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A LIVING LAB EXPERIMENTATION ENVIRONMENT OF MOBILE APPLICATIONS

Thesis submitted in partial fulfilment of the requirements for the degree of Master of Science in Technology

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Abstract of the Master's Thesis

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Up to 70-95% of private and public investments in research and development of ICT-based products and services fail to produce market valid value. One major problem observed is that traditional ICT R&D projects are initiated and executed in closed or artificial laboratory environments with too limited and too late interaction with the potential market and its users.

An emerging research concept called the Living Lab tries to address this issue by large-scale, long-term experiments that take place in realistic contexts. A Living Lab project – OtaSizzle in Espoo, Finland – focuses especially on mobile social interaction services. OtaSizzle utilizes a combination of emerging and traditional data collection methods. Prototype services developed in-house enable highly controlled experiments. The goal is to support the emergence of mobile social media by creating a research instrument that can see further and deeper.

This thesis constructs a framework for experimenting new applications in the OtaSizzle environment. The framework covers the whole experimentation from creating awareness to reporting results to stakeholders. Device measurements and questionnaires are the main data collection methods.

Experiments conducted show that the framework is suitable for service experimentation; however, the applied methodology should be extended with methods that provide deeper insight on how users experience a single service. Now the applied methodology is more suitable for understanding holistic usage of mobile services. For analyzing individual services a more direct approach is suggested for future studies.

While limitations and challenges remain, OtaSizzle in general is forming out to be a promising environment for doing scientific research and service studies.

Keywords:	User centric research, Living Lab, data collection, mobile service, service experimentation

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Jopa 70–95% yksityisistä ja julkisista investoinneista informaatio- ja kommunikaatioteknologian tuotekehittelyyn epäonnistuu tuottamaan arvoa markkinoilla. Eräs merkittävä havaittu ongelma on se, että alan tuotekehittelyprojektit aloitetaan ja viedään loppuun keinotekoisissa tutkimusympäristöissä, liian rajoitetulla ja myöhäisellä interaktiolla mahdollisiin markkinoihin ja käyttäjiin.

Uusi tutkimuskonsepti nimeltään Living Lab, niin sanottu elävä laboratorio, pyrkii tarttumaan ongelmaan mahdollistamalla laajan skaalan ja pitkän aikavälin tutkimuksen todenmukaisissa ympäristöissä. Uusi Living Lab–projekti, OtaSizzle, Suomen Espoossa keskittyy erityisesti mobiilin yhteisömedian palveluihin. OtaSizzle hyödyntää yhdistelmää uusia ja perinteisiä tietojenkeruumenetelmiä. Projektin puitteissa kehitellyt palvelut mahdollistavat kontrolloidut tutkimukset. Tavoitteena on tukea mobiilin yhteisömedian kehittymistä luomalla tutkimustyökalu, joka näkee kauemmalle ja syvemmälle.

Tässä diplomityössä rakennetaan viitekehys uusien palveluiden tutkimiseen OtaSizzlessä. Viitekehys kattaa koko palvelututkimuksen kulun tietoisuuden luomisesta tulosten raportointiin sidosryhmille. Laitemittaukset ja kyselyt ovat tärkeimmät tietojenkeruumenetelmät.

Suoritettujen kokeiden perusteella kehitelty viitekehys soveltuu palvelututkimukseen, vaikka onkin suositeltavaa laajentaa metodologiaa menetelmillä, jotka antavat syvemmän näkemyksen siihen kuinka käyttäjät kokevat yksittäiset palvelut. Nykyisellään metodologia soveltuu parhaiten selittämään kaikkien käyttäjän käyttämien palveluiden yhteiskäyttöä. Yksittäisten palveluiden tutkimukseen ehdotetaan jatkotutkimuksissa suoraviivaisempaa lähestymistapaa.

Haasteineen ja rajoituksineenkin OtaSizzlestä on kehittymässä lupaava ympäristö tieteellisen- ja palvelututkimuksen tekoon.

Avainsanat:	Käyttäjäkeskeinen tutkimus, Living Lab, tietojenkeruu, mobiilipalvelu, palvelututkimus

Preface

This Master's Thesis has been written as a partial fulfillment for the Master of Science degree in Helsinki University of Technology. The work has been conducted as a deliverable for the Otasizzle project in the Department of Communications and Networking.

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Abbreviations

2G	Second Generation
3G	Third Generations
API	Application Programming Interface
ARPU	Average Revenue Per User
ASI	Aalto Social Interface
ENoLL	European Network of Living Labs
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communications
GUI	Graphical User Interface
HIIT	Helsinki Institute for Information Technology
ICT	Information and Communication Technology
IP	Internet Protocol
IT	Information Technology
MIT	Massachusetts Institute of Technology
MMS	Multimedia Messaging Service
OS	Operating System
R&D	Research and Development
SME	Small and Medium Enterprises
SMS	Short Message Service
SQL	Structured Query Language
STOF	Service Technology Organisation Finance
TKK	Teknillinen korkeakoulu
UI	User Interface
WAP	Wireless Application Protocol
WEB	WWW – World Wide Web
Wi-Fi	Wireless Fidelity (see WLAN)
WLAN	Wireless Local Area Network

1 Introduction

1.1 Motivation

The usage patterns of Internet users have changed from being passive content consumers to active co-creators of content and services. This is apparent in the success of communities of users around Facebook, Twitter, YouTube, Google Earth, Second Life and Wikipedia or developers around Linux or MySQL, for example. Service providers are beginning to discover the potential of involving users in contributing to richness of content and innovation of services. However, estimated 70-95% of private and public investments in research and development of ICT-based products and services fail to produce market valid value. One major problem observed is that traditional ICT R&D projects are initiated and executed in a closed or artificial laboratory environment with too limited and too late interaction with, the potential market and its users. (CoreLabs, 2007b)

Based on the examples set by successful services there is considerable potential in doing IT services. However, based on statistics there is a high risk of failure. How to create successful services while reducing the risk of failure? One emerging possibility is to experiment services in a *Living Lab* before a full-fledged market launch. Living Labs are relatively new and interesting testing and experimentation environments in which technology is given shape in real life contexts and in which end users are empowered to contribute to the development of a service (Ballon, Pierson & Delaere, 2005).

A new Living Lab project – OtaSizzle – has been established in Otaniemi, Finland to study the technical, social and business phenomena around new mobile applications and Internet services. OtaSizzle will create prototype social media service platforms and study them with extensive field tests, coupled with quantitative analysis measurements and qualitative analysis. The outcome of the experimentation will be a packaged

"SizzleLab" experimentation environment concept. The final goal is that SizzleLab could be made into an easily scalable platform that can be implemented practically at any location.

This thesis is to develop a framework for experimenting new applications in the OtaSizzle context, and collect data on real usage and attitudes of panelists. Of particular interest is the SizzleLab concept which requires rigid planning in order to be properly implemented. It is important to define the interface with SizzleLab and 3rd party service providers who wish to test and experiment their services in SizzleLab.

1.2 Research questions and objectives

The thesis aims to answer the following research questions:

- What is a suitable mode of operations for doing service experimentation in SizzleLab?
- What is a suitable service experimentation framework in Sizzlelab, particularly for providing a feedback loop between users and developers?
- What is the SizzleLab value proposition towards customers (service providers)?
- What is the SizzleLab value proposition towards users?
- How to measure the efficiency of SizzleLab?

The research questions can be answered by achieving the following objectives of the research:

- Understand already existing Living Labs, and their shortcomings and advantages
- Conduct experiments with OtaSizzle panelists, explore data collection methods, and analyze real data
- Establishment and specification of the SizzleLab service experimentation context in OtaSizzle
- Implement it, plan the deliverables (e.g. report), plan the value offering, consider the costs

- Measure efficiency, suggest a future roadmap

Understanding existing Living Labs is important to reach a mutual understanding on what consists a competent Living Lab, what are the necessary requirements for such Living Labs and what are the practices applied in them. Experiments are conducted to research for surveying and data analysis methods that bring most value to clients by effectively involving users in service improvement and innovation. The results of these experiments will support the formalization of SizzleLab. When implementing SizzleLab, particular importance will need to be put on the value proposition for clients wishing to use SizzleLab services. Part of this value proposition will be a report that provides insight on actual service usage and users contribution to improvement of the service. The report will be standardized to the extent possible for easy and effective compilation. Furthermore, in order to make SizzleLab feasible, costs have to be covered somehow, the objective is to apply simple pricing mechanisms in order to avoid unnecessary bureaucracy.

For clarity let it be defined that OtaSizzle is the name of the project that aims to create a Living Lab in Otaniemi Finland and its community, while SizzleLab is the body organizing new services into Living Lab testing and providing feedback on them.

1.3 Scope

The SizzleLab concept is a large work package involving many researchers (Mäntylä, 2009). In the scope of this thesis only a specific area of the concept can be addressed, mainly the interaction between 3rd party service providers and the SizzleLab environment in the case of new service introductions to SizzleLab. This includes the planning of the value proposition, necessary agreements, the process of launching the service through SizzleLab, collection and analysis of data and reporting the results. As SizzleLab is still in an early phase, this interaction can only be studied through experimental cases, and not in a completely established Living Lab environment.

Experiments are conducted in a panel of OtaSizzle users in Otaniemi, Finland. The panels consist mostly of university students of technical disciplines. Panel participants are limited mainly to those with Nokia S60-platform smartphones. Data is collected mainly through a handset based data collection method (see section 2.3.1) and end-user surveys (Verkasalo & Martin, 2009).

1.4 Research methods

A **literature survey** is conducted to form an understanding of the underlying concepts, specifically living labs, mobile business models and data collection and empirical research methods relevant.

A **living labs implementation** will be conducted to experimentally test the framework in development and to provide insight for the requirements of the framework.

Descriptive statistics are used to form the basis of quantitative analysis and to describe the basic features of the data under examination.

Handset based usage measurements and **survey studies** are used to provide data on user behavior and empower users to contribute to service development.

1.5 Structure

Section 2 introduces the key areas of academic study related to the topic. The section starts by introducing the Living Lab concept after which notable Living Lab research is covered and the shortcomings and advantages of existing Living Labs are reviewed. The focus then shifts to mobile business models to better understand the nature of the services under study. Finally relevant user evaluation methods are covered.

Section 3 presents the plan for the SizzleLab framework for experimenting services. The framework covers interacting with clients, planning of the experiment, conducting the

experiment, analysis of data and reporting of results to clients. Section 3 also provides an in-depth look in to the current state of the OtaSizzle project and Living Lab. Furthermore the value proposition for different stakeholders is planned.

Section 4 covers the experiments and related data analysis, results are presented and evaluated, implications and possible improvements to the experimentation framework are discussed.

Section 5 provides a summary of the results of the study, discussion of the pros and cons of the framework are discussed, suggestions for future research are given.

2 Background

In this section background for this thesis is presented. First the concept of Living Lab is presented from different perspectives. Then a short look on mobile services and the industry landscape is provided. Finally this section is concluded by presenting the data collection and evaluation methods used in this thesis.

2.1 Living labs

2.1.1 Definitions

Living Lab is a relatively new concept in supporting user driven information and communications system (ICT) development. The concept of Living Labs started to develop in the late 1990's and one of the first ones to mention it were researchers at the Georgia Institute of Technology, where smart home, office and classroom technologies were investigated in real like laboratory environments. (Markopoulos & Rauterberg, 2000) Similarly an early Living Lab concept originates from MIT, Boston, where it was used by MIT MediaLab and School of Architecture to study technology and design strategies in context in home-like laboratories (Eriksson, Niitamo, & Kulkki, 2005). Since then the concept of Living Labs has evolved so that they are situated in real-world contexts not constructed settings (Ståhlbröst, 2008).

As a new concept with rapid growth, there are currently various definitions for Living Labs. Følstad (2008) offers three categories of Living Labs: (1) Living Labs to experience and experiment with ubiquitous computing. (2) Living Labs as open innovation platforms; and (3) Living Labs exposing testbed applications to users.

Eriksson et al (2005) defines the Living Lab concept as: *an R&D methodology where innovations such as service, products or application enhancements are created and*

validated in collaborative multi-contextual empirical real-world environments. This definition defines Living Labs as a methodology where humans are perceived as collaborative sources of innovation, not merely as objects of R&D.

Ballon et al. (2005), present another definition of Living Labs as: *an experimentation environment in which technology is given shape in real life contexts and in which users are considered co-producers.* This definition views Living Labs as an environment and experimentation is stressed. Note that in both above definitions real-world context and involvement of users as collaborators and co-producers is mentioned.

Yet another definition of Living Labs is given by the CoreLabs project that coordinates the activities towards establishments of co-creative Living Labs as part of the Common European Innovation System. CoreLabs defines Living Labs as: *a system that enables people, users/buyers of services and products, to take active roles as contributors and co-creators in the research, development and innovation process* (CoreLabs, 2007b). This definition views Living Labs from the system perspective. Again the active role of contribution and co-creation is stressed, however here the real-world context is excluded. As this definition offers a system perspective, there needs to be a defined boundary and the interactions between users, services, research and development needs to be considered (Ståhlbröst, 2008).

In her Doctoral Thesis, Ståhlbröst (2008) sums the above definitions of Living Labs by stating that: *the starting point for any Living Lab is to, in close co-operation with involved stakeholders to develop products and services from the basis of what users really want and need, where the role of the Living Lab is to engage and empower users to participate in the creation of valuable and viable assets.* The interaction between users should be carried out in real-world contexts with active users aiming for innovation in close correlation with ongoing research and development processes.

2.1.2 Test and experimentation platform

Ballon et al (2005) examines Living Labs as one among many test and experimentation platforms (TEP). Other TEPs include prototyping platform, testbed, field trial, market pilot and societal pilot. Ballon combines these types of TEPs with a general conceptual framework based on three central characteristics. First, in terms of technological readiness focus goes from mature technologies (market-ready) to more immature ones. Second aspect goes from focus on testing technology to focus on design aspects. The third aspect is the degree of openness ranging from in-house activities to open platforms. These aspects are illustrated in Figure 1.

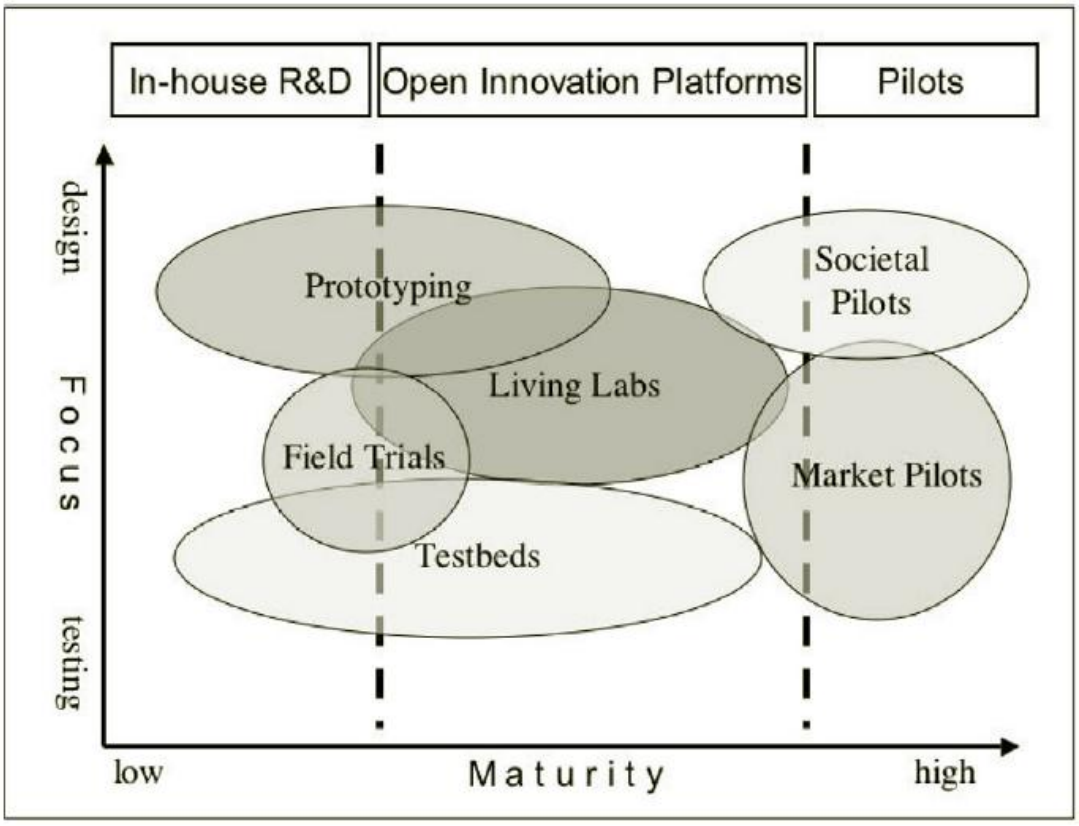

Figure 1 Living Lab in relation to other TEPs (adapted from Ballon et al 2005)

The figure indicates that Living Labs are suitable for products and services that are "semi-mature" in terms of distance to market, and Living Labs answer the industry need for innovation. Focus can be divided on design and technical testing.

