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m-Living Labs, A Framework for Collaborative Community Advancement

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Abstract: Within Southern Africa the establishment of Living Labs for community development is steadily gaining momentum. The majority of the established living labs aim to improve and address various aspects and issues encountered in rural environments. Internet access barriers also referred to as the digital divide, is becoming a lesser issue due to the high saturation rate of mobile technologies. The cellular phone industry is a rapid growing platform for development in all possible fields of science and education as researched by this paper. The capabilities of cellular phones grow each year, allowing us to push the very boundaries of what content is presentable to end users as well as creating new, innovative services. This paper will revisit the Living Lab concept and provide a possible framework for the application of various mobile Web 2.0 and Web 3.0 technologies, to render different envisaged services.

Keywords: Mobile Living Labs, Collaboration, Knowledge Sharing, Mashups, Web 2.0, Web 3.0

1. Introduction and Background

Within South Africa, the Living Lab (LL) concept has reached international status with its European counterparts, in providing an alternate approach to the LL concept. Two of the ten established LL's, i.e. Siyakhula Living Lab (SLL) and the Reconstructed Living Lab (RLab) have shown tremendous growth and have advanced through different phases rendering successes in various aspects.

Both of the LL's mentioned have seen the potential of mobile technologies and is conducting experimental research and delivering products. The SSL has recently rolled-out five Digital Access Nodes for their immediate communities. The RLab has identified the possibilities of utilising mobile tools and platforms e.g. JamiiX and Twitter to provide and render services with successful outcomes.

Russel [1] predicted that: "Africa is being tipped to pass one billion mobile subscriptions to become the world's second largest mobile market by 2016 according to new research from analyst firm Informa."

In a report by [2] it was indicated that 71% of 15 to 19 year olds in South Africa owns or have access to a cellphone. The report also indicated that at least 40% of all the users within this age group utilize their cellphones for instant messaging purposes and at least 20% of those users for other purposes, which include web functionality. The application of cellular phones in various aspects normally addressed by the LL concept e.g. education, health, trade and agriculture could provide a mechanism for reaching potential users that

would otherwise be unable to receive such services or support. These topics have been researched by many *cf.* [6][9][10][11] have proven to be one of the more practical uses for mobile technologies in a Living Lab environment. With technologies like FlashLite, Silverlight and JavaFX, content developers are provided with the opportunity to create new, innovative solutions to everyday human needs. These applications satisfy a wide range of needs from social and entertainment to education, health care and business.

The Mobile Living Lab environment not only acts as a test bed for new technologies or ideas, but provides valuable insights into the requirements of consumers as well as real-time feedback on issues they experience, creating a dynamic environment where technology is designed to augment day to day life and not become another task for the individual.

With the emergence of newer web technologies in the form of Web 2.0 and Web 3.0 the Internet now provides services that have not been seen before. Collaboration and social networking services provided in current Web 2.0 applications are utilized by millions of users daily. The real power of social networking and collaboration are only being realized now. Living labs based on the utilization of a portal which consist of portal factories which render user specific services are seen as a key in delivering, supplying and the creation of knowledge to fulfil the knowledge needs of the applicable Community of Practice (CoP)

In the subsequent sections of this paper we will revisit the Living Lab concept and provide, new suggestions, thoughts relating to the advancements in mobile technologies for use in LL environments, for various domains. We will also provide a possible mobile LL implementation framework incorporating existing and emergent Web technologies.

2. Living Labs

The term Living Lab has emerged in parallel from the Ambient Intelligence research communities' context and from the discussion on Experience and Application Research (EAR) based on the concept of user experience and Ambient Intelligence. [3].

Over the last few years the term has been promoted and implemented by the EU which has resulted in the creation of the European Network of Living Labs (ENoLL), which in 2008 has expanded also beyond European borders ("European Network of Living Labs. 2010 [4]. Its mission is to help create first class innovation environments for ICT-based products, services and social innovations and facilitate innovation and collaboration between users, industry and research stakeholders.

