCampus and HQPN (Heterogeneous, Quad-Play Research Network Testbed) are 'clean' and 'dirty' environments to explore town and city like network infrastructures.

Stakeholder engagement

Looking at DLC experience from the iDorm, through the iSpace and iCampus to iSouthend, it is clear that there are different scales of Living Lab work being carried out at Essex. There is an interest to understand its stakeholder constitutions and explore its potentials. A mini-workshop with Dr. Gardner and Prof. Callaghan was then held in mid-Aug at Essex. Following the instruction of stakeholder generation (Mitroff et al. 1981), a stakeholder map indicates important stakeholder shown in Figure 1. The Research Enterprise Office (REO) at University of Essex (the interface between Essex University and the outside world) and various funded projects from EU, UK government are identified to be the most crucial stakeholders in the sense that the survival of the centre requires continuous funding and support. In the case of the REO, its responsibility is to deal with all the aspects related to business development, promotion, charging and finance, recruitment and ethics that DLC is confronted with. It is the link between DLC and users and companies. Being a University, ethical issues are subject to lengthy approval cycles, which often affects the research timeline.

Figure 1. DLC's stakeholder map

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various projects across the university for showcasing, sandpiting and user testing (more mature) developed technologies (DLC 2010).

[36] An environments "where (networked embedded computing) devices, services and applications work together seamlessly supporting even richer, more engaging and deeply connected (user) experiences" (Bill Gates, 2006)
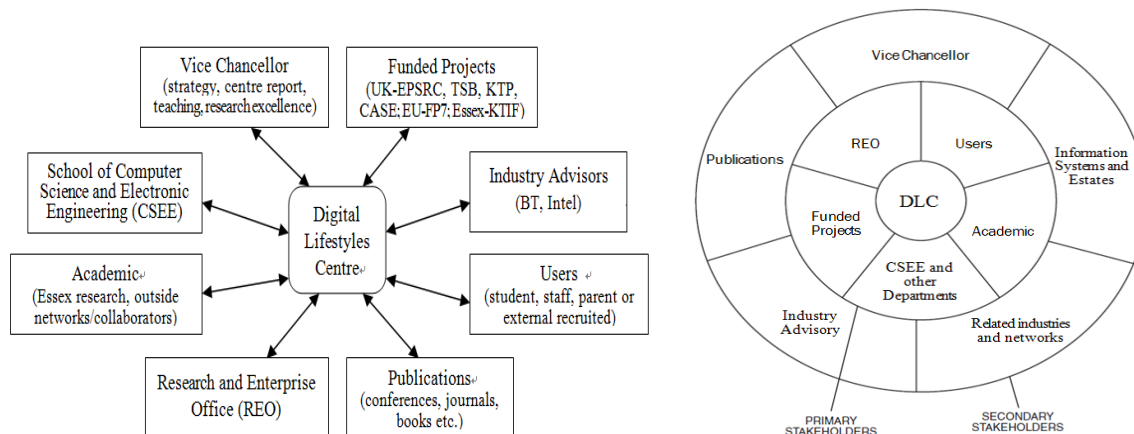
User involvement and service creation

For research purpose, users are involved in different stage of R&D process. Their involvement is to act as co-creator from their perception, imagination and behaviour of technology. They are usually invited to stay in iSpace and to use the technology in as natural away as is possible. There is no direct monitor (ie no cameras, nor human observers) but the actions of the networked appliances are recorded (providing indirect, secondary evidence of the occupants behaviour). In addition to this automated indirect monitoring more traditional social research techniques are used such as diaries, interviewing and post-trial debriefing. The sources of users are by traditional payment-based recruitment, lead-users or by clever targeting of parents of students who might wish to visit the campus, visiting research fellows in need of accommodation, and friends and families of University staff (Fowler et al. 2010). The technology being tested and type of questions differ. For company projects, users are usually playing with technology which has clearly-defined specification. For basic research, the starting point is earlier without clear-defined specification of new technology and questions are more open. Fundamentally, the user-centric research in the iSpace is aiming to understand the interaction between people and technology so as to discover the basic behaviour and attitudes of users in relation to technology. While the DLC tries to promote user-centred methods to aid the research it seems that most of engineering and manufacturing companies are more technology-led.