Ballon et al (2005) further characterize Living Labs based on a case study of three notable Living Labs. The Living Labs in Ballot's sample were characterized by large scale, vertical scope and medium-to-long term time horizon (See Figure 2). They closely involved end-users in creating value inside Living Labs. Living Labs were found to provide more user-centric and context-specific insights on development and acceptance processes than traditional methods. Furthermore they appear to be able to make innovation processes highly visible and more imbedded in society.

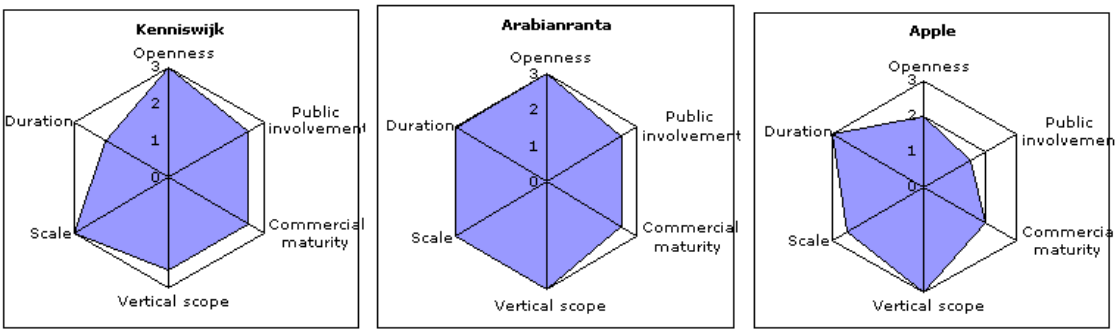

Figure 2 Living Labs in Ballon's case study as characterized by TEP characteristics (adapted from Ballon et al 2005)

2.1.3 Components

Ståhlbröst (2008) discusses the necessary components for a Living Lab environment to reach its general aim, which is to facilitate user involvement in open innovation processes. These components are also observable objects and as such can guide the design of a Living Lab environment which is also in the interests of this thesis.

The key components are users, organization & method, partners, application environment and technology & infrastructure; these are illustrated in Figure 3.

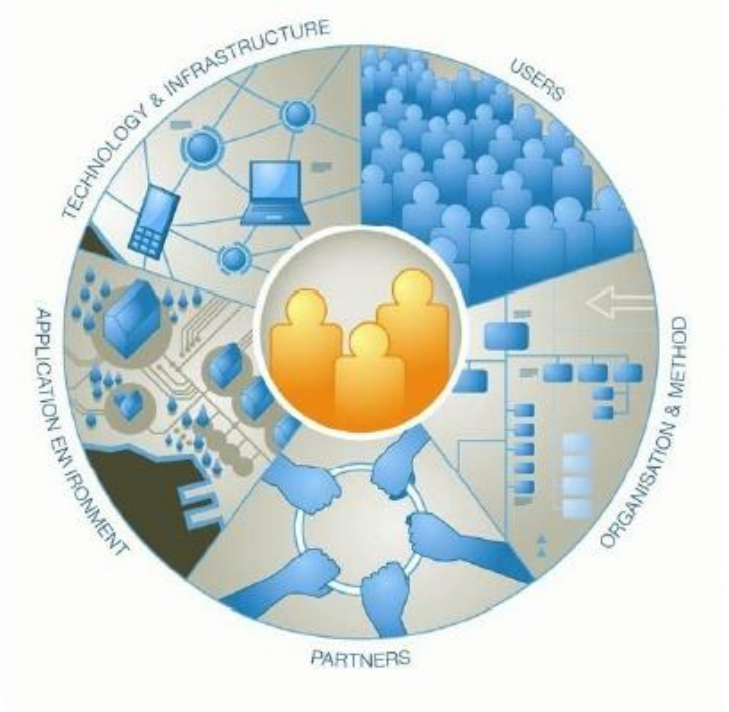

Figure 3 Key components of a Living Lab (adapted from Ståhlbröst 2008)

- *Users:* User involvement is one of the key features of Living Labs. It is generally accepted that usable systems should be designed through an iterative approach with users involved in the process (Mulder, 2004). In practice a Living Lab environment should have a good relation and access to users willing to be involved in systems development processes (Ståhlbröst, 2008).
- *Organization and method:* This component defines how a Living Lab is organized at different levels such as the operational or strategic level. Related issues include exploitation of results, stakeholder involvement, financing, ownership of the Living Lab etc. The methods used in the Living Lab should be planned carefully with the whole organisation in order to: (1) integrate service development in the Living Lab infrastructure, (2) facilitate the co-creation of services and (3) standardize data preparation (CoreLabs, 2007).
- *Partners:* The component of partners emphasizes the need for involving a variety of organisations and individuals to facilitate open innovation. Living Lab operations have a broad scope and require a variety of expertise such as technical, managerial, regulatory and scientific expertise.

- *Application environment:* This is the context where *users* interact and where the real world usage scenarios take place. In practice these are portals where end-users can discover new services and participate in service development. The services and applications users test are also part of the application environment.
- *Technology and infrastructure:* This component defines the basic facilities, services, installations, frameworks and features required for the operation of a Living Lab. The infrastructure depends at least on the environment in which the Living Lab is deployed and the requirements of the Living Lab stakeholders (organizational network). For an example the infrastructure of OtaSizzle is depicted in Figure 10 in section 3.1.1.

To summarize, Living Lab environment should have a good relation with, and access to, users willing to be involved in systems development processes. Any Living Lab should also have access to multi-contextual environments, as well as high-end technology and infrastructure that can support both the processes of user involvement and technology development and tests. Each Living Lab environment also needs organization and methodologies suitable for its specific circumstances. Finally, a Living Lab needs access to a diversity of expertise in terms of different partners, since the scope of Living Lab activities often differ in character. (Ståhlbröst, 2008) (CoreLabs, 2007b).

2.1.4 Principles

Having the right components does not guarantee a Living Lab, equally important are the key principles of the approaches applied in Living Lab activities (Ståhlbrös 2008).

CoreLabs project defines the key principles as follows (CoreLabs, 2007a):

- *Continuity*: This principle is important since good cross-border collaboration, which strengthens creativity and innovation, builds on trust, which takes time to develop.

- *Openness*: The innovation process should be collecting of many perspectives and bringing enough power to achieve rapid progress is important. The open process also makes it possible to support the process of user-driven innovation, including users wherever and whoever they are.

- *Realism*: To generate results that are valid for real markets, it is necessary to facilitate as realistic use situations and behavior as possible. This principle also is relevant since focusing on real users, in real-life situations is what distinguishes Living Labs from other kinds of open cocreation environments.

- *Empowerment of users*: The engagement of users is fundamental in order to bring the innovation process in a desired direction based on human needs and desires. Living Labs efficiency is based on the creative power of user communities; hence, it becomes important to motivate and empower the users to engage in these processes.

- *Spontaneity*: In order to succeed with new innovations, it is important to inspire usage, meet personal desires, and both fit and contribute to societal and social needs. Here, it becomes important to have the ability to detect, aggregate, and analyse spontaneous users' reactions and ideas over time.

These principles have been defined by the European Network of Living Labs (ENoLL). The principles do not offer the "right way to do things", but rather a "vision" based on successes in existing European Living Labs. Ståhlbröst (2008) discusses these principles extensively based on several service experimentations conducted in the Botnia Living Lab during previous years. So far these principles appear to be the best effort to standardize the principles that are considered crucial for Living Labs. In Section 3 these principles will be evaluated in the context of the SizzleLab environment.

A shortcoming in currently published Living Lab research seem to be the lack of results related to the benefits and impact of Living Labs based on facts and data. This is probably in part due to the novelty of the Living Lab concept itself. Setting up the Living Lab research infrastructure is time consuming suggesting that many Living Labs are not yet mature enough to produce these results.

2.1.5 Stakeholders

Many sources stress the importance of having wide co-operation with various stakeholders in Living Lab contexts. Reasons stated include: addressing the full systemic innovation aspects of society by public involvement (Eriksson et al, 2005), building trust, allowing business model experimentation and promoting the formation of clusters (Ballon et al, 2005) and to facilitate a complete cocreation approach (Ståhlbröst, 2008).

The CoreLabs project identified stakeholders important to include or at least consider in Living Lab initiatives (CoreLabs, 2007b):

- *Academia and research organisations*. These are key stakeholders in determining the efficacy of collaborative validation approaches.
- *SMEs*. Small and medium enterprises are considered the chief beneficiaries of the environment of increased innovation and competitiveness fostered through the Living Lab approach.
- *Corporations (device vendors and carriers)*. These stakeholders can have an interest in market trends and business practices that emerge from close collaboration with players in that field.
- *Civic Sector and End Users*, These users will play a critical role in the validation environment that drives innovation
- *ICT professionals*. These stakeholders have an important stake in the technical aspect and requisites for a project of this scope or nature.
- *Public Partners*. Their aim is to drive the development and innovation in a specific region in order to encourage enterprises and industry, and attract specific resident groups

Table 1, illustrates the wide range of stakeholders involved in existing Living Labs (CoreLabs, 2007c)

Table 1 Stakeholders in existing Living Labs (adapted from CoreLabs, 2007c)

Living Labs / Stakeholder	Mobile City Bregenz	Testbed Botnia	Mobile City Bremen	Freeband	Kenniswijk	Cantabria	CASST Centre	Arabianranta	Turku	I2CAT
Public and Civic Communities	X	X	X	X	X	X	X	X	X	X
Public and Regional Authorities	X	X	X	X	X	X	X	X	X	X
Industry	X	X	X	X	X	X	X	X	X	X
SMEs	X	X	X	X	X	X	X	X	X	
Academia	X	X	X	X	X		X	X	X	X
Investors			X		X		X	X	X	
Content Providers	X	X	X	X	X		X	X	X	X

2.1.6 Success factors

Living labs are characterized by the users as innovators approach and their objective is to enable sustainable, collaborative and user-relevant innovation. Based on this the CoreLabs Living Labs roadmap report states that success in Living Lab environments can broadly be measured in terms of four elements (CoreLabs, 2007b):

- *Innovation*: The CoreLabs report presents three measures of innovation in Living Lab contexts: The number of peer-reviewed publications, the number of legally held patents and the number of products that reach market.
- *Collaboration*: As cooperation is a major facilitator for innovation, it is also necessary in Living Lab contexts, especially the maturity of collaboration is stressed to stimulate positive outcomes

- *Multi-Contextuality:* Context is important so that users can contribute, evaluate and be evaluated in a multiple of diverse environments. User participation reaches new levels of multiple and merging contexts.
- *Sustainability:* In order to reach long term success, sustainability is important and can be measured by: durable employment creation, inclusion and equality issues, competitiveness

Ståhlbröst (2008) considers how these success factors are related to the principles of Living Lab approaches (see 2.1.4). She argues that spontaneity is related to innovation, continuity can be related to collaboration, realism can be related to multi-contextuality and empowerment of users and sustainability can be related to each other.

2.1.7 Living Lab projects

CoreLabs Best Practices Report (2007) presents an extensive study into existing Living Labs. Ten European Living Labs were examined regarding how they operate, how they have implemented the "user as a co-creator" approach, what the implemented infrastructure is and what the future perspectives of the Living Labs are. Table 2 presents the Living Labs examined by country. The Living Labs were examined by structured interviews and questionnaires targeted at the administrators of the Living Labs. The key observations include:

- Living labs are very heterogeneous in their composition
- The main focus of the Living Labs is to create innovative services out of Information and Communication technologies
- All of the Living Labs are Public-Private partnerships
- All of the examined Living Labs address more or less the same stakeholders
- All of the examined Living Labs are integrating their stakeholders into the development process of new products and services.
- The ICT infrastructure provided is very heterogeneous.

Table 2 Living Labs examined by CoreLabs report (adapted from CoreLabs, 2007c)

European Living Labs	Country
Mobile City Bregenz	Austria
Testbed Botnia	Sweden
Mobile City Bremen	Germany
Freeband	Netherland
Kenniswijk	Netherland
Cantabria	Spain
CASST	Ireland
Arabianranta	Finland
Turku Archipelago	Finland
I2CAT	Spain

Most Living Labs are service driven, but also technology driven operations exists. Some were both. For most cases Living Labs had regional focus, as opposed to national or international focus. Multiple of ICT infrastructures are in place but especially telecommunication related and mobile technologies (3G, WIFI, WIMAX, Bluetooth, mobile IP etc.) are heavily represented. In Living Labs a highly wide variety of methods and tools are applied to integrate users in to the development process of new products or services, some often applied methods are listed in Table 3. Behavior logging which is under product/service development methods in the table is an important data collecting method in SizzleLab as usage is measured straight from mobile devices.

Table 3 Popular methods to integrate users in development processes at different levels of service maturity (Adapted from CoreLabs, 2007c)

Product/Service Idea methods	Product/Service Concept methods	Product/Service Development methods	Market Launch methods
Interviews (oral, written, telephone)	Conjoint analysis	Workshops with customers	Product testing
Focus groups	Concept tests with lead users	Product testing	Test markets
Empathic design	User design	Prototype tests	Usability tests
Customer suggestions	-	Usability tests	-
Online interviews	-	Behaviour logging	-
Idea generation with lead users	-	-	-

This concludes the literary study of Living Labs. The concepts covered above will be evaluated and applied to the development of the SizzleLab experimentation framework in Section 3. These include the key components of Living Labs and the key principles used in Living Labs.

2.2 Mobile industry

Understanding of mobile services and their business models are important in studying how SizzleLab can best provide value to its stakeholders. As a Living Lab the aim is to improve innovation, development and user cocreation of mobile services. Service innovation is directly related to the business models that support these services (Bouwman, De Vos, & Haaker, 2008). Furthermore it is important to allow business model experimentation in Living Labs (Ballon, Pieter, Pierson, Delaere, & Simon, 2005). To be able to fully experiment and improve services (and thus their business models) in a Living Lab environment, an understanding of the basic elements or components of business models is necessary. The STOF model (Bouwman, De Vos, & Haaker, 2008) presented in 2.2.3 provides a structural model to understanding business models. The strength of the STOF-model is its focus on business models of mobile services.

This section first defines services and business models, after which the STOF-model is introduced. Finally an examination to the mobile services landscape is given.

2.2.1 Services

Before defining services it is good to note that SizzleLab is a "service for researching services". Thus SizzleLab as well as the services inside SizzleLab can be evaluated with similar methods.

Grönroos (2007) defines service as a *"process consisting of more or less intangible activities that normally but not necessarily, take place in interactions between the customer and service employees and/or physical resources or goods and/or systems of*

the service provider, which are provided as solutions to customer problems". Services are at least to some extent produced and consumed at the same time. Customers participate in service creation to some extent, in other words consumers create a service together.

Furthermore there are four basic characteristics of services that are often emphasized when defining services (Grönroos, 1992):

- *Intangibility or non-material:* Services are non-physical and its acquisition does not result in the ownership of any physical products, although it results in a right to receive a service.
- *Inseparability:* Production and consumption of services takes place at the same time, significant parts of the service depend on the interaction between producer and customer and the information that the customer provides. Customer is usually present when the service is taking place, or the interaction is mediated by channels such as the Internet, e-mail or telephony.
- *Heterogeneity:* Service outcomes and processes are hard to standardize. Quality control as with physical products is impossible with services. Setting quality standards however is helpful. The evaluation of the quality of service depends on the customers subjective expectations.
- *Perishability:* The service cannot be transferred or resold. If not utilized the capacity to deliver the service is wasted.

Dahlbom (2005) describes a good service as mobile, always in the background and ready to be activated when needed. In this sense mobile services that this thesis is especially concerned with, are an interesting category of services.

2.2.2 Business models

There are various definitions of business models, quite a simple but descriptive one is given by Osterwald and Pigneur (2002): *"A business model is nothing else than a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners, for creating, marketing and*

delivering this value, relationship capital, in order to generate profitable and robust revenue streams."

Reflecting on the various definitions of business models including the above and taking into account investigating of business model over the years Bouwman et al (2008) propose the following definition: *"A business model is a blueprint for a service to be delivered, describing the service definition, and intended value for the target group, the sources of revenue, and providing an architecture for the service delivery, including a description of the resources required, and the organizational and financial arrangements between the involved business actors, including a description of their roles and the division of costs and revenues over the business actors."* As can be seen from this definition the concept of service is very central to a business model.