[5] defines Living Labs as: Systemic initiatives, which focus on creating multi-stakeholder collaboration in different stages of the research, development and innovation (RDI) process. The concept refers to a research and development methodology where innovation such as services, products and application enhancements are created and validated in collaborative, multi-contextual empirical real-world settings. In Living Labs, users or citizens are seen as a source of new innovation, as co-creation or application of ICTs or ICT-enabled services. Living Labs are platforms for exploring these opportunities in various areas. A more recent definition which depicts the an integrated developed and developing country perspective is the one of [6] which defines Living Labs as environments, a methodology or an approach which caters for user-driven open innovation within real-life rural and urban settings/communities, where users can collaborate with multiple committed stakeholders in one or more locations, to become co-creators or co-designers of innovative ideas, processes or products within multidisciplinary environments. Successful deployments can results in improved processes or service delivery, new business models, products and services and can be replicated (with necessary socio-cultural adaption) to improve overall quality of life and wider socio-economic impact (including entrepreneurship) in participating with other communities.

These days, several Living Lab descriptions and definitions are available from different sources [4],[7], [8]. It is a concept which refers to a research and development methodology

where innovations such as services, products and application enhancements are created and validated by users in collaborative, multi-contextual empirical real-world settings [7] According to [9] the current established LLs within the network in SA each has distinctive uniqueness focussing on the: 1) capacity building of the communities involved, as well as the 2) enhancement of the innovation skills of the individual community.

According to [5] the main difference of a LL is that in Europe they apply different models of innovation as they are more focussed on industry involvement in a LL from the beginning whereas in Southern Africa the focus is currently more on rural community engagement and upliftment and to keep innovation within the community and not to allow the value to go to the industry but to the community as a whole. Concepts also evident from various definitions of LL are open innovation ecosystems, territorial contexts, concurrent research and innovation processes where users are either the drivers of innovation or where users are used to validate products. [10].

2.1 Mobile Living Labs defined

Based on the above definitions and concepts involved in LL one can therefore create a definition for a mobile LL (m-LL) where the different types of mobile devices are used or tested by different users who are the drivers of innovation within real-life settings and new services or products can be produced through user engagement. The m-LL incorporates a symbiosis of web-based technologies including that as rendered by the cloud.

The Living Lab concept is fuelled by knowledge sharing, collaboration and experimenting in open real environments. Within the developing context with rural communities in South Africa specifically it is even more pertinent.

Figure 1 depicts a graphical representation of the m-LL concept.