Methods and tools

There are two methods that are special to DLC; these are SUNA (Scenario-based User Needs Analysis) and PIP (Pervasive Interactive Programming). SUNA is a method developed by Fowler and Helvert (2003) "for envisioning, clarifying and refining ideas for developing software products and services usually where there are two or more parties involved". is the method is most effective for eliciting user needs from scenarios and for managing collaborations. SUNA is combined with a workshop based process which helps to ensure that the development team shares

a common understanding of the high-level product or service requirements. PIP (Pervasive Interactive Programming) is a patented system with "show-me-by-example" approach allowing non-technical end-users to create "programs" for customising their personal space. It may sound magical but users are neither required to write program code, nor follow a rigid sequential list of actions. All they need to do is to *show* the system the required behaviour by demonstrating it via physical interactions with the environment (Chin et al. 2006). By consumers being able to use this method to create their own "virtal appliances" invaluable date about what users actually require from technology is obtained. The other advantage of this method is that the data collection is automatic and authentic (not an interpretation of social science researcher). This novel approach to socio-technical research can be used in conjunction with other methods, such as Intel's Consumer Experience Architecture (CEA) (Johnson et al. 2008).

Impact

As Fowler (2010) claimed "Living Labs could potentially have a very significant impact on the world of social science research". The real contribution of DLC is to lead research towards a new era. The 'service' provided by DLC and iSpace changes the way researchers and companies are doing research and design. Kodak gave the following feedback after they experienced iSpace research, "It is vital that we get early customer feedback to these concepts so that the products we roll out really address customer needs and desires. We work with our customers in a variety of ways and iSpace offers us options that we cannot readily reproduce elsewhere". Living Labs can help generate innovative ideas and validate technology from real life experience, meanwhile it saved time and cost above having a more conventional field trial. As Fowler (2010) argued, "They are essentially a 'quasi-experimental' platform sitting somewhere between the traditional customer behaviour laboratory and the field trial. They have an element of co-creation not usually in terms of users being part of the design team, but in the sense that the users, not just the designers, are a major source of innovation. Users can and often do the most unexpected things". The Essex PiP approach takes this co-creation concept further by enabling users to create their own services and virtual appliances and, as Fowler suggested, truly opening up the possibility of changing the way researchers and companies are doing research and design.

In the future, DLC will take part in a city wide evaluation of how networked technology might change society; the Essex iSouthend project. This greatly expands the Essex Living Lab facility. Southend is on the edge of London and its local government has identified that there is a group of creative industry professionals based in town who seem to work in an uncoordinated way. The East of England Development Agency (an arm of government) together with Southend Council (the local arm of government) are exploring the opportunity to make use of LL infrastructure as a means to foster cohesion of the creative industry, and the wider town, which the hope will lead to

beneficial innovations in the Southend society.

6. Discussions

Manchester EastServe can be regarded as a classic model of a government-led partnership type of LL. EastServe was started at a the perfect time, when local, regional and national governments were putting effort on bridging digital divide. East Manchester was a particularly good location for such an enterprise as the area was characterized by high crime levels, low educational attainment, poor health condition and a general lack of local facilities which created a massive incentive and opportunity for investment in a LL. In such an environment a LL was seem as a catalyst for regenerating the area, motivating local government, residents, and local organizations to collaborate actively and continuously. Various partnerships and a strong leadership from local government have EastServe to remain a viable operation for longer that some other types of LL. In addition to resources from local, regional and national government, holding regular meetings has also helped to smooth operation of this LL. For example MDDA has expended some five years of effort on establishing user groups and infrastructures. To help EastServe become financially independent from government support, MDDA created a company to manage EastServe. Although Manchester has withdrawn from direct management of EastServe LL, there are lasting benefits from their experience. For instance, Manchester Knowledge Capital has been established to foster innovation in Manchester city-region together with a partnership involving the University of Manchester and Manchester Digital Development Agency to establish a City Innovation Lab in Manchester, aiming to develop a new "Living Lab" capability to deliver large-scale open networked innovation via expert trial facilities.