2.2.3 The STOF view of business models

The four components or domains of business models shown in Figure 4 are the basis for the STOF-model (short for Service, Technology, Organisation, and Finance). (Bouwman et al, 2008)

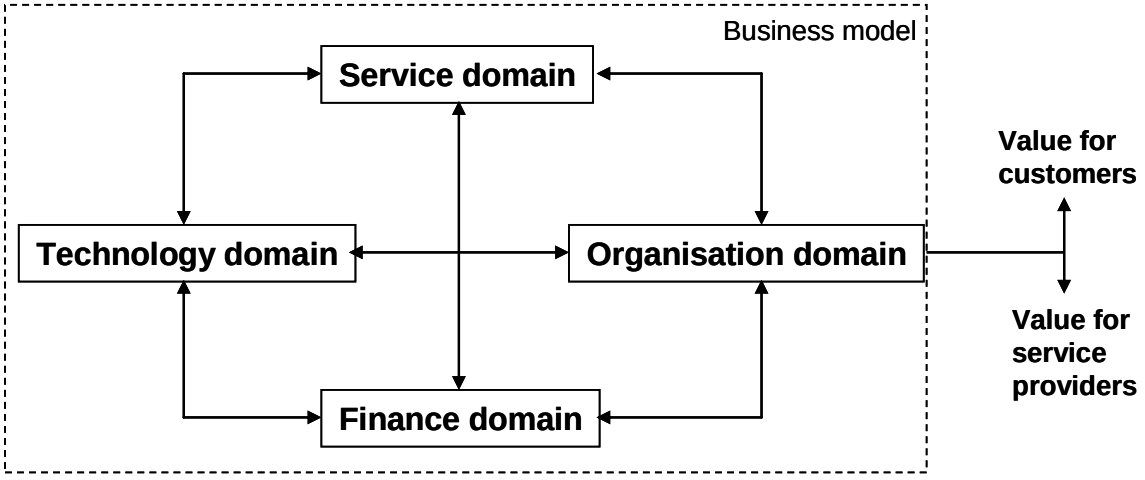

Figure 4 The components of a business model (adapted from Bouwman et al 2008)

The STOF-model attempts to provide a holistic view on business models with these four interrelated domains. The STOF-model gives an extensive overview on what issues should be considered when dealing with business models. Following, some details of STOF-model are presented to facilitate understanding of the services introduced to SizzleLab and to facilitate understanding of SizzleLab as a service.

The service domain describes the service offering, the value proposition and the target group. The technology domain describes the technical functionality required to realize the service offering. The organization domain describes the structure of the multi-actor value network and the organizational arrangements. Finally the finance domain describes how revenues, costs and benefits are generated and divided over partners.

Service domain

The service domain is the starting point for the approach. There are generic issues for any services such as customer value, but there are also specific issues when the service domain is specified as the mobile domain.

Customer value and innovation are very central concepts and are also in the core of interests in SizzleLab. Customer value can be seen as a new, innovative offer to a customer, it is seen as a part of an equation in which customers in target markets compare the benefits and total costs of ownership of a product or service. The value proposition of a firm must be recognized as being better and as delivering the desired satisfaction of human needs and wants more effectively and efficiently than competitors do Value can be divided in four sub groups (Bouwman, De Vos, & Haaker, 2008):

- *Intended value,* is the value a provider intends to offer to a customer or end-users of the service.
- *Delivered value,* is the value actually delivered to customers and end-users of a service.
- *Expected value* is the value a customer or end-user expects from the service, based on their experience with previous versions of the service or in case of a new service with similar services.

- *Perceived value* is the value end-users actually perceive (in relation to expectations) when they consume or use the service. This is what eventually determines the value of a service, as it is the customer who values the service.

Other core concepts of the service domain include the context in which the service is consumed, the price (tariff) and effort needed to use the service, possible bundling of services. See Bouwman et al (2008) for more details.

Technology domain

Requirements defined in the service domain, specify the technical architecture, which is part of the technology domain. In the technical architecture middleware, including web services play an important role, in addition to network and infrastructure characteristics. There are various choices in ways to embed business processes in IT-functionalities.

Some generic technical issues that have to be developed in any service and application that run over a network are authentication of users, management of user profiles, and security.

Different technological design variables deliver the technological functionality of a service; this functionality in turn affects the *delivered value*. Some important technological design variables are: the technical architecture, applications, devices, service platforms, access networks and data. (Bouwman, De Vos, & Haaker, 2008)

Organisation domain

A core concept in the organisation domain is the value network. It consists of actors with certain resources and capabilities, which interact and together perform value activities, to create value for customers and to realize their own strategies and goals. It is assumed that any service needs inputs from many actors (organizations) such as suppliers and distributors in order to be realized, thus service creation is always a collaborative effort.

Relevant topics in the organisation domain are: actors, the value network, interactions and relations, strategies and goals, organizational arrangements, value activities and

resources and capabilities. Organizational arrangements and value activities most directly affect delivered value. (Bouwman, De Vos, & Haaker, 2008)

Finance domain

Finance domain describes the financial arrangements between the various actors in the value network. It shows how the value network intends to capture monetary value. For a business model to be viable, the division and sharing of benefits and costs should be balanced to create a win-win situation for the involved partners. The structure of the value network has a strong influence on the financial variables.

Relevant topics in the finance domain are, investment sources, cost sources, performance indicators, revenue sources, risk sources, pricing and financial arrangements. Finance domain is affected by value activities and technical domain requirements and the above topics in large part determine the pricing in the service domain.

Based on the analysis of the STOF domains and specific issues on the domains it is possible to analyze and design business models. However business model design ought to be dynamic in nature and change over time. Thus an iterative approach should be adapted when designing business models (Bouwman, De Vos, & Haaker, 2008).

2.2.4 Industry structure

The rather complex mobile Internet industry has lately been strongly converging with the fixed Internet industry. Companies formerly active in these separate industries are entering the same markets. Soininen (2005) presents a model of the mobile internet industry that describes the relationships between different players in the industry. The model illustrated in Figure 5, consists of six main elements of: 1) end-users, 2) networks, 3) devices, 4) operating systems, 5) content, services and applications and 6) support services and regulation. Competition occurs inside each circle as well as between circles.

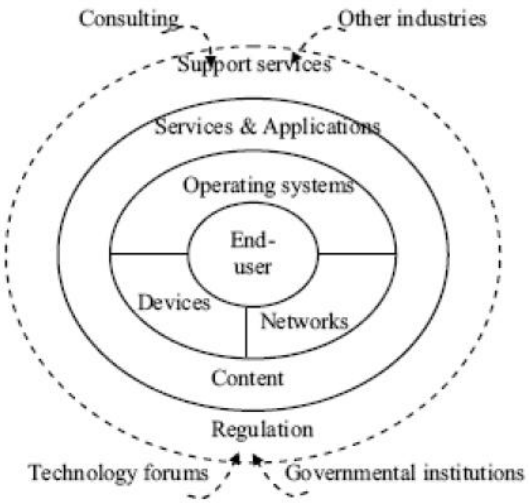

Figure 5 Elements of the mobile Internet industry (adapted from Soininen, 2005)

The following review concentrates on mobile services, but it is useful to remember that the evolution of other elements of the industry and its complex value networks have a significant effect on services. For example changes in end-user behavior or capabilities of devices will probably impact the nature of services.

Mobile services allow users to consume the service anytime, anywhere, thus there is a distinct value in mobility. Furthermore mobile devices are one of the few objects along with keys and wallet that people carry with them at most times. Bouwman et al (2008) describe how this symbiotic relationship makes it possible to identify users and collect data about their demographics, handset type and typical behavior, which can then be used to personalize service experiences and strengthen this symbiotic relationship. This also means that issues of privacy and security become even more important for mobile services than they are for other electronic services.

Apart from static information, real-time context related information can make mobile services more useful and relevant. Context information could be information about location, time of the day, temperature, tasks in the user's agenda and social contacts etc. With regards to context related information also, user's privacy and security is of high importance.

Mobility also comes with considerable challenges for service developers. Network data rates are often lower than with fixed networks, costs per packet are higher, handheld devices often possess less processing power, less available memory and limited battery power. Further problems include small screens and keyboards, many different types of handsets, operating systems and micro-browsers. These issues are also related to the poor usability of mobile services (Kangas & Kinnunen, 2005).

From an organizational point of view there is a high level of dependency between actors compared to the fixed Internet world. While Internet Service Providers typically merely provide connectivity, cellular network operators tend to control access to the customer and billing services and impose rules on the content providers when offering services in their networks.

Although a large variety of services are available in the marketplace (see Figure 6 for a categorization), there is little wide adoption of newer services. In fact the Finnish Communications Regulatory Authority (FICORA) states in a report that markets have been stagnant and despite efforts to develop new services, users are only interested in voice communications and SMS (FICORA, 2007). These rather old innovations continue to be the most popular services (Verkasalo, 2008) (Bouwman et al, 2007). Recently hyped services such as mobile-TV, Instant Messaging or Nokia's N-gage gaming platform have not faced considerable success (Helsingin Sanomat, 2008). FICORA also states that services should be increasingly consumer driven, in order to better meet consumer needs.

Many users possess Internet enabled handsets but not nearly all users use handsets for browsing. However gradual increase in the usage of mobile data services is taking place (FICORA, 2008).

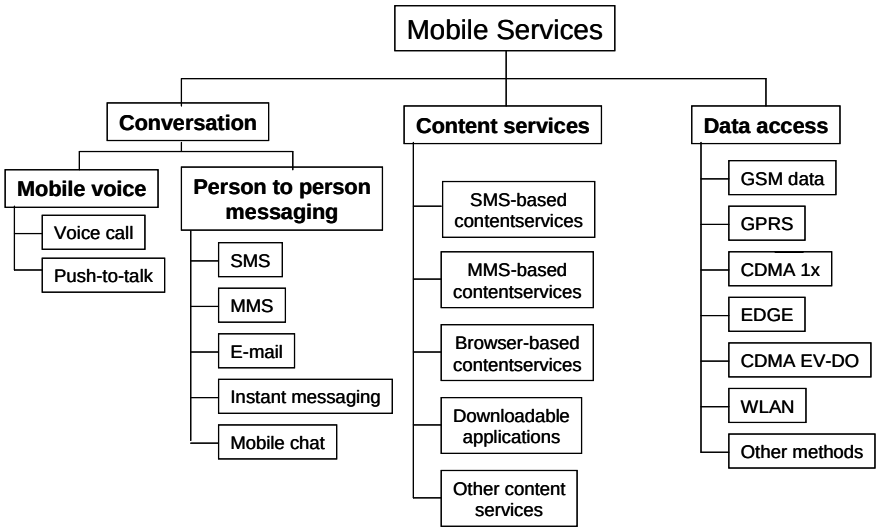

Figure 6 Mobile service categories (adapted from Vesa 2005)

As the lack of success of new mobile services seem to span (among others) from a lack of innovation and not meeting users needs, a Living Lab environment, if implemented properly could provide a substantial benefit for service developers in understanding users needs better and enable users to cocreate services and improve innovation with developers. Furthermore Living Labs provide a chance to test innovative business models in a low-risk environment. This is especially beneficial in the turbulent and complex mobile services ecosystem where it has been difficult for service providers to succeed.

2.3 Research tools

Evaluating the usage of services introduced to a Living Lab is one of the most important tasks performed in a Living Lab. Evaluation of usage is connected to the principles of *empowering users* and *realism*, which are two of the five principles of Living Labs (see 2.1.4). Evaluation techniques such as questionnaires and interviews are essential in empowering users to affect and take part in development of services. Objective handset based measurements are important in facilitating measurement of actual usage of mobile services. It is good to keep in mind that there is no such thing as a perfect evaluation design (Preece, Rogers, & Sharp, 2002). Thus there is no immediate way to tell what strategy or combination of evaluation methods will provide the most useful answers.

Each case has its own specific characteristics, imposing requirements for the used methods.

Handset-based logging combined with questionnaires has so far been the main data collection method in SizzleLab. (Tirkkonen, 2008). This basic framework can be extended with data collected from interviews, networks and servers (Verkasalo & Martin, 2009). Figure 7 illustrates this holistic methodology. In the figure: (1) behavior is measured with the in-device application (2) contextual feedback is collected straight from the devices by utilizing questionnaires after usage sessions (3) background surveys are conducted over the web (4) interviews can be used with a sub-sample of participants to acquire detailed data on user-experiences (5) various data of the whole subscriber base can be collected from networks (see Kivi, 2007) and (6) servers can provide very detailed application level data that in-device measurements can not provide. More details on each method in the following section.

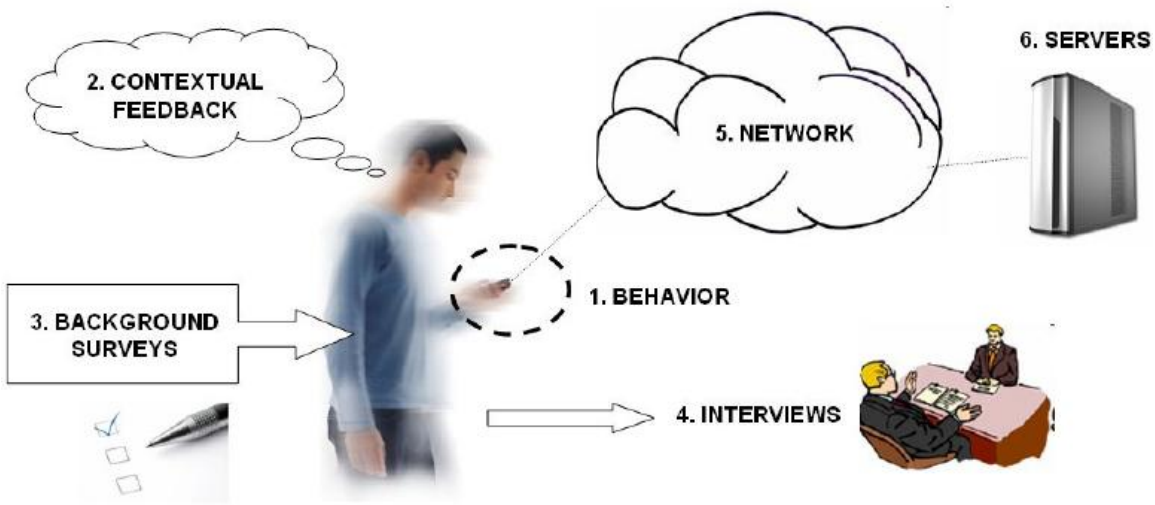

Figure 7 SizzleLab measurement framework (adapted from Verkasalo & Martin, 2009)

2.3.1 Handset-based measurement of usage

The handset-based logging method in use in the OtaSizzle-project is presented in Verkasalo and Hämmäinen (2007). The method is structured around a software client that

can be installed on a Nokia Symbian S60 handset. The client logs various data such as application usage, data session details and context (time and location) of use. Users volunteer in installing the software to their handsets and participating in a research panel.

Verkasalo (2006) argues that monitoring usage with the handset based method can overcome the problem with mobile users' perceptions not being in line with their actual usage. Furthermore, with the handset based method data can be collected on a wide range of relevant smartphone functions with high accuracy. Ståhlbröst (2006) discusses how observing mobile service usage has not been possible in their Living Lab context due to real mobile service usage happening in diverse locations. Thus by supporting measurements of usage data SizzleLab can provide value that this previous Living Lab environment has not been able to provide.

Weakness with this method is related to the sample population. Panel participants are required to be 18 years old due to legal restrictions; furthermore they must own a Nokia smartphone that runs the S60 software platform and be capable of installing the usage monitoring software in their phones. Further weaknesses include not being able to see how usage occurs *inside* a single service (see server logs below) and not being able to understand how users experience a service. The data acquisition process is also rather complicated.

2.3.2 Questionnaires

Questionnaires are one of the most popular methods of studying service usage. Questionnaires are cheaper and less time consuming than interviews, they can easily be distributed to a large area. Respondents have confidence in their anonymity and can thereby express their opinions. Standardization makes questionnaires relatively free from various errors. Disadvantages include the challenge of getting a random sample of informants since they are self-selected. They are not suitable for studying complex social phenomena (central in OtaSizzle) as surveys do not give a full sense of social processes (CoreLabs, 2006). They also lack the depth of interviews (Ståhlbröst, 2006).

Questionnaires are suitable in complementing data from handset measurements. Surveys can provide knowledge about issues that are not directly measurable. End-user satisfaction and opinion levels are often measured with surveys, thus making it an essential tool in the context of prototype service testing environment such as SizzleLab. Other common uses of questionnaires are to collect data on demographics, and establish quick facts and patterns within a certain context.

Kuniavsky (2003) grouped questions related to web services into to the three major categories of characteristic, behavioral and attitudinal. Characteristic questions describe who someone is and what their environment is like. Behaviour questions describe how someone behaves and attitudinal questions inquire into what people want and believe.

In SizzleLab questionnaires can be administered through a web portal where they can also be created and managed. Furthermore contextual questionnaires can be deployed by utilizing the in-device measurement application. These can be deployed after a usage session and are valuable as the interaction takes place when the experience is fresh in mind.