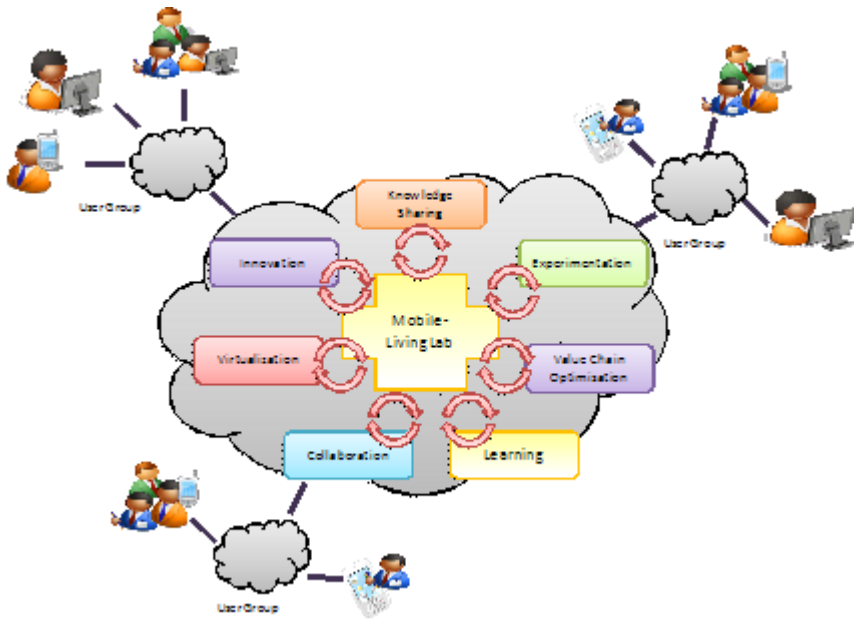

Figure 1: m-LL Graphical concept

2.2 m-Living Lab framework

In previous research conducted generic Living Lab framework was presented. c.f. [11],[17]. The proposed living lab framework consists of four key components presented as factories, which groups and facilitates the various functions and LL activities. The factories aim to address some of the objectives and proposed functionalities of Living Labs in general, but

also that which is explicitly defined by LLiSA which include: 1) Building coordinated networks of users, 2) Facilitate learning, 3) Encouraging collaboration between various stakeholders, 4) Disseminate and create knowledge, and knowledge transfer between various entities, 5) Creating platforms for research implementing different technologies and models, 6) Providing evaluation, feedback and reporting services on ongoing innovations and initiatives. [5]

In brief each of the factories will render and facilitate the following services and functions:

- Product Factory (PF) - represents the processes and activities involved to deliver and create products in various forms. The objective of the PF is to aid in the development of an innovative "product": physical, abstract, a service, artefact. The "product" delivered will normally address and fulfil a specific CoP needs or requirement. The researcher sees the creation of artefacts in the form of knowledge objects (KO) as one of the key deliverables of the factory.
- Network factory (NF) helps to find people that the community need. The primary objective of the networking factory is to establish a platform for the engagement of various role-players within the LL. The network factory therefore is to network various communities of practice members and stakeholders into various virtual teams.
- Knowledge Factory (NF) creates a dynamic set of knowledge objects (KO's) implementing a question and answer extrapolation tool (QAET). The QAET is build upon the utilization of questions in order to create reusable knowledge objects. The primary purpose of the QAET is in the management of user requests, and the formation of knowledge objects. We define a knowledge object (KO) as any artefacts that could be implemented by a knowledge seeker in order to learn or expand the user's current knowledge regarding the specific search topic. KO's can take on a variety of formats, ranging from digital media to WEB 2.0 mashed objects. [16] Defines knowledge objects as a set of appropriate components of knowledge that are required for a particular need, of which the components of a knowledge object include various entities and properties of the entities as well as the various activities that could be associated to the processes of the entity to describe the knowledge represented. All KO's utilized are stored and managed in a Knowledge Object Repository, which is in essence a semantic web cataloguing system
- Services Factory (SF) produces all the web services needed in order for the living lab to function. It included resource planning, information, business and communication, and knowledge support and analytical services [11]

Our revised LL framework incorporates various mobile technologies applicable to each of the factories. A number of services provided on the Internet are evolving towards providing mobile equivalents of their technologies. Examples of these would be Flickr, YouTube, Facebook, Wikipedia and del.icio.us to name only a few. With the advancement of such technologies into the mobile domain users can easily get access to services normally provided from traditional internet enabled devices, which resided at passive or fixed locations, e.g. Internet lounges or IT centres.

The technologies which include amongst others, social media platforms e.g. Facebook, twitter, service and knowledge sharing platforms such as micro-blogs and mobile wiki's, and m-commerce sites, as well as communication platforms such as Nimbuzz and Mxit is also indicated. Internationally there is a big drive towards the development and deployment of current web services into the mobile domain, as is evident from the annual Mashable awards which promote amongst others developments in mobile technologies. [12]. The listed technologies as depicted in the m-LL framework are not intended as fixed

prescriptions for use, rather as suggestions for possible use in their applicable application domains. A mixture of technologies is suggested, supported by the Cloud.