On the other hand, the DLC case was one where the key figures expressed concerns about the sustainability of the LL in the university. Lack of financial sources and poor coordination mechanisms restrain its development. After four years of operation, their perception of LL is constrained by the nature and needs of a university research centre. As my finding from interviews have revealed, Essex LL researchers are struggling to find LL cases which could provide a financially self-sufficient and a sustainable business model for a university research centre. They do not feel a radical shift has taken place from traditional or existing methods to LL, as the funding bodies for University research still operate a traditional funding model that is not compatible with a more radical LL approach to research. Various industrial collaboration models have been proposed, such as a 'club model' has been suggested by the Essex Research Enterprise Centre but the relative immaturity of the DLC meant it was not yet ready to accommodate such a sophisticated model. As such the DLC is now focusing on creating a sound development plan and seeking Knowledge Transfer Funds to develop a business plan. The strong research energy and an

underlying socio-technical research capability is a particularly strong asset of this centre. There is much potential since the Essex DLC has excellent researchers and facilities which are needed to advance socio-technical and human-computer interaction related research. For instance the Essex DLC researchers are prime movers in the annual international conference on Intelligent Environments as well as on the editorial boards of journals such as Ambient Intelligent and Smart Environments and Intelligent Buildings International. One crucial point to be noted in DLC experience is that 'guanxi'[37] matters in many dimensions. Individual researcher's have strong personal links to industry (eg Intel and BT), but they are mostly ad-hoc based and maintaining long-term collaborations are deemed to be difficult. Incidentally, the process of listing the key stakeholders reminds the Essex DLC Director to rethink the importance of aligning all the departments which are involved in iSpace research. It is also apparent that Industrial Advisors should not simply act as a marketing advertisement but should be treated as strategic alliance to bring important information and network into the DLC. By keeping this DLC two-tier stakeholder map in mind, a future strategic action plan can be clearly drawn.

To sum up, based on different context and incentives, government-led and university-driven models have significantly different directions of LL activities. Universities are more aimed at fundamental computer science or social science research (with outputs in terms of papers and advances to basic research) whereas government-led LLs are more concerned with the regeneration of business, local economies or the well-being of communities. From Manchester government-led experience we found a well-coordinated mechanism for LLs in city-region which can fasten the innovation process. Also the early and active participation of MDDA in ENOLL has strengthened its LL knowledge and experience. Even though, ENOLL claims itself as an 'open' network, the policy of differentiating membership by cost creates a social hierarchy within the network. Some parties may find membership difficult to afford and so those parties with strong support (usually policy-makers or innovators), are better able to shape the direction of future LLs, influencing and prolonging their dominance in national and European levels.

7. Conclusions and Implications

This paper is attempted to find the bottlenecks from various stakeholders in LL practice. By looking at the Living Labs in the UK, three modes of operation are suggested from the findings, (1) government-led partnership-type Living Labs for digital inclusion, (2) university-driven research-type Living Labs, and (3) open network-type Living Labs. Among these, the government-led mode is more mature than others and its impact for transforming citizens'

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[37] "Guanxi is a particular kind of interpersonal relationship or connection that serves as a form of social currency. It provides managers with access to scarce information, resources or influence." (Tsui, Anne S. et al. 2000)

Hsuan-Yi Wu
An Empirical Study of UK Living Labs

lifestyles can be huge when local government commits to building up an intelligent city environment via a living lab approach directed at social well-being. However, for this to be effective well-coordinated management, from the experience of Manchester EastServe and Digital Lifestyles Centre, we can know that, an agreed set of mutual benefits and goals among actors, as well as continuously available financial sources from public and private sectors is essential. Some suggestions are provided for Living Labs practitioners. Firstly, the ambiguity of the purpose and mechanism may confound the LL users and stakeholders, and make it difficult to find long-term financial support and to implement viable business models, especially in the case where the public sector works with the private sector. Secondly, the strong relationship and partnership between actors from different sectors can lead to a strengthened innovation system where innovation can occur spontaneously. Thirdly, an alignment between social and technical constituencies resulting innovation process can help provide significant opportunities for research, business and the community as a whole. At this level, university and community LLs can act as the seeds to foster relatively small-scaled user groups and collaborations with the wider city LL. More work can be done by following up the ongoing development of these UK Living Labs to see their impact on innovation and society in the short and long run, and by validating the three operation modes of Living Labs in other country scope comparative analysis via a set of LL case studies in the future.

Acknowledgements

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Hsuan-Yi Wu
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