2.3.3 Interviews

Interviewing is a method for data collection that can be used as a means to get feedback from users. Interviews can be conducted face-to-face or over the phone. Interviews can have differing levels of formalization; they can be structured, semi-structured or unstructured, standardized or not standardized. In structured interviews users get different alternative answers they can choose among and in this sense structured interviews resemble close-ended questionnaires. In unstructured interviews users can express their views freely (Fontana & Frey, 1994). The approach should be chosen based on the objective of research. A less structured interview provides more in-depth insights and more interactivity (Ståhlbröst, 2006) (Verkasalo & Martin, 2009).

There are a lot of advantages in using interviews for data collection. Advantages are that they can be conducted with all kinds of people; they give flexible possibilities for follow-up questions and answers to questions about motives and feelings the user might have. Setbacks of interviews include expenses in carrying them out, time required to carry them out and risk of bias in the material. (Verkasalo & Martin, 2009) (Ståhlbröst, 2006).

Interviews can be a valuable tool in SizzleLab as one of the goals is to empower users to improve services. Interviews give access to users desires and suggestions better than other methods described here. Some novel methodology in interviewing has been experimented in OtaSizzle. In this setup unstructured interviews were recorded and the records were distributed to all other interviewees. This presented the interviewees with alternative angles to the research questions. After the interviews each participant was asked to write a brief summary of their interview and main conclusions. (see Verkasalo & Martin (2009) for a more detailed description of the setup).

2.3.4 Server logs

In case of services that utilize servers (such as OtaSizzle prototype web-service Ossi) server side measurements can give highly accurate data that delve deep in to the behavior of the user. For example usage patterns and even single clicks can be observed.

Server logging typically produces very large datasets. The large size of datasets calls for some research goals and problems to guide the data analysis. Kuniavsky (2003) lists four different types of analysis that can guide in formulation of questions: (1) aggregate measurement, (2) session-based statistics, (3) user-based statistics and (4) path analysis. *Aggregate measurements* concern large amounts of data and give answers to questions such as the "total number of pages viewed in a given period" or "user's operating system and browser proportions". *Session-based statistics* include statistics such as "number of pages per session" and "average duration of session". *User-based statistics* give further information on individual (aggregated) user behavior, "number of visits" and "total time spent on site" fall into this category. Finally *path analysis* is concerned with the "typical

path through the site" or "proportion of pages that are the successor of a given page" (next pages statistic). For examples of server log analysis, see: Kamvar & Baluja (2006).

Analyzing mobile services with servers pose some problems, as many of the common methods used for data collection either do not work or are unreliable. JavaScript tagging, used by services such as Google Analytics, does not work in over 80% of internet capable mobile devices (Atomiclabs, 2009). Also HTTP cookies which are an indispensible tool in the traditional internet are not supported by most mobile devices. The OtaSizzle data collection server is to be designed so that meaningful data can be extracted despite the above limitations.

A disadvantage with server side measurements is that access to the server should be achieved and potential legal problems with regards to end-user privacy should be solved in advance.

The disadvantages regarding privacy and access to server do not affect OtaSizzle prototype services *Ossi* and *Kassi* (see section 3). Server data is freely available for researchers and users sign an agreement acknowledging that server data will be used for research. Thus in OtaSizzle server side data can be used to study detailed usage patterns and formation of social networks. The technical infrastructure of OtaSizzle has been designed so that server logs provide data that is comparable between services to some extent (example: friend connections existing in one service can automatically be imported to a new service). A setback is that during the writing of this thesis, the server data collection is in an experimental phase and not readily available for researchers.

2.3.5 Traffic measurements

Traffic measurements are another method recently used in studying mobile usage (Kivi, 2007). They provide less granular data than the other described methods but can be based on the entire subscriber base. Traffic measurements take place in network gateways that are typically managed by wireless network operators. Advantages of the method are

access to a very wide user base and good possibilities for data mining automation. Difficulties include the divergence of mobile access networks (2G/3G/WLAN/others) and lack of possibilities to study services that do not require network connectivity (games, maps, offline multimedia).

Traffic measurements do not appear feasible in the SizzleLab context. SizzleLab experiments are highly focused and traffic measurements are not suitable for studying individual users or small groups of users with accuracy. Also they are not a feasible method for studying single services or applications.

2.3.6 Method comparison

A range of methods for collecting information on service usage has been presented; each method has its advantages and disadvantages. Research objectives should determine what method(s) to use. In summary, questionnaires, interviews and handset monitoring provide different but detailed data. Server side measurements provide data on detailed usage patterns of a focused user population. Traffic measurements provide less granular data but can be based on a very large sample. Traffic measurements were determined unsuitable for SizzleLab experiments.

Verkasalo (2009) and Kivi (2007) compare the different measurement methods with focus on mobile usage measurement. In the comparison they use a variety of criteria such as:

- *Subjectivity:* The extent to which end-users or researchers can affect the data based on their own interpretations.
- *Detail of accuracy:* Reflects the amount, detail and type of data collected.
- *Type of data:* i.e. is the data quantitative or qualitative, research objectives set requirements for the type of data.
- *Target services:* The type of services it is feasible to study with the particular method (i.e. all services or only the services that the user is aware of)

- *Reach and scalability:* refer to the type of end-users studied. Good reach and scalability means a sample representative of the target population can be collected and that there are small barriers to collect large amounts of data.

There is also a variety of other criteria, see Verkasalo (2009) and Kivi (2007) for more in-depth comparisons. Table 4 below compares the different methods based on the above criteria.

Table 4 Comparison of end-user research methods (modified from Verkasalo, 2009)

Method / Criteria	In-device measurements	Questionnaires	Interviews	Server measurements	Traffic measurements
Subjectivity	Low	High	High	Low	Low
Detail of accuracy	Very Good	Poor	Poor	Very good	Very good
Type of data	Qualitative + quantitative	Qualitative	Qualitative	Quantitative	Quantitative
Target services	Any mobile services	Services that the user is aware of	Services that the user is aware of	Any services using network servers	Any services utilizing the network
Reach & Scalability	Moderate	Moderate	Poor	Good	Good
Pros	Wide scope of research questions, objectivity	Cost-efficient, good coverage	Flexible, interactive	Good coverage, detail, data mining automation	Good coverage, data mining automation
Cons	Early-adopter bias	Inflexible, rigid	Costly and slow	Only client-server services included	Access to network gateways needed, not suitable for focused studies
Main uses in SizzleLab	Service adoption, usage patterns, "the big picture"	Background variables, intentions, feedback	End-user experience studies	Detailed single service usage patterns	N/A

Depending on the requirements and interests of 3rd party service providers, evaluation methods apart from those above can be applied or at least considered in SizzleLab. Some other commonly used methods in Living Lab context were presented in Table 3 (section 2.1.7). These include: focus groups, idea generation with lead users, usability tests,

workshops and product testing. Whether or not to apply these methods in SizzleLab should be evaluated after getting feedback from service developers on data provided by early service experiments.

2.3.7 Descriptive statistics

Descriptive statistics are used to describe the basic features of the data collected. Key findings can be presented through descriptive statistics. Together with simple visualizations they form the basis of almost any quantitative analysis of data. Various techniques that are commonly used (Sternstein, 1996):

- Graphical displays of data in which charts summarize the data or facilitate comparisons
- Tabular descriptions in which tables summarize the data
- Summary statistics (e.g. averages) that summarize the data

In the case of mobile service usage data some commonly used descriptive statistics include share of applications used, adoption of usage, usage per time of day/week and comparing actual service usage with intention etc (See e.g. Verkasalo 2008).

In SizzleLab experimentations and this thesis descriptive statistics are used to summarize demographics and features of the dataset, but also especially used to discover how services relate to other services in terms of popularity, adoption, time context of usage etc.

3 SizzleLab Framework

This section builds on the knowledge collected and reviewed in section 2. The section starts with an overview of OtaSizzle (SizzleLab). Then the value proposition for clients who wish to participate in SizzleLab is planned, after which the service experimentation framework is proposed.

3.1 OtaSizzle

3.1.1 Context

As mentioned in the introduction, OtaSizzle is a Living Lab project established in the Otaniemi campus of Helsinki University of Technology (Name changes to Aalto University in year 2009). The project will develop an open experimentation environment for testing mobile services. The result of the project will be the SizzleLab function. It will be a "packaged" experimentation environment that can be applied in other environments where there are incentives to study social media services. (Mäntylä, 2009)

During the writing of this thesis OtaSizzle is in development phase and is creating prototype services and preparing to study them with extensive field tests coupled with qualitative and quantitative analysis. At this phase external service providers are not actively contacted for participation, but can be included for purposes of refining the SizzleLab concept. Examples include Nokia's Sports Tracker and ILPO-location tracking service.

Apart from helping service providers to experiment their services, research is one of the main interests in OtaSizzle. Following are some core research topics OtaSizzle aims to research (Mäntylä, 2009):

- The impact of social networks for service diffusion and on user experience and social impact of services in general.

- The role of user innovations and emergent everyday practices in adapting services for novel and unforeseen uses.
- Incentives of various stakeholders in service provision and in general the digital service economy and local service ecosystems.
- Privacy and trust of mobile social media services and security issues in general
- Scalability issues of the technical service platform, especially emergent bottlenecks

The above are some possible research topics, however the attitude to research in OtaSizzle is rather data oriented. The consensus seems to be that since OtaSizzle will provide very large datasets, the data will guide the formation of research topics.

During the writing of this thesis OtaSizzle is preparing for its first public launch. The goal is to launch OtaSizzle prototype services Ossi and Kassi in autumn 2009 for the students of the new Aalto University in Finland. Ossi is a social networking service similar to Facebook aimed mainly for Aalto university students. Ossi is especially designed for mobile web browsers (see Figure 8). Kassi is a traditional web service for exchanging goods and services. The goal is to integrate these services to university student life and reach a variety of groups or social networks within the campus.

Figure 8 Ossi mobile social interaction service running on a Nokia N95 handset

Figure 9 shows a technical overview of OtaSizzle during the writing of this thesis.

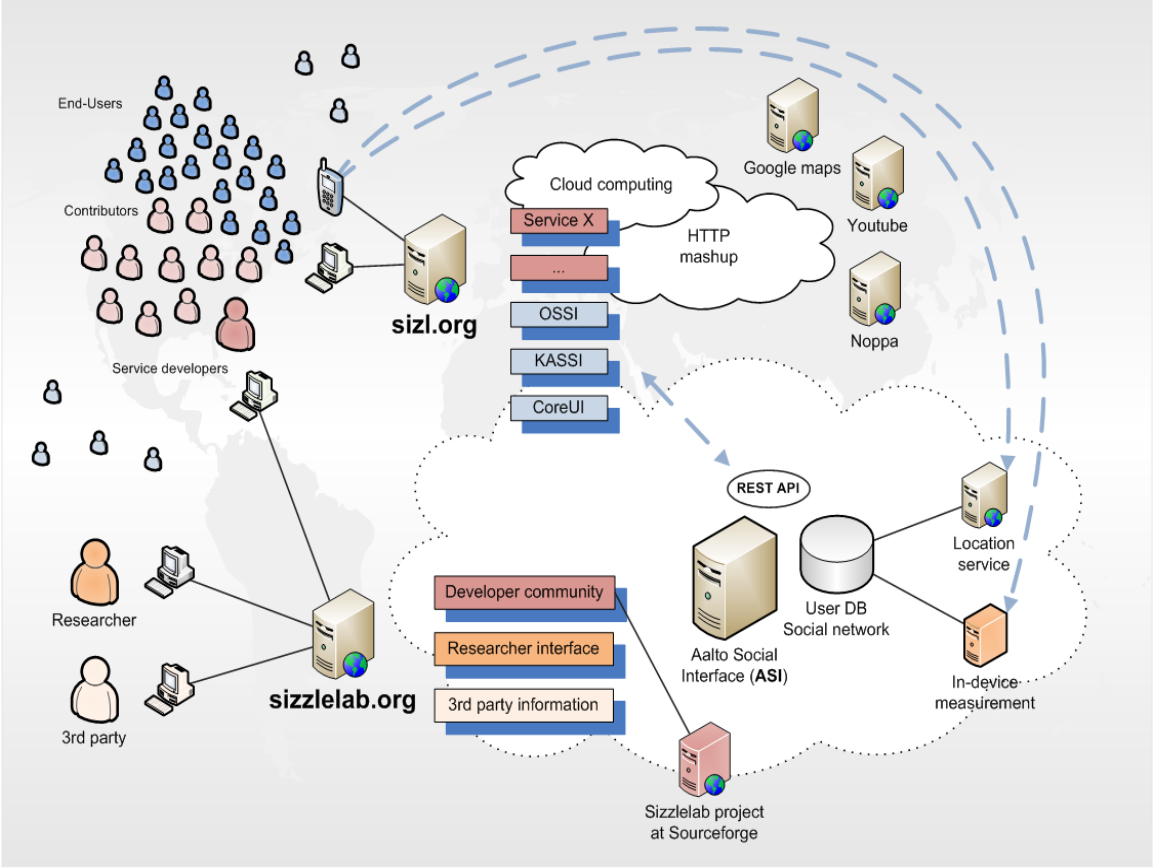

Figure 9 OtaSizzle Architecture during preparation for autumn 2009 experiment (OtaSizzle, 2009)

The left part of the figure shows the users of OtaSizzle services: end-users, contributors, researchers and 3rd party service stakeholders. End-users can simultaneously be a contributor suggesting the Living Lab principle of involving users in the improvement of services. Thus an active end-user can develop new functionally to OtaSizzle open source services. Users discover newly introduced services through the end user portal (sizl.org). Currently the services available are Ossi and Kassi. In the future a wider portfolio of services will be available for experimentation. Researchers and 3rd party participants have their own SizzleLab portal (sizzlelab.org) which is more oriented to the needs of research and 3rd parties.

The web-portals will evolve to be platforms where different stakeholders can share information and collaborate. Developers can search for documentation to aid in service development. End-users can discover new interesting services, share their ideas and communicate. External service providers can participate in OtaSizzle through the portal and communicate their needs to researchers. Researchers can access service data. Ideally the portals would act as "sizzling" virtual collaboration spaces of the stakeholders.

Also shown in Figure 9 is the "core" of OtaSizzle, including the components of Ressi, ASI (Aalto Social Interface) and Sassi. Explaining their purpose is best done with the help of Figure 10, below, that presents the logical structure of OtaSizzle.

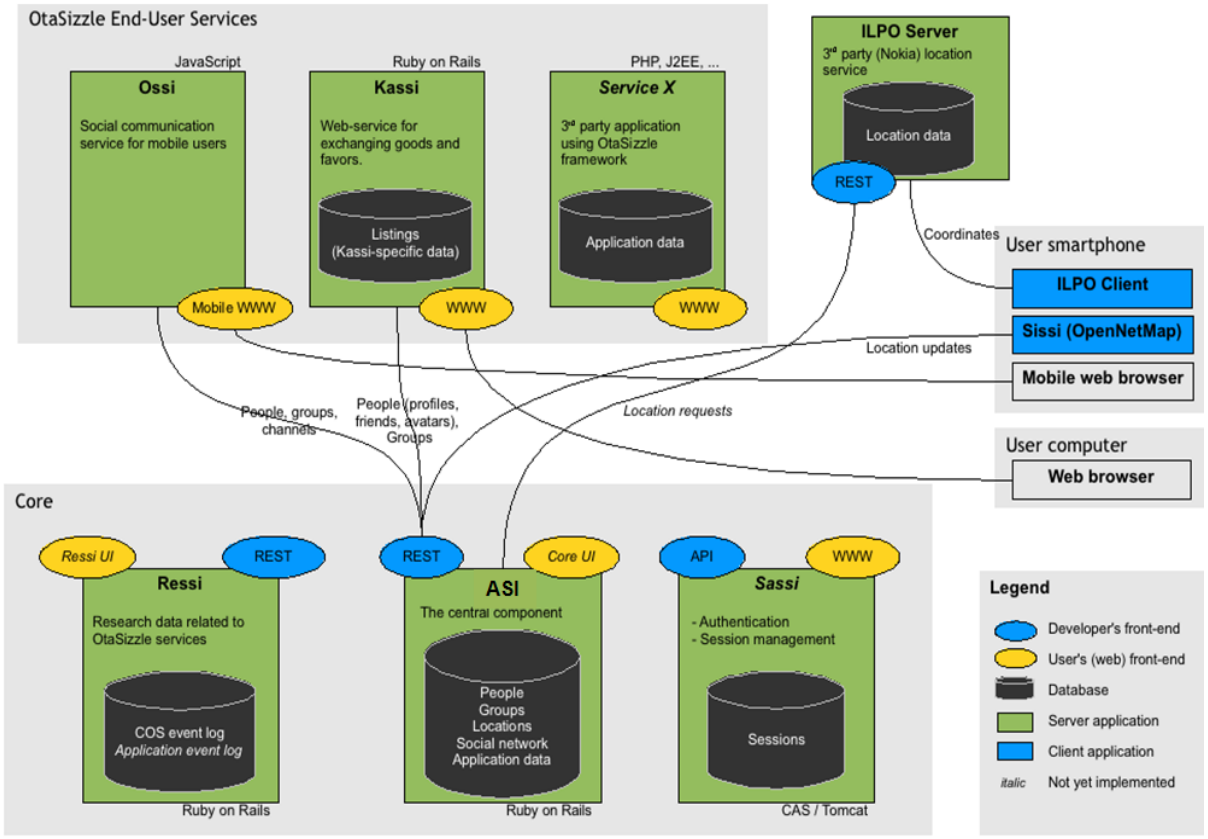

Figure 10 Logical structure of OtaSizzle network

The top part of the figure shows the services experimented in OtaSizzle; these services operate on a mobile device or PC over a network. The services are connected to the

OtaSizzle “core” in the bottom part of the figure. The “core” includes Aalto Social Interface (ASI), Ressi research database and Sassi authentication service.