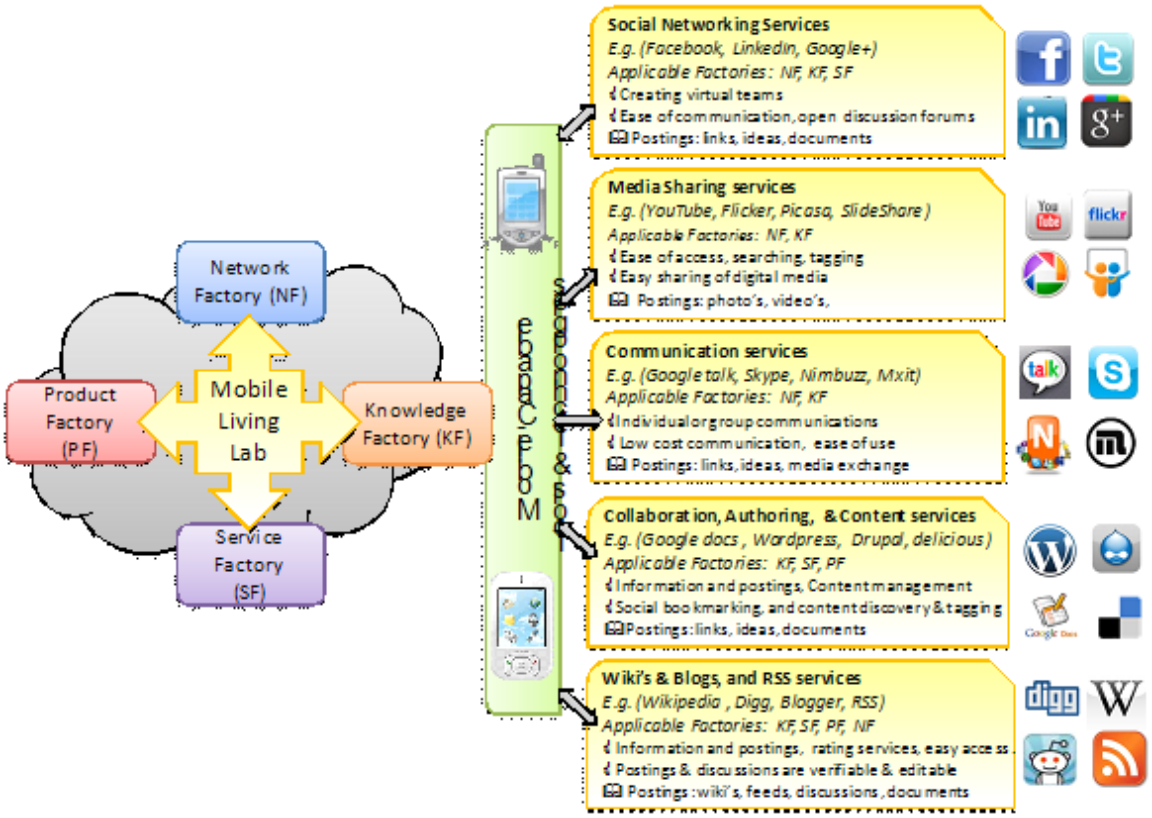

Figure 2: m-LL framework illustrating LL use areas and suggested m-Capable tools

2.3 Living Labs as mechanisms to catalyse innovation and improve the value chain

Innovation and innovation stimulation is one of the key outcomes of following a LL approach. The LLiSA network substantiates this notion by explaining that the LL concept refers to a research and development methodology where innovation such as services, products and application enhancements are created and validated in collaborative, multi-contextual empirical real-world settings. In Living Labs, users or citizens are seen as a source of new innovation, as co-creation or application of ICTs or ICT-enabled services. [5] Our proposed factory framework aim to address and support each of the activities through the grouping of common functions and activities to drive user centric innovation.

The objective and drivers of the innovation process (see Figure 3) is to create and design the different components that we need in the LL, which aim to address the needs of the LL itself as well as that of its' broader community i.e.; 1) Analyse and identify key issues connected to the problem at hand and the role players, create partnerships where needed. A deep understanding of the problem environment and its drivers are required in order to respond quickly to opportunities in the market; 2) Brainstorm all value chains (primary and support activities) connected to the component; 3) Identify suitable strategies to create and design the component; 4) Create and implement the strategies; 5) Evaluate and improve the performance of the component.

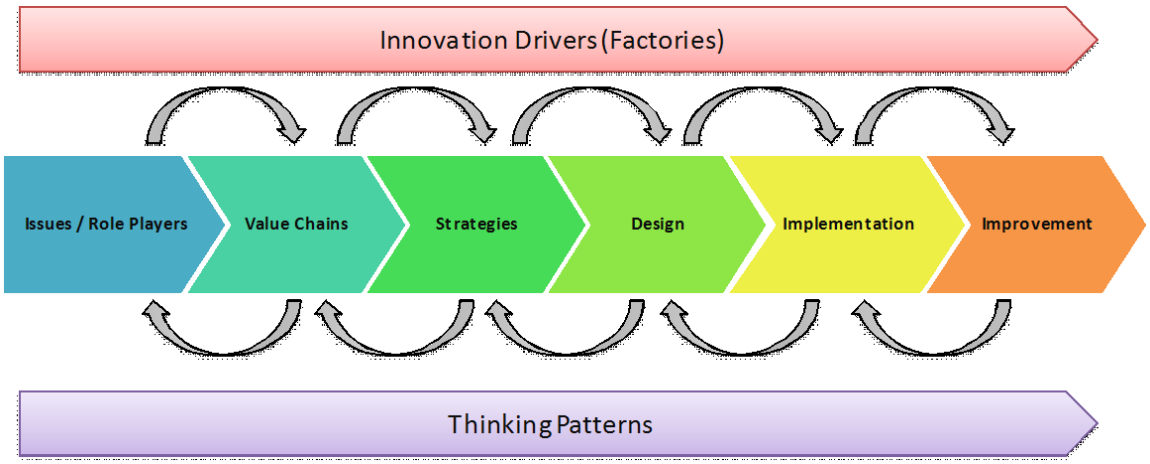

Figure 3: Innovation drivers and value chain optimisation

The innovation process is supported by the application of thinking patterns (system, process, value, critical, analytical, etc), based on simple questions, for example: What? (Governance mechanisms) What? (Value networks) Why? (Objectives) What? (Processing) where?, who?, how? (Enable) etc.

We argue that sub optimisation is one of the main issues causing the problems that many CoP's currently experience. We therefore need to look at big complex systems holistically, constantly asking questions, and for this reason we strongly believe that LL's are ideally suited to address many of these issues.[17]. The application of mobile technologies will greatly enable more citizens to form part of the innovation chain, by allowing for both direct and indirect participation.

3. m-LL enabler technologies

There are currently numerous technologies available for bringing rich content to consumer mobile devices. These technologies allow developers to create applications with rich content, providing the end user with an engaging experience.

Using these tools in a Living Lab environment allows us to create applications that can provide various forms of content to the end user. As an example, consider that we wish to provide information to a consumer regarding how to start small scale farming of corn. We can provide animations, video, audio and textual information to the user at any time and location where there are suitable data services available, wirelessly. Two key factors impacts the m-LL concept directly, i.e. available Mobile platform Operating System (OS) technologies, and development tools aimed at providing users with the opportunity to develop and deploy mobile applications. The subsequent section will briefly look at these concepts.

3.1 Mobile OS: Windows Phone 7, Android and iOS

Recently mobile OS's have advanced to the point where they natively support rich content as a standard feature of the OS. The Windows Phone 7 OS utilizes a scaled down version of the Microsoft Silverlight platform that allows for the easy creation of rich-content applications with touch interfaces. Similarly, the Android and iOS variant allows us to create rich-content based applications that are designed to run on those platforms.