ASI provides generic services for OtaSizzle participants, it holds user information, information about groups and social networks and application data. It works as a database for various service related information. For an example Ossi and Kassi both use the same account information from ASI and a friend connection made in Ossi can automatically appear in Kassi. ASI is especially provided for services developed in OtaSizzle, but can probably be used in some scale to support external services also (e.g. authentication).

Ressi is a database for research data and is especially interesting in the context of this thesis. Relevant data collected through OtaSizzle data collection methods (introduced in Section 2.3) will be aggregated in Ressi for researcher access. The future goal is that most of the raw service data from all the important data measurement points of mobile devices, servers and questionnaires of each service is available in Ressi for download and analysis.

Sassi provides the authentication for OtaSizzle services. All OtaSizzle services can be accessed with a single user-id. Sassi also manages usage sessions.

Finally OtaSizzle aims to provide location based services for mobile devices. Location service can be provided by Nokia ILPO service or the SISSI service developed in OtaSizzle. ILPO data is in Nokia 3rd party servers, while SISSI data is in ASI. These services can track user’s location data and display it for example in the Ossi social media service.

3.1.2 Positioning

As a Living Lab, OtaSizzle positions as especially suitable for studying mobile social interaction services. OtaSizzle aims for holistic data collection and can provide more in-depth data than many other Living Labs especially in the mobile domain. OtaSizzle

devotes resources to establishing a standardized feedback loop between developers and end-users to facilitate the improvement of services. Also, OtaSizzle has its own prototype services. With these there is a high level of control for experimentation by varying service features. Furthermore, the technical infrastructure allows for a high level of detail on server data and for good comparability between different OtaSizzle services. Finally the lack of commercial pressure facilitates higher flexibility.

As a downside OtaSizzle has not emphasized the multi-stakeholder nature of Living Labs as much as other Living Lab operations. There has been less emphasis on open innovation and public-private partnerships. OtaSizzle is interested in end-user innovation, but cannot yet be called a multi-stakeholder innovation ecology in the Living Lab sense. For now OtaSizzle remains mainly a university initiative managed and run by the university. (Mäntylä, 2009)

The next paragraphs examine the current state of OtaSizzle from the perspectives of components, principles and success factors of Living Labs presented in section 2.

Although OtaSizzle is a relatively new Living Lab it is already possible to identify the key components of Living Labs presented in Figure 3 (section 2.1.3), although the components are still in the process of forming and reaching their final form. The nature of the component of *organisation and methods* is still somewhat vague in the context of OtaSizzle. It is still unclear whose task it is to communicate with external service providers or who will eventually take care of data analysis needs. The methods to be used are also not clearly defined. This thesis aims to clarify the issue especially in the area of data analysis methods. Once OtaSizzle becomes more mature and established these issues will become easier to clarify.

The direction OtaSizzle is taking seems to be in line with the key principles of Living Labs (section 2.1.4). Following are some comments related to each principle:

- *Continuity*: OtaSizzle aims to be a continuous project and to be integrated as part of campus life at the university.
- *Openness*: As the SizzleLab concept is still being developed, OtaSizzle is not open for any willing participant. However the goal is to become an open platform where participation is easy and for instance does not require complicated legal contracts to join.
- *Realism*: OtaSizzle aims to study users in their real-life environment. This is made possible by logging of service usage in a non-obtrusive way from various data points such as handsets and servers. OtaSizzle also aims to integrate as part of daily campus life.
- *Empowerment of users*: The concept of empowering users is noted in the planning of OtaSizzle. The documentation of the prototype services and ASI is provided to facilitate user participation in service improvement. Improvement of services can be made as special assignments or course assignments at the university. User participation is actively sought by arranging code camps. Users are asked about their opinions through questionnaires and interviews.
- *Spontaneity*: OtaSizzle facilitates spontaneity by enabling observation of usage right when it happens. The time scale of observation is not event-based, but continuous. End-user phenomenon can be studied with great detail. Furthermore OtaSizzle attempts to inspire usage by contacting different stakeholders within the university such as student clubs, guilds and teaching staff in faculties. Spontaneity also includes meeting personal desires of users.

Section 2.1.6 discussed the success factors of Living Labs. It is too early to measure the success of OtaSizzle other than in the sense that progress is being made in providing the technical and organizational infrastructure. However the success factors identified for living labs: innovation, collaboration, multi-contextuality and sustainability seem feasible in the OtaSizzle context, if the concept reaches the level of maturity to start experimentation in full scale.

3.2 Value proposition to stakeholders

The concept of value proposition was briefly covered in 2.2.3. As SizzleLab is a service for experimenting services, it is important not to confuse the services being experimented in SizzleLab and SizzleLab itself as a service. This section concentrates on SizzleLab as a service and the *intended value* it seeks to provide for its stakeholders.

According to Bouwman et al (2008), the critical success factors of an IT-service are related to customer value and network value. *Customer value* focuses on what creates value from the viewpoint of the customer. *Network value* focuses on how stakeholders cooperate in creating value based on common interests and, on the other hand, compete among each others in capturing value based on individual interest.

3.2.1 Customer value

According to Bouwman et al (2008), in creating customer value critical success factors are: (1) clearly defined target group, (2) compelling value proposition, (3) acceptable quality of service and (4) unobtrusive customer retention. This subsection considers these factors in the SizzleLab context.

Target group

The target group of SizzleLab is the 3rd party service providers (often small or medium size enterprises) that want to experiment their services in SizzleLab. The other target group is the end-users (SizzleLab panelists) who try these services and contribute to either content or development of these services. End-users are very important since without them SizzleLab cannot exist. The value proposition has to be planned especially well for these parties as they are the most critical target groups. End-users are recruited from Aalto-university students in Finland.

Value proposition to 3rd party clients

After the target group has been defined, it is critical for a service to have a compelling value proposition for them. For service providers in the wireless telecommunications sector the increasing cost of verifying and certifying applications and services is a major barrier. In addition, many providers enter markets looking for a market niche. For many it is a huge financial risk to take on without awareness of their potential user market (CoreLabs, 2007c). SizzleLab provides an open testing environment that allows providers to experiment their services, but also provides a real test market of end-users before preparation for a market launch. In short: *SizzleLab enables service and business model experimentation in trusted, reduced risk environment.*

Furthermore, in SizzleLab the usage of mobile services can be observed 24/7, with the objective handset based logging method. In previous Living Lab contexts it has not been possible to observe the usage of mobile services realistically (Ståhlbröst, 2006). Thus SizzleLab can provide added value that some other Living Labs or experimentation methods have not been able to provide. When this objective usage data is combined with qualitative surveys and other experimentation methods, a rather holistic view of user's impressions and actual usage can be formed.

Added value is also given to 3rd party service providers by empowering users to contribute to services. This contribution can be as improvement suggestions, content (especially in social media services) or – in case the technological side of the service is open-source – as new functionality programmed by the user. Furthermore, visibility of services is increased, as panelists discover new services through the SizzleLab web portal. The portal is an effective way to introduce a service to tech-savvy and well networked groups of university students. The objective is that SizzleLab will be integrated as an active part of campus life and is ideal for experimenting social networking type of services, thus special care should be taken that selected end-users form social networks.

Value proposition to end-users

Providing value to the end-user panelists is something that needs to be given more thought. These panelists face costs such as mobile data connectivity costs. Furthermore, they are being asked for data describing their behavior. The question is how end-users benefit from taking part in a panel such as this? This question was asked to an early panel conducted in the OtaSizzle project. Respondents installed an application that collects their mobile usage data and answered to questionnaires. After the panel, panelists were asked in a final questionnaire on suitable rewards for taking part in a panel such as this. The results can be seen in Figure 11 below.

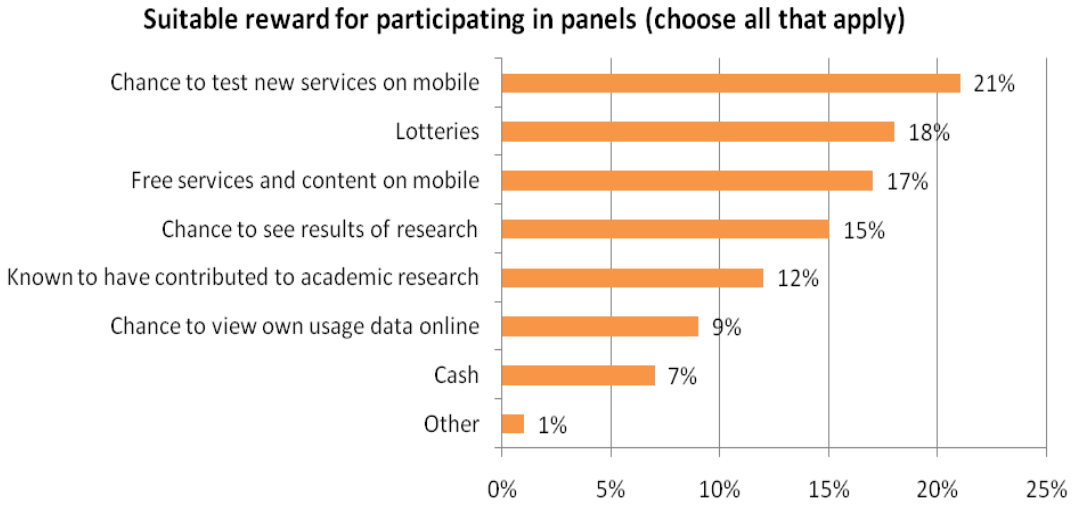

Figure 11 Suitable rewards for participating in a panel according to panel participants (n=45)

The results look positive in the sense that the best reward was seen as simply being given the chance to test new mobile services before the mass market (21%). This is very well in line with SizzleLab objectives. Other rewards that are easy to provide are "chance to see results of research" (15%) and "known to have contributed to academic research" (12%). Lotteries would require some participation from stakeholders, willing to donate prices, and seems feasible. There have also been talks on giving the "chance to view own usage data". It could also be discussed if panelists could try some services that have a fee, without fees or receive some charged content for free. This would however hinder the

experimentation of business models. Overall the reward options presented in the questionnaire seem feasible.

However users who replied to this survey already took part in the panel and thus were users who are willing to participate in such panels Also it should be remember that it is easy for users to reply positively to a questionnaire such as this. It is possible that if users have to face costs, such as data costs for using a mobile service, some of these rewards are not enough. If this seems to be the case, one possibility is to subsidize the data costs, by making an agreement with one of the mobile operators. One question that was not asked but could have been interesting is related to users as co-creators. Do users experience the opportunity to voice their needs and requirements for services as a benefit? Such a question should be considered in the future.

A larger problem at the moment is probably that in the panelist target group (university students) the adoption of smartphones is not very high. For newer data and content oriented services and for the handset usage logging tool, a smartphone is essential. This issue is not directly related to the value proposition, but severely limits the target user population (and thus affects customer value). A costly and bold solution would be giving out handsets for free or for a very cheap price in exchange for participation in the studies. Subsidized handsets and data plans were given to a group of students for the autumn 2009 experiment (see section 4.2)

Acceptable quality of service

Technical as well as functional quality of service from the viewpoint of the target users is important. Security is also an important issue related to here as is integration of systems in the technical architecture. In a previous OtaSizzle panel study, when asked on functional or technical problems, users reported problems with installing the measurement application (22%) and functioning of the measurement application in the phone (56%). These percentages are very high and thus alarming from the viewpoint of quality of service. In future efforts problems with the measurement application should be given careful notice. Also the technical infrastructure of SizzleLab is still under

development, among others, efforts should be aimed at providing an acceptable quality of service.

Unobtrusive customer retention

Customer retention is aimed at keeping customers satisfied and loyal with the service. An ideal situation for SizzleLab would be that 3rd parties would keep coming back when they have new services to introduce and end-users will keep coming back to look for new and interesting services. Personalization of services, accuracy and actuality of information can be used to retain customers (Bouwman et al, 2008). As SizzleLab does not aim for financial profit obtrusiveness is not such a big issue. In practice target users should be given the chance to stop participating in SizzleLab without much effort if they feel they want to stop.

The critical success factors described above contribute to customer value. Some issues still remaining and possible solutions were discussed. It is believed that if these issues are carefully considered, substantial customer value can be delivered. The next subsection concentrates on value from a different perspective, the value for the network of stakeholders.

3.2.2 Network value

According to Bouwman et al (2008), critical success factors for creating network value are: (1) acceptable risks, (2) acceptable profitability, (3) sustainable network strategy and (4) acceptable division of roles. It is assumed that succeeding in these factors will create a win-win situation for the value network, which is essential for creating a sustainable service.

Various stakeholders are involved in OtaSizzle-project, of which the most central are: 3rd party service providers, industry, academia, device & connectivity providers and funding organizations. These stakeholders compose the SizzleLab value network depicted in Figure 12.

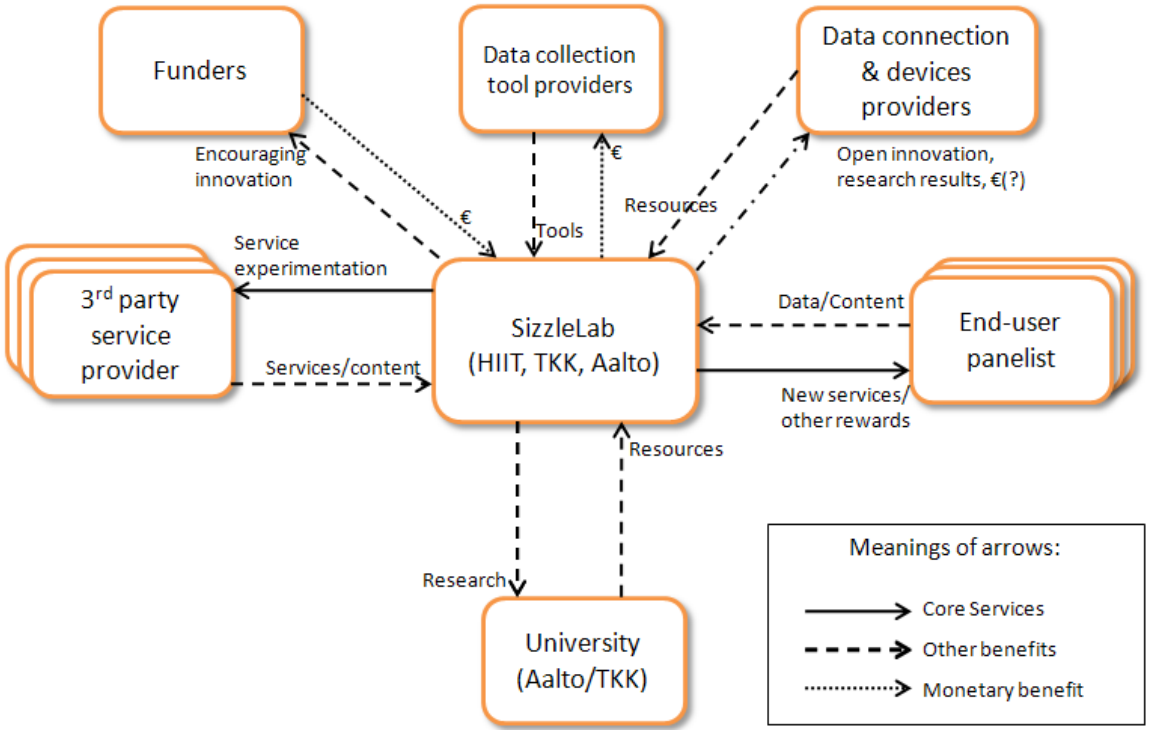

Figure 12 High level view of the OtaSizzle value network

The arrows in the above figure describe the different benefits divided between the value network actors. The solid arrows depict the core services, dashed arrows depict other intangible benefits and the dotted arrows depict monetary benefits.