Applications on these platforms allow the mashing of many services like location based (maps, GPS and aGPS), search functionality and media (video and images) in a single application or even screen. These platforms allow us to create applications that allow a user

to solve problems or find solutions to problems easily without having to use individual applications to perform the same task, at any location and time.

3.2 Mobile Development platforms

There have been significant enhancements towards the release of tools to promote mobile development. Some technologies currently available include Silverlight, Flash Lite, HTML 5, and Embarcadero FireMoney [14],[15]. Other companies or third party developers are creating similar tools, but have not yet achieved the success of these technologies discussed. Figure 4 below provides a brief overview of some available mobile development platforms.

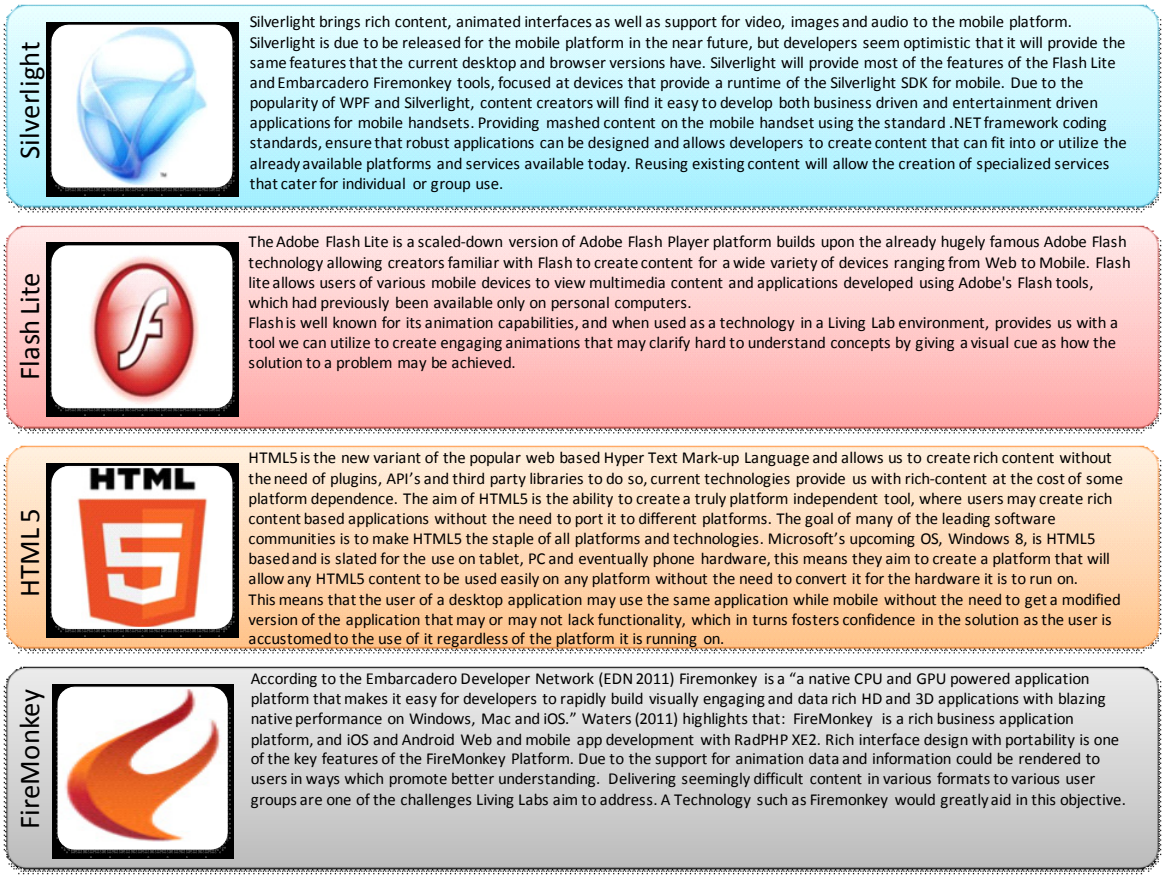

Figure 4: Mobile platform development tools

Looking only at these three technologies provided, among other, by the JavaFX framework, it becomes abundantly clear that this is an extremely suitable platform for creating content that may be used in a Mobile Living Lab environment. We could create a community portal, where individuals may post or search topics of interest by using their cellular phones. Applications used to search our knowledge base may either be custom designed for catering exclusively for the functionality exposed by the portal or more generic in approach such as the built in browser. The user may perform a search and the results may contain combined or mashed results providing the user with animation, video and textual solutions to a problem.

4. Mobile Mashups

In their research paper entitled Context-Aware Mashups for Mobile Devices, Brodt, [13] argues that mobile devices have become powerful enough that context aware mashups may

be created for these platforms. To clarify this point, consider the definition of context aware as explained by the authors: "Context is any information that can be used to characterize the situation of an entity, which is used to adapt the behaviour of a context aware application." [13]. Like existing mashups, we want to combine information and existing services publically available on the Internet in such a way that we can create new products and services for consumers. Mashups gives us the flexibility to easily add new features to custom software solutions, and being able to make an application context aware provides us with many extended uses of existing ideas or mashed applications.

Context aware applications allow us to create more powerful applications in the sense that we do not only retrieve or display information to the end user, but we provide it in a way that is immediately meaningful or useful to the consumer. [13]

Take for instance the use of built in GPS functionality in most of the mobile devices released in 2008 to 2011. This allows us to combine a user's current position, leveraging the GPS capabilities of the device, with an online mapping application that can link the current user position to point of interest close to that area.

Mashups provide us with a mechanism to create custom software solutions, such solutions are key to successful Living Lab experiments, as we need to provide information as dynamic units to the end user. As the result we want the end user to be able to decide what media he or she would prefer to use, while still achieving the goal of providing the service or solution required. Mobile mashups provide the flexibility of mashing web applications and services with the convenience of 'service anywhere, anytime' thrown in. Figure 5 depicts some of the applicable m-LL domains of service delivery enabled with mashups.