3rd parties introduce their services to the SizzleLab portal for experimentation. SizzleLab handles the distribution of services to end users and analysis of usage data. SizzleLab is strongly related to university research and thus provides the university input for research in exchange for resources and services developed at the university. In some sense the university and SizzleLab are the same entity, but for the purposes of the value network it is useful to depict them as separate entities. It is good to note that in the open environment of SizzleLab, it is possible that services (or service improvements) and content come from 3rd parties, university or active end users. SizzleLab funders are interested in encouraging innovation and creativity that among others leads to economic growth, jobs and private investment in the capital area and Finland. Telecommunications operators and device vendors support the project by providing panelists with free data connectivity and modern devices. By doing so they contribute to open innovation that

might benefit their business, their services might also get priority in SizzleLab experiments. Finally, external companies provide data collection tools such as handset-based measurement software and web-based survey platforms that SizzleLab requires.

Now that the value network has been described on a general level, focus can move to success factors in creating network value.

Acceptable risks

With a new service as SizzleLab there is a rather high uncertainty with respect to market acceptance and technology choices. Division of investments, division of costs and revenues and valuation of contributions and benefits should all result in an acceptable risk level. For SizzleLab establishing adequate funding is necessary. Also if there is considerable demand from 3rd party service providers, they should participate in handling costs. It has been discussed that service providers would pay for SizzleLab portal distribution and data analysis. A fixed price might be appropriate for the sake of simplicity and to support the openness principle of Living Labs. A problem from the openness viewpoint is that SizzleLab is a university effort and the university would consider SizzleLab services as university research services and price them based on university guidelines managed centrally.

Acceptable profitability

SizzleLab does not seek to provide direct financial profit to its stakeholders; the intangible benefits are shown in the value network of Figure 12. Together with the value provided, it is believed that the benefits can be divided equally to result in a win-win situation.

Sustainable network strategy

Sustainable network strategy is required for securing access to resources and capabilities, including capabilities for managing the network. Network governance contributes to a sustainable network strategy. It is typical to have a dominant actor in a network. The dominant actor has access to the clients and the users of the service, sets the rules with regard to collaboration (organizational arrangements), and monitors compliance with these rules. (Bouwman et al, 2008). In this context the dominant actor is SizzleLab.

Network complexity also influences sustainable network strategy; network should not have too few or too many actors. In its current form SizzleLab has a manageable network size

Acceptable division of roles

Acceptable division of roles refers to the distribution of roles among firms and the integration of roles within firms that participate in the business network. Network complexity also influences here, as in the success factor of sustainable network strategy. Another influencer is partner selection. Some criteria have to be imposed on service providers wanting to experiment their services (For example services should be safe and working prototypes). However SizzleLab should make participating easy, in order to facilitate for an open environment.

Overall the SizzleLab value network appears to be of manageable complexity. It can provide for a win-win to all parties. Special care should be taken to provide end-users enough incentive and service providers with enough value compared to effort or price.

3.3 Experimentation framework

This section proposes a framework for experimenting services in the SizzleLab environment. The framework is to guide in the experimentation of services starting from choosing and screening services for evaluation, to planning the experimentation and to analyzing the data and reporting the results.

The purpose of having this framework is to assist researchers in conducting evaluations in a well structured manner so that researchers can better concentrate on relevant issues. The framework should benefit by saving time, effort and providing equal quality service to service developers who wish to experiment their services in SizzleLab. The framework attempts to create a feedback loop between service developers and users.

Figure 13, below illustrates the steps in the framework. Following is an explanation of each step.

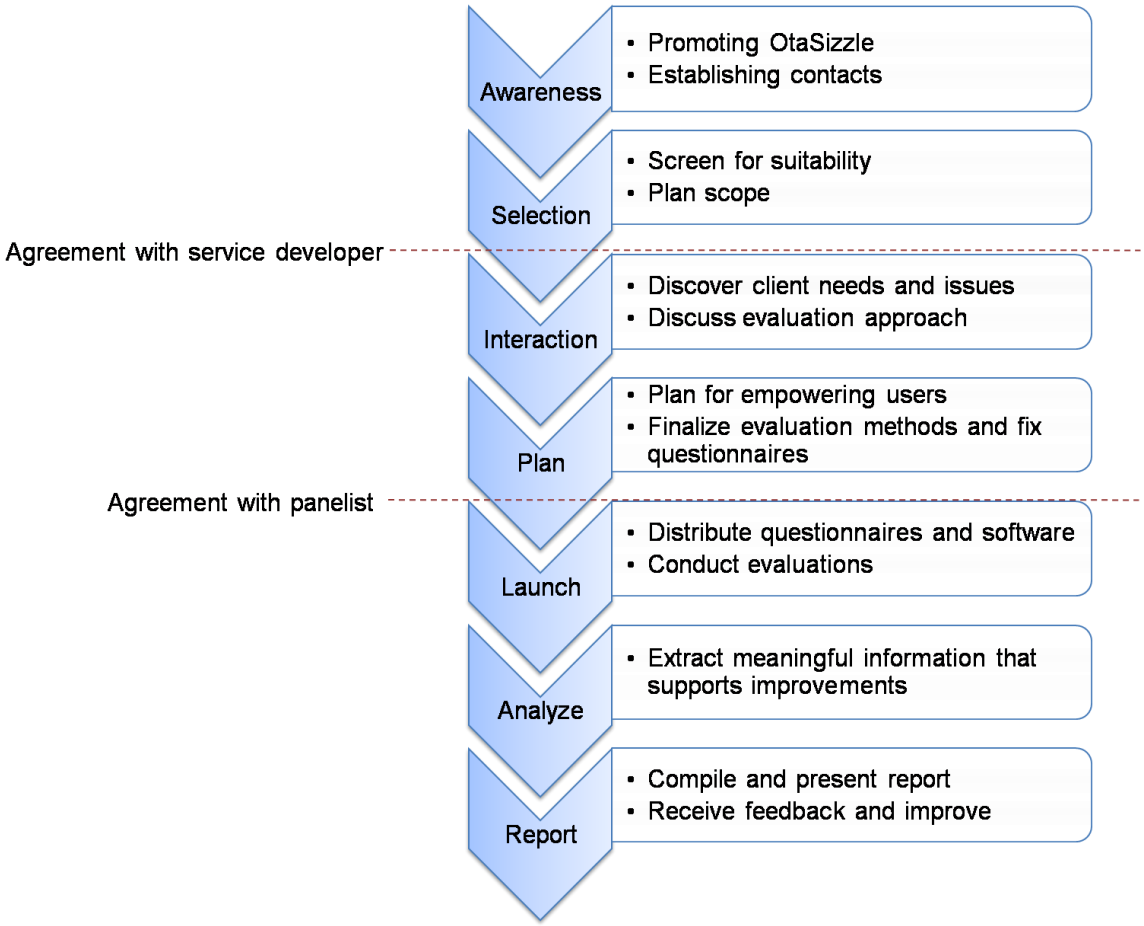

Figure 13 SizzleLab service experimentation framework

Step 1: Awareness

Before anything can happen clients need to be aware that a service such as SizzleLab exists. The core place to increase the awareness of SizzleLab is the web-portal at sizzlelab.org. The portal will contain information for service developers, researchers and other participants. Furthermore awareness of SizzleLab can be increased by participating at events where service providers gather. In the university campus there are active societies that promote start-up companies, such as Aalto Entrepreneurship Society. Participating in the events of these societies could be very fruitful for SizzleLab and the societies.

Awareness should also be increased among the industry major players such as Nokia, that Otasizzle already has cooperation with. In the case of these important clients direct

contact from Otasizzle side might be reasonable, as was the case in the Nokia Sports Tracker experiment (section 4.1).

Once contacts with service providers and interest have been created, the next step will be to select and screen a service for experimentation.

Step 2: Selection

Once a client expresses a wish to experiment services, a quick evaluation of the service should be performed to check that experimentation of the service is feasible in SizzleLab. The service should be a working version and "semi-market ready". SizzleLab could be considered as a "friendly" environment before full-blown market pilots. Services should be screened for suitability, legitimacy and quality. For an example SizzleLab may not be the suitable place to experiment adult services. As for legitimacy it should be checked that services are really what they state to be and do not contain harmful components such as viruses or spyware.

Once the pre-screening is done the experiment should be planned on a high-level. Approximate time duration, scope, client expectations and how SizzleLab can respond to these expectations should be discussed. After this it is possible to discuss pricing and sign necessary agreements. Pricing is something that currently cannot be discussed very reliably as SizzleLab is still in a very experimental stage of development. It is also possible that SizzleLab will be free.

After an agreement on conducting experimentation has been reached, the next step will be to have more in-depth interaction with the client.

Step 3: Interaction

The purpose of this step is to find out as much relevant information as possible related to the service under experimentation. What kind of data is available from the service provider (server logs etc.) and is this data available for use? Are there some aspects of the service that the developer wishes to experiment without the help of SizzleLab? What

types of evaluations are possible and most relevant for the service in question? Can handset based measurements be used (mobile service)? Contacts should be formed with the key stakeholders of the service inside the firm providing the service (product manager, developers, marketing etc.). Major issues of each stakeholder should be discussed. This discussion should affect the evaluation methods chosen and the design of the experiment. Enthusiastic service providers can access OtaSizzle Aalto Social Interface (ASI) API. Using the API service providers can integrate their service with OtaSizzle services to enhance the quality of service data collected.

After the interaction step, the next step is to plan the experimentation in detail.

Step 4: Research plan

Based on the interaction with the client, some goals for the experimentation should be identified. Goals will guide the planning of the experiment to a desirable direction. A goal can be for an example: "*Discover technical and usability faults in Nokia Sports Tracker"* or *"Discover reasons for the lack of popularity of Ossi-service"* or *"Track the adoption of location tracking service X within the user community"* If possible try to identify multiple goals and prioritize them based on importance, severity and priority. After goals have been identified one can rewrite goals as research questions to be answered. If studying the adoption of location service X, one can rewrite the goal as questions such as: *How many used it? What incentives did adopters have to use it?* Or *why did some users only try the service?*

The next step is to choose the group of end users. Depending on the research needs it can be all OtaSizzle panelists or panelists that belong to some group such as *first year computer science students* or *panelists with GPS-enabled phones* etc.

After this it is time to finalize the questionnaires given out to users. There are some questions that can be asked related to all services such as satisfaction and technical reliability type of questions; overall questions should support research questions set for the service. If interviews/focus groups are planned these should also be designed. Input

received from developers is important when finalizing the design. When planning, it is good to remember that Living Labs are characterized by the "users as innovators" approach; the basic idea is to get access to users ideas and knowledge (CoreLabs, 2007c). Furthermore collaboration among different stakeholders and researchers within OtaSizzle is important in order to synchronize activities and make the end-user experience smooth.

Once the experimentation plan has been established, the next step is to launch the experiment

Step 5: Launch

The experiment is launched by inviting the targeted students to join the panel by taking the initial questionnaire and installing the application for handset based measurements. Figure 14 below depicts the process related to joining the panel.

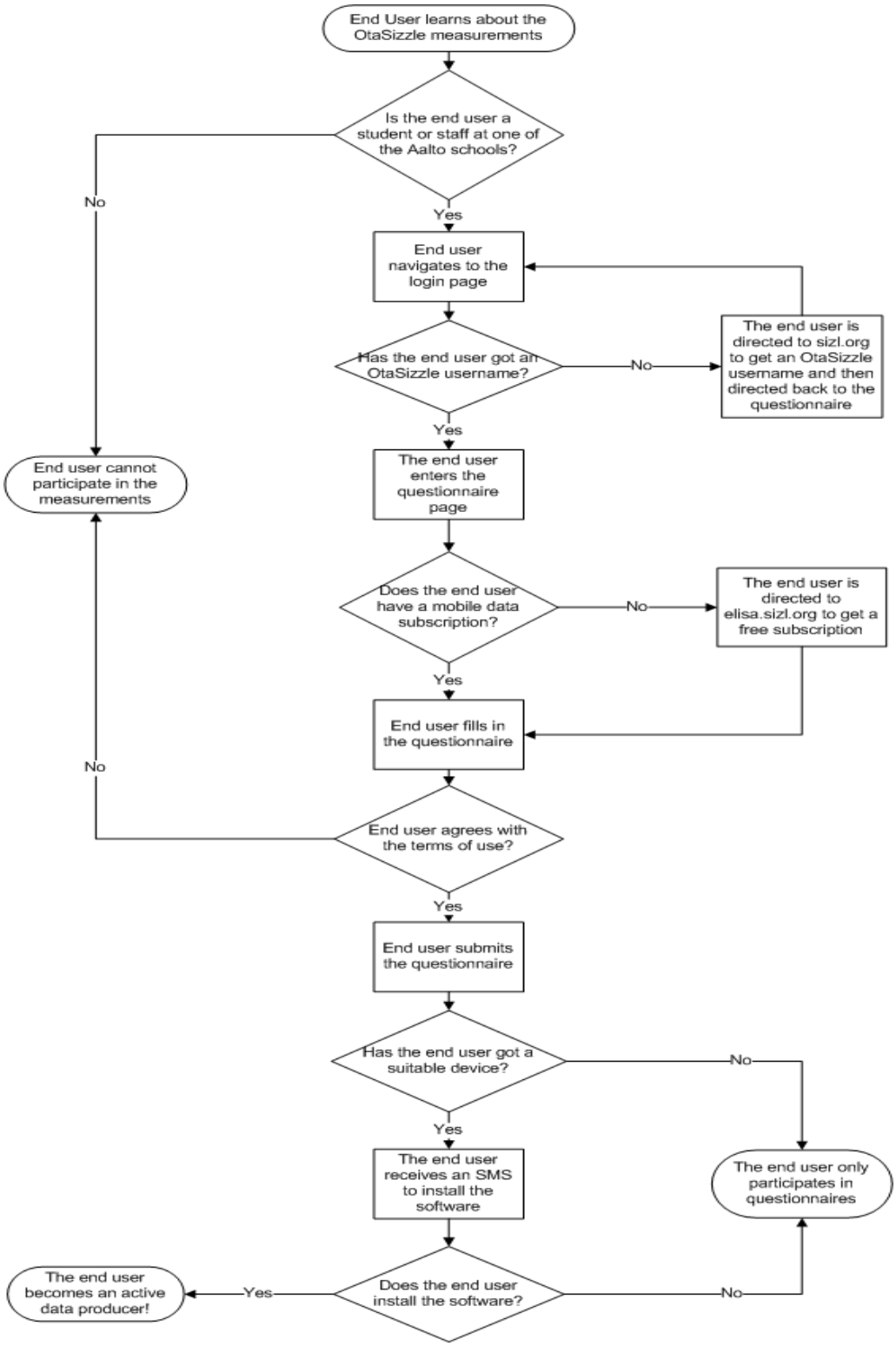

Figure 14 Process of joining SizzleLab panel

Once the panel has launched and panelists have been using the services for some time additional questionnaires can be deployed, interviews and focus groups can be conducted. Researchers might also have to respond to feedback and issues from users or clients. Researchers should take care that data collection goes smoothly and that panelists have no problem installing the measurement software.

During an on-going panel service experiments are launched simply by inviting registered users by email to participate in service experiments.

After enough data has been collected or the deadline for the agreed panel duration has been reached, the experiment is closed by informing the participants and analysis of the data can begin.

Step 6: Analyze

First raw data is exported from servers and imported to suitable statistical tools. Currently in SizzleLab raw data from questionnaires and handset measurements are in different servers. A future goal is to have all of this data aggregated to the Ressi research database. (See Figure 9 & Figure 10). After export some datasets can be merged, for example handset measurement data can be combined with demographic data from questionnaires. Data is then filtered based on the requirements, for an example panelists who have not generated enough data are extracted from the final data set. Verkasalo (2009) discusses the data analysis process in more detail, especially in the case of handset measurement data.

The research questions based on research goals should guide the analysis. Once the datasets are in proper order, statistical analysis is performed by starting with descriptive statistics. If necessary and feasible, more in-depth statistical analysis can then be performed based on the descriptive analysis. Finally findings are confirmed and the next step of reporting can begin.

Step 7: Report

The last step in this framework is to report the findings of the experiment to the client. First the report is compiled (see section 3.4 for more detail on the structure of the report). Findings are presented to the client and feedback is received. At this stage, if the client wishes, agreements on future experimentations can be made, either to conduct more in-depth research on the experimented service or to conduct an experiment of another service. Feedback received should be applied in improving future experiments

The proposed framework resembles well used experimentation frameworks (i.e. Kuniavsky, 2003) in that the experimentation flows through the stages of planning, data collection, analysis/reporting, feedback, improvement. What is different is that the proposed framework is adapted for SizzleLab and for example takes into account the complexities of launching the research panel. Or that in the SizzleLab users' awareness and interest needs to be captured on a large scale in a non-intrusive way. The core aspects are however the same; planning is crucially important and clear goals should be set. The process should be iterative and feedback should be invested in improving the framework and thus future experiments.

3.4 Reporting

This section proposes a structure for the experimentation report given to clients in the end of the service experimentation. The report is to give insight in to the major findings of each experiment. It should also be standardized to the extent that reports can be created for different services fast and with documented methods. However the reports should also be flexible enough so they can address service specific issues in sufficient detail.

The report is created with presentation software (such as Microsoft PowerPoint), the following structure is proposed:

1. Starting slide – "*Service X* experiment"
2. Brief overview of SizzleLab

3. Explanation of measurements (handset based measurements, combined with other methods)
4. Describe dataset of experiment, e.g. demographics, histogram diagram depicting amount of usage sessions per user during panel etc.
5. Slide briefly describing main findings of experiment
6. Slides that explain main findings in part (5) in more detail
7. If handset based measurement of usage was applied in experiment:
    a. Chart showing services “active” and “trial” usage
    b. Chart comparing total time spent on experimented service and some other interesting services
    c. Chart showing usage adoption after first usage
    d. Context (time, weekday) of usage
    e. Correlation between services
    f. Other interesting charts depending on service
8. Slides that present interesting findings from questionnaires or other evaluation methods.
    a. Satisfaction
    b. Use cases
    c. Wishes for future / requirements
    d. Open-ended feedback
9. Conclusion slide with contact information

Graphical illustrations of some of these charts can be found in section 4. Tirkkonen (2008) lists many other chart types that can be created with usage measurement data or by cross-referencing usage data with questionnaires. Overall a wide variety of charts can be created based on the needs of the experimentation.

3.5 Cost of experimentation

According to Kuniavsky (2003) the costs of service experimentation tend to fall in three categories of: people's time, recruiting and incentive costs and equipment costs. The most basic SizzleLab experiment requires:

- One full-time researcher (or research assistant)
- A web platform for conducting questionnaire surveys
- A handset-based measurement application
- Panelists and incentives for joining (free data plans, lotteries)
- Data analysis and presentation software (e.g. SPSS, Excel, PowerPoint)

The hardest cost to estimate is the time of the researcher. It depends heavily on the experience of the researcher, but also in an OtaSizzle type of Living Lab it depends on the schedule of many stakeholders, because the schedules have an effect on when experiments can start. The long scale scope of SizzleLab experiments means that the full-time researcher will be mostly idle in the data gathering phase if only one experiment is on-going. If this idle time is calculated as a cost, the costs can easily become heavy.

At least the following steps of experimentation require the time of the researcher (the estimated times are based on limited experience and can vary greatly):

- Preparation (1-2 work days)
- Meetings with service development (1-2 work days)
- Recruiting panelists (1 work day in an on-going panel, up to 1 month or more if a new panel is started)
- Data gathering – mostly monitoring and support (1 month)
- Analyzing data (10 work days)
- Writing report and presenting results (2-3 work days)

Thus the cost of the experiment differs greatly if the time of the researcher during the data gathering phase is included in the cost. The hourly salary of approximately 18 days compared to the hourly salary of 48 days or more.

It is recommended that experiments are pipelined so that a new experiment is started while the data gathering phase of a previous experiment is on-going. This would improve the general (cost)efficiency of experimentation If experiments are timed properly one full-time researcher can handle perhaps two to three simultaneous long term (1-2 months) experiments that have moderate data analysis requirements. If reports can be standardized to a high level and the researcher has accumulated considerable experience, more simultaneous experiments can be feasible.

As a final note, in a multi-stakeholder Living Lab environment it is rather unlikely that time usage is as ideally effective as presented above, differing schedules and the whole state of the project are likely to result in some inefficiency. For instance while meetings with service developers might only take a few days, arranging these meetings can take up to weeks.

4 Applications

This section covers the service experiments conducted in OtaSizzle in relation to this thesis. Data analysis, results, implications and the performance of the experimentation framework are discussed.

4.1 Experiment: Nokia Sports Tracker

4.1.1 Design & Implementation

The Sports Tracker experiment was conducted before the work on this thesis started so the proposed framework was not wholly tested during the execution of this experiment. However the data from this experiment was used to prototype the data analysis process and compilation of the report handed to service providers in the end of experiments.

The experiment was conducted during a student panel organized in 2008, the so called TKK Panel. The TKK panel studied the overall smartphone usage of Helsinki University of Technology students by in-device measurements from devices and questionnaires. For more information on the TKK panel, see: Tirkkonen (2008).

The application experimented; Nokia Sports Tracker is a GPS-based activity tracker that runs on compatible Nokia devices. It stores information such as speed, distance and time to users training diaries. It also supports sharing of and storing of workouts and routes on the Sports Tracker website.

This experiment was initiated by OtaSizzle research staff contacting Nokia expressing their wish to conduct an experiment in order to study the data analysis processes and reporting in the OtaSizzle context. Unfortunately there was little interaction with the

development team at Nokia when planning the experiment. Thus an important step of the experimentation framework was not carried out during this experiment.

Sports Tracker was introduced to the TKK panel by an email invitation sent out to panelists with GPS-functionality in their handsets. The number of panelists with GPS enabled phones was 28. In the end 11 users had used Sports Tracker during the panel. The benefit of introducing the service to an on-going panel was in that panelists had already installed the data tracking application in their devices. Thus there was no risk that willing panelists could not install the application. As discussed in 3.2.1 this has been a considerable problem previously.

A brief questionnaire survey was also designed within the OtaSizzle research team to complement the device based measurements. In the ideal case this would have also been designed in cooperation with the development team at Nokia. An invitation to fill the survey was sent one week after the invitation to start using the service.

4.1.2 Documentation

The observed usage of Sports Tracker was rather minimalistic. 11 users tried the application. Of these only four users used the application more than once. The data was however analyzed in order to try the data analysis methods and to demo the reporting process. The charts produced by the analysis can be used as templates in future experiments and demonstrate what kind of analysis can already be performed in OtaSizzle in this early stage.

Following are some findings from the study. To begin with, an interesting remark was found from the questionnaire survey. Most users did not use Sports Tracker during sports activities. These were either users who only tried the application or users who used it for other purposes such as tracking their own movements when walking around town. This suggests that if the sample was larger this kind of experiments could be used to discover

"unexpected" ways users use services, which is desirable in a Living Lab that supports open innovation.

It is possible to observe how an application ranks with other applications in terms of users. Figure 15 below shows how Sports Tracker compares with other applications used by Sports Tracker users.

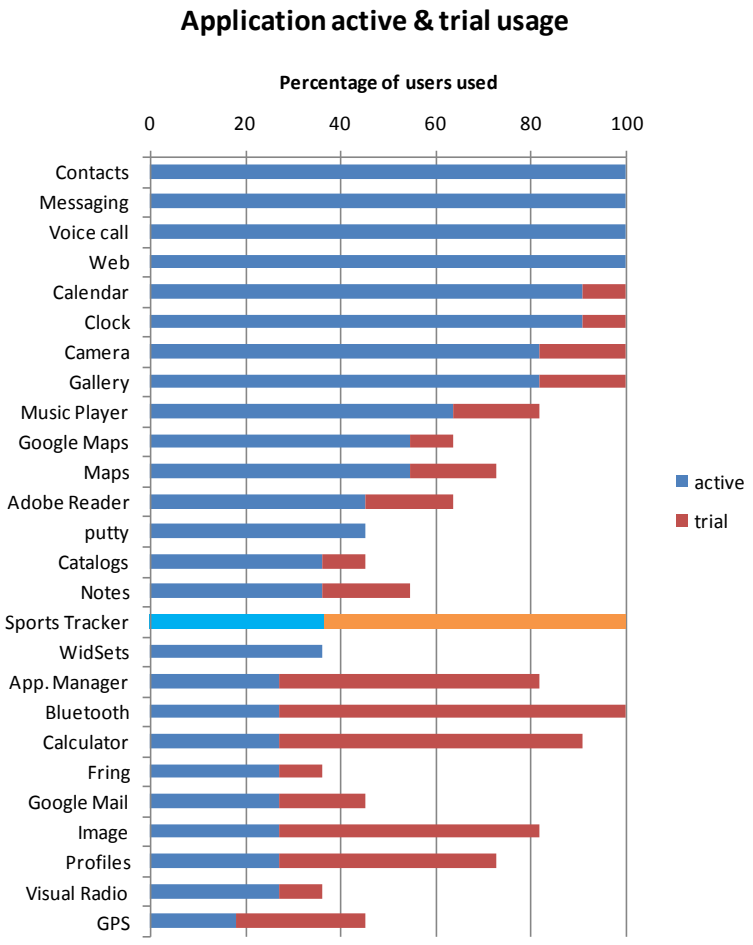

Figure 15 Application usage among Sports Tracker users

In this figure "trial" usage means that the service was used less than five times during the panel. The figure shows how services like voice calls and messaging have 100% active penetration while niche applications such as Sports Tracker, putty or WidSets have lower penetrations. Charts like this can be interesting for service providers to discover how their

services rank among other services. However it should be noted that the numbers for Sports Tracker are biased since panelists were asked to use Sports Tracker.

Figure 16 below shows a chart that plots the adoption of Sports Tracker among panelists.

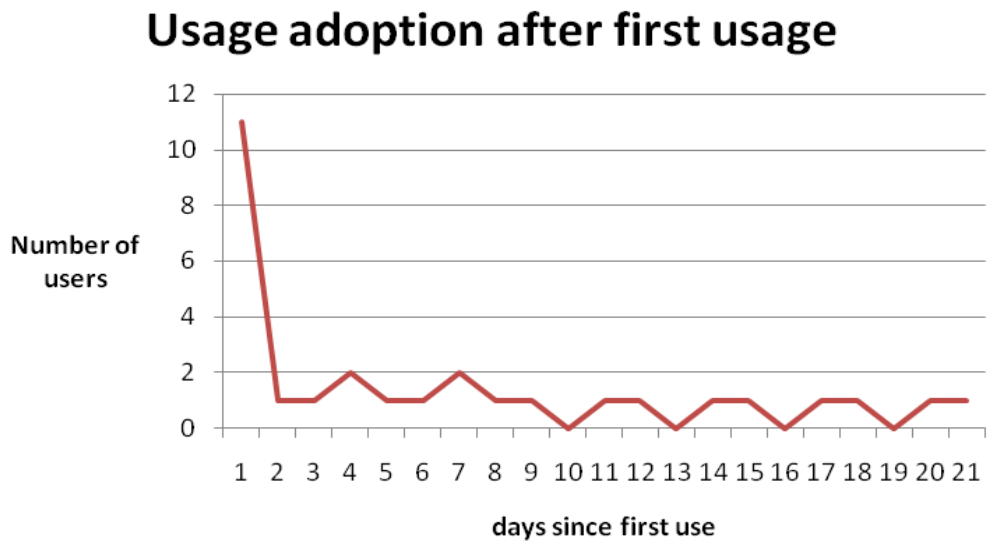

Figure 16 Adoption of Sports Tracker among panelists

The adoption figure shows that only one or two panelists seemed to have used the application continuously during the panel. It is typical that niche type services are not adopted by all users who test the services. If there was more data available, this kind of chart could possibly be used to evaluate how well services "stick" with users who try them out.

Time context of service usage can also be easily presented, below Figure 17 shows the usage of Sports Tracker depending on the time of day. All other applications are also plotted for comparison. It can be seen that in this experiment Sports Tracker usage concentrated on mornings and evenings, while the averaged usage of all other applications was more "even" as expected.

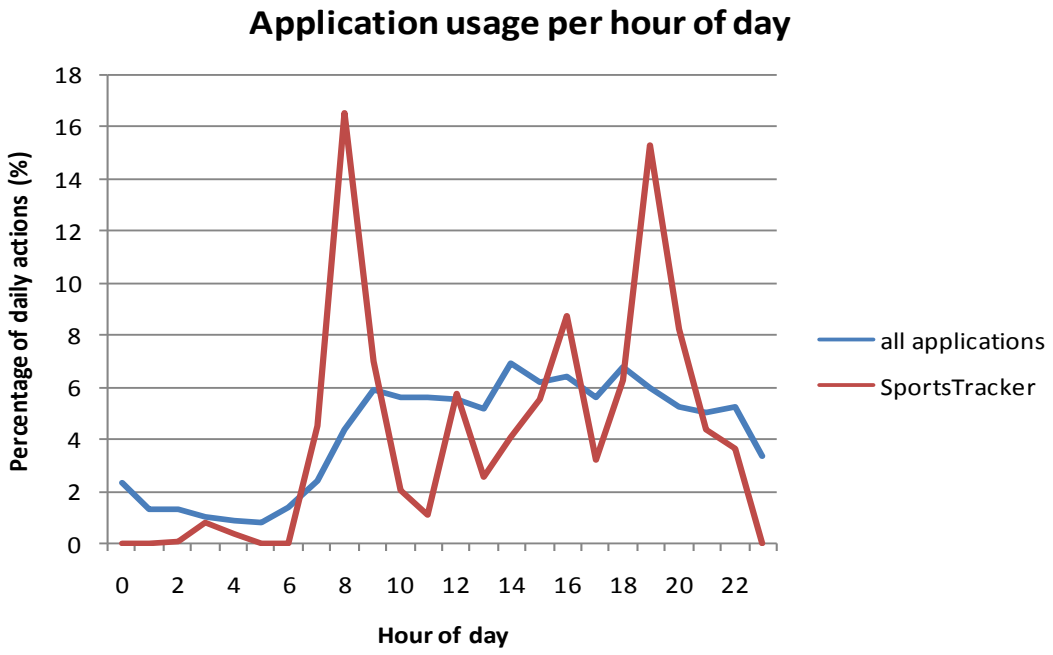

Figure 17 Sports Tracker time context of use

To complement this objective observation of usage, the questionnaire survey asked users for what activities they used the service and how they feel about the technical, usability and other aspects of the service. Figure 18 below summarizes users' evaluations on usefulness, usability and technical reliability of the service. In general the service was evaluated positively by users; however the lack of actual usage observed suggests that the positive evaluation did not result into adoption of the service. Interestingly many respondents stated the application to be more than satisfactory in usefulness for themselves, but only a few adopted it. This result demonstrates how handset based measurements complement questionnaire results by providing a more holistic view on users.

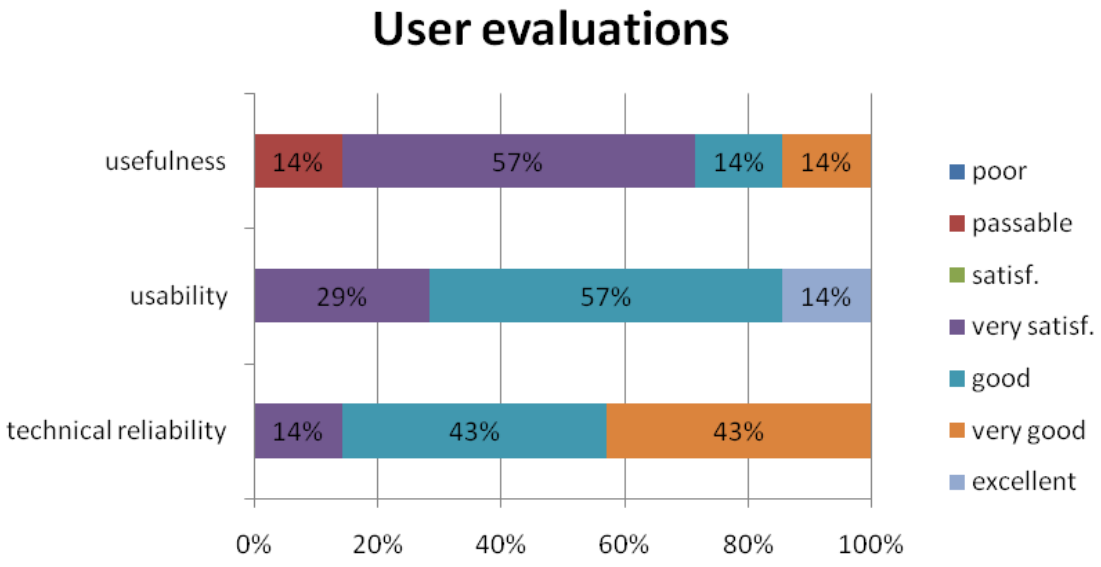

Figure 18 Sports Tracker questionnaire results

Above, some of the chart types that can be used during almost any mobile service experiment in OtaSizzle were presented. There are also likely to be some analyses that are only feasible to perform on certain type of services. Thus although standardizing the data analysis and reporting is desirable, it should also to an extent be performed on a service-by-service basis.

4.1.3 Findings

The results of the experiment were reported to Nokia Beta Labs, who then responded with some constructive feedback. First of all they mentioned that niche type of services such as Sports Tracker tend not to be adopted widely by users, but are still important to those who use them actively. Thus the analysis should not concentrate on average figures, but on how active users use the application. Unfortunately the small amount of active users in this experiment prevented from performing such in-depth analysis. This is however something worth noting in future experiments.

Not directly related to Sports Tracker, Beta Labs also expressed their interest in OtaSizzle in studying social media type of services. Studying these services in traditional betas is challenging since end-users are collected from all over the world and do not typically form social networks. An environment like SizzleLab can be effective in studying social networking services, since it is integrated with a university campus where natural social networks exist. This suggests that during experimentation of social media services in the future, panelists should be picked so that they form tight networks. Recruiting panelists that belong to the same student club or department guild could be effective.

Due to lack of data, definitive conclusions on Sports Tracker as an application were hard to make. The data analysis and reporting phase was however demoed and similar charts can be used in future experiments. Although the handset based measurements of usage provide some interesting insights on adoption, time context and how applications rank among others, discovering users' ideas, needs and desires is important in a Living Lab context. To realize this, future experiments should put more emphasis on evaluation methods that are flexible and give users' the chance to participate in order to realize open innovation. The scope of questionnaires could be more extensive and methods such as interviews and focus groups could be considered. Overall handset based measurements and questionnaires can provide quick insights into how the service performs and how it is used. After some interesting issues have been discovered with these methods, interviews or more in-depth and open ended questionnaires should be deployed to give users the chance to state their needs and give their contribution to develop better services.

It is becoming increasingly clear that a considerable risk facing OtaSizzle experiments is a lack of end users willing/capable to test services. Currently, not enough users seem to have required handsets for some high-end services such as Sports Tracker. Also there should be enough users in experimentation panels, so that even niche services collect enough interest. Finally services should be semi-market ready as depicted in Figure 1, section 2.1.1, so that users' interest can be with caught with reasonably feature rich and content rich services. There needs to be enough active and interested panelists, before

individual services can gain enough interest to produce data that enables in-depth research.

4.2 Experiment: Nokia Ovi Contacts

4.2.1 Design & Implementation

Ovi Contacts is a mobile internet communication service by Nokia with various added-value features such as instant messaging and location sharing. Ovi Contacts was chosen for the experiment as it is a mobile service with a clear social purpose and was expected to fit well in to the needs of the OtaSizzle community. Additionally the software is compatible with a wide variety of Nokia Series 60 devices. As the goal was to study OtaSizzle external services, the internal service, Ossi, was not experimented in this thesis.

The experiment was conducted during OtaSizzle autumn 2009 panel. Planning of the experiment started in early autumn and the experiment launched in October 22. The methods were in-device measurements combined with a web-survey. Device data was gathered for three weeks. Two weeks after the launch, an email with a link to a web survey was sent to panelists. The experiment set up was light in that it was launched in an on-going panel and no technical integration with OtaSizzle was necessary.

The flow of the experiment followed the framework presented in section 3.3. Most importantly the Interaction and Planning steps were conducted together with the service stakeholders at Nokia. Talks were held with stakeholders and the following goals for the experiment were formed:

- Discover how Ovi Contacts compares with other communication tools such as Phone, SMS and Email.
- Track the adoption of the service within OtaSizzle community.
- Discover users' impressions, recommendations and feedback with a general focus questionnaire.

Nokia provided questions for the web-survey. The survey was launched through OtaSizzle web-survey platform with slight additions from the OtaSizzle side.

4.2.2 Documentation

As with the Sports Tracker experiment the observed usage was rather shallow. Out of 46 users whose device usage was measured, only 11 had tried out Ovi Contacts in the three week time period (24%). The questionnaire was sent to 79 users and 20 usable replies were gathered (25%). Of the 11 users who tried Ovi Contacts it is apparent that there was no active users, no one used the service to its full potential as a communication tool. There is value in the questionnaire data as it asks for users' wanted features and brings out some problems users' had.

The expectations for the Ovi Contacts study were higher than for Sports Tracker but there was a major setback, the flat-rate data plans promised for users were not activated in time for the experiment. The result was that only a few users tried the service.

Participants in the experiment were predominantly male (90%), technical university students (90%). Around 65% had flat-rate data plans, median Average Revenue per User (ARPU) was 30€. All users were using Symbian S60 devices.

Following are some selected findings from the data. Figure 19 below shows how Ovi Contacts compares with some selected mobile applications in terms of user share, share of days used and average usage sessions per day per user. Note that there is a bias in this chart since the analyzed data only includes users who used Ovi Contacts at least once. Thus user share for Ovi Contacts is 100%, which it would not be the case if all OtaSizzle users were included in the dataset. The chart shows that among those who used Ovi Contacts, they basically tried it during one or two days.

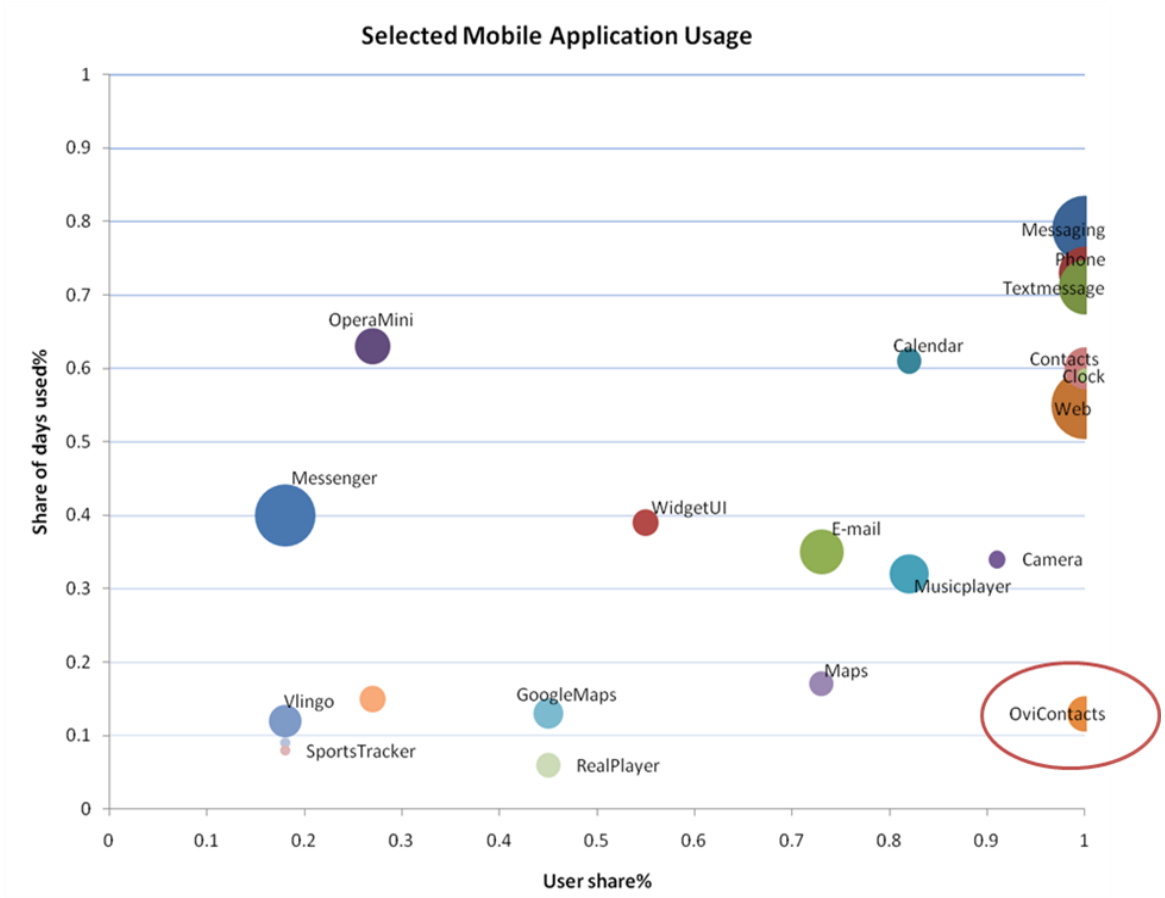

Figure 19 Mobile application usage comparison with Ovi Contacts (size of bubble avg. usage sessions/day/user)

One of the goals of the study was to discover how Ovi Contacts compares with other communication tools. Figure 20 below shows the comparison in terms of time spent with the applications and sessions spent with the applications. The result is as expected. Since phone calls and text messaging are by far the most used communication tools in smartphones, it is not likely that during the three week period Ovi Contacts would become the preffered communication method.

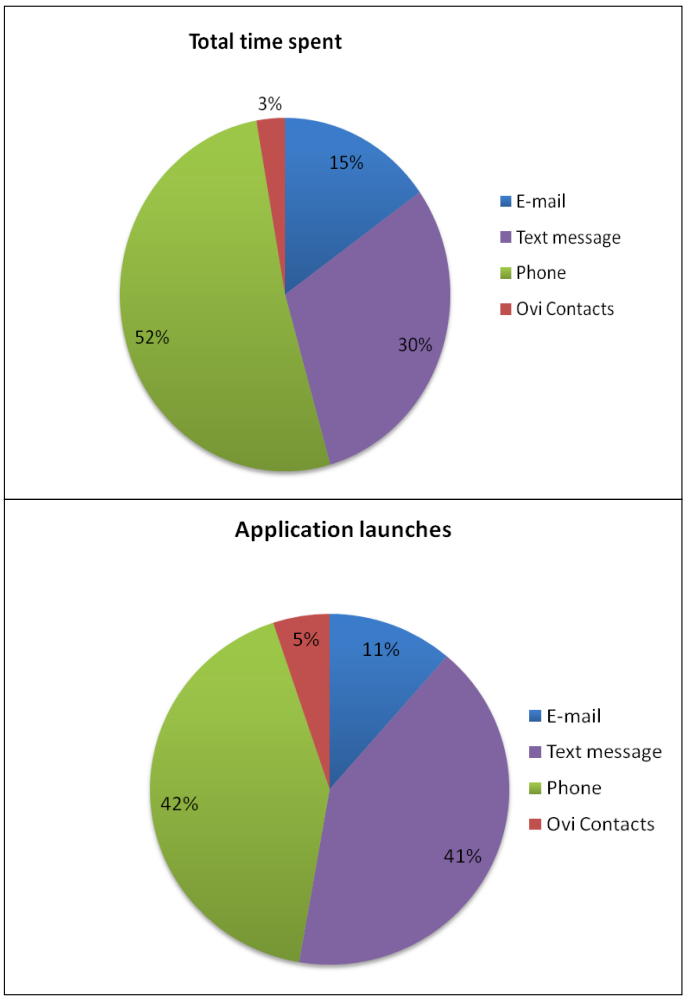

Figure 20 Communication tool comparison with Ovi Contacts

Another goal was to track the adoption of the service within the student community. Figure 21 shows how usage occurred after the first trial of the service. The figure shows that only a few users seem to have tried the service on days following the first trial.

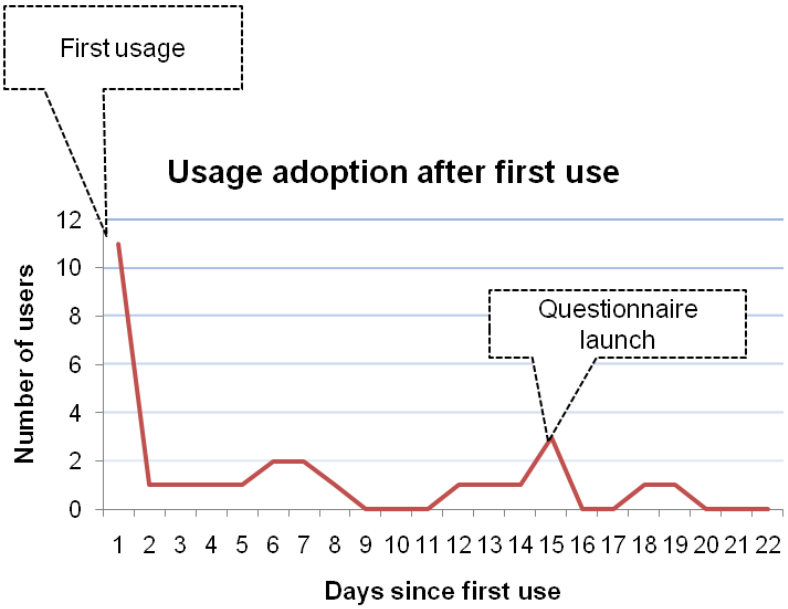

Figure 21 Ovi Contacts adoption

Following are some findings from the questionnaire. Figure 22 below shows that over half of the users evaluated the overall user experience as "average", while half of the users reported overall reliability as "good".

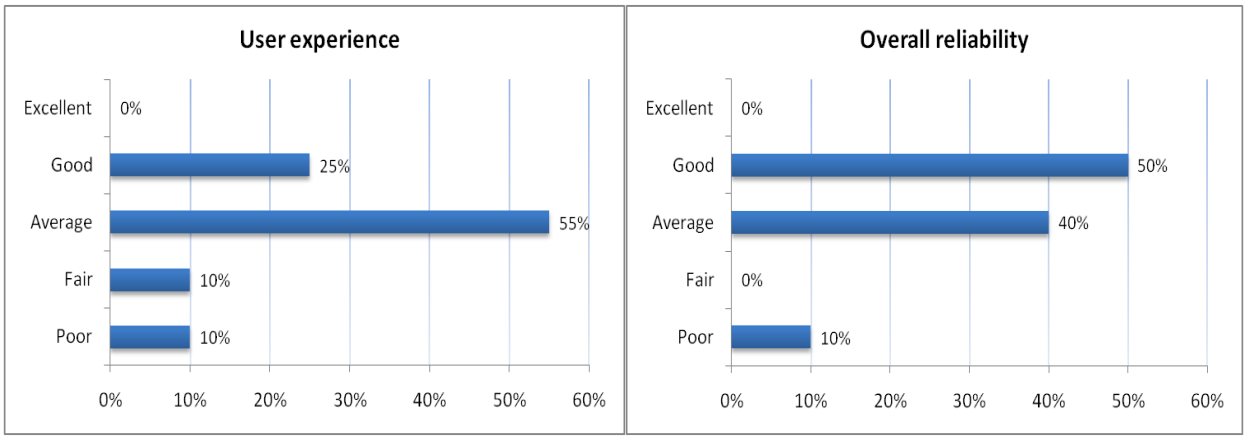

Figure 22 Ovi Contacts user experience and reliability as evaluated by users

One calculated metric from the questionnaires was a Net Promoter Score (NPS). It is a management tool that can be used to measure the loyalty of the users of a service. NPS can be used as a simple alternative to customer satisfaction research (Satmetrix Systems Inc, 2009). The NPS can be calculated by asking a single question: "How likely are you

to recommend this service to a friend or a colleague?" on a scale from 0-10. Respondents are grouped to Promoters, Passives and Detractors based on their evaluation. The percentage of Detractors is subtracted from Promoters to obtain the score. A score of 75% or higher is considered high. Figure 23 shows the result.

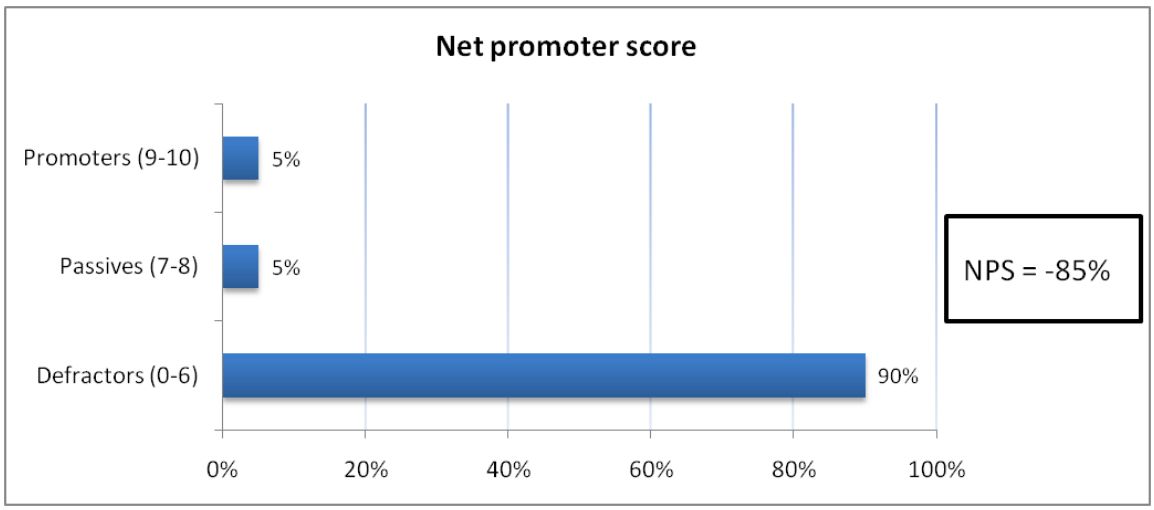