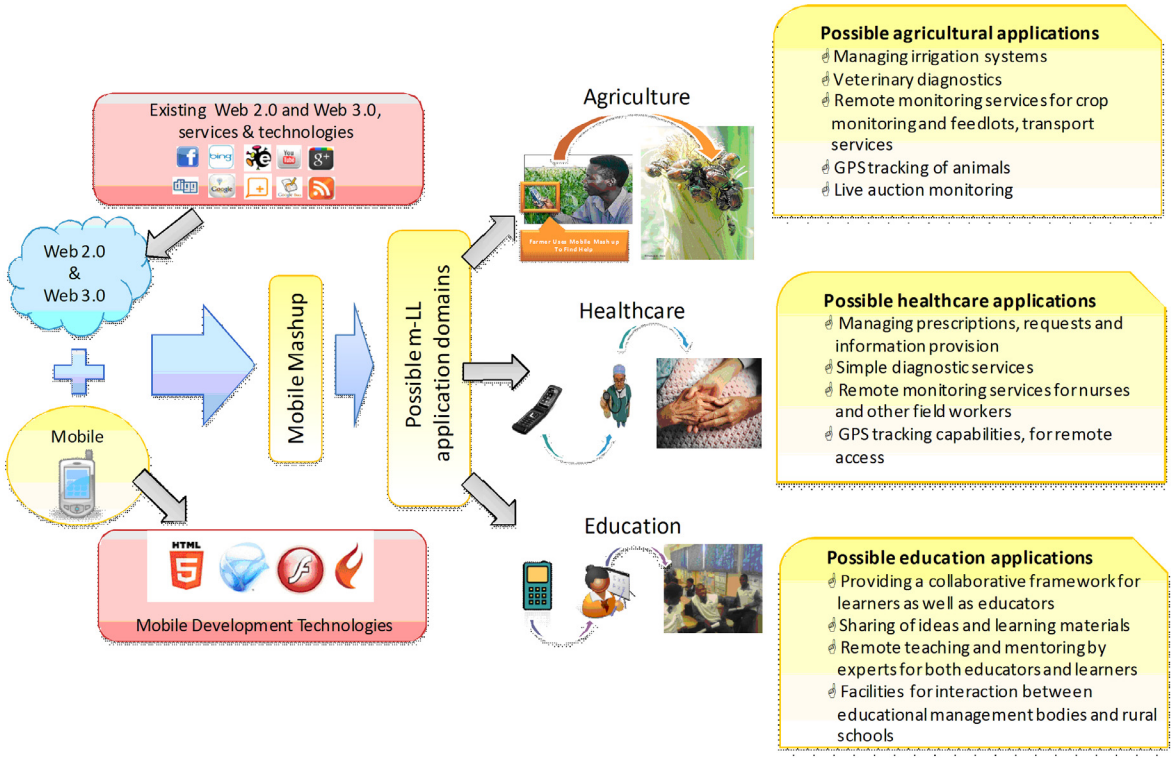

Figure 5: Mobile Mashups and Possible mLL application domains

We argue that mobile mashups are the future of mobile applications and will soon outweigh the frequency of use compared to their desktop variants. Referring back to our earlier statements that larger groups of people own cellular phones, it seems that the mobile market will provide the perfect environment for testing new ideas and services or simply provide access to information that would otherwise be hard to come by. Mobile mashups

should focus on reusing as much of the existing Web 2.0 and Web 3.0 technologies as possible so that new applications can be built upon existing technologies, promoting agile software development practices. It should also expose the consumer to the known and loved technologies they favour whilst providing new and exciting features. In our Living Lab environment we wish to create applications based upon their desktop counterparts that provide the user with a feeling of confidence while using the software. The software developed should still provide all the content in such a way that it is not overwhelming as mobile devices are known for their limit resources and screen real-estate.

The last few years have seen a shift in this law; the devices still have limited resources but are about as powerful as their desktop counterparts were about a year ago. This allows us to run resource intensive and engaging experiencing without the need to sacrifice as much as was required 2 years ago.

Extreme caution should be taken when designing these applications as we do not want to create an application that is distracting to the end user with too much animations and graphical effects. A balance should be struck between subtle effects that provide consumers with a memorable exiting experience without sacrificing the intended functionality of the application. We must find a suitable way of providing the end user with the required information he or she requires to solve a problem. This includes audio, video, images and text, in such a way that it at no time becomes an information overload and still provide the user with all possible choices and links to suitable solutions

5. Conclusion

This paper gave a brief overview of the technologies we can utilize in a Mobile Living Lab, by focussing on mashing existing applications and services allowing us to provide consumers with new value added applications. Relevance within a Living Lab as a representation of a larger environment can act as a test bed for new concepts and technologies as well as services. By using technologies like Silverlight, FireMonkey and Flash Lite we create a platform for designing applications that are multi disciplinary in nature, by this we mean, creating mashed applications that focus on the social and health sector, education and business functions of day-to-day life. Advancements in Mobile Cellular Technology is rapid and as cellular phones are becoming more and more powerful with every new generation of devices released. As these technologies permeate society, the effects are potentially so much more. The distinguishable line between Smart phones and Dumb-phones are blurred and a wider range of end users have access to devices that support a more captivating experiences.

We believe that a substantial amount of focus should be placed on the educational and health care application of mobile technology as a tool in a Mobile Living Labs. Creating applications that fill the needs of consumers and provide a mechanism for solving problems is essential to the research being conducted as well as for the future advancement of m-LL's.

The researchers strongly support the notion that mobile devices will eventually become more used than other mediums of communications like Personal Computers. Mobile phones also grant third world countries with a viable alternative to computers and present the users with access to resources on demand, a true step towards bridging the digital divide.

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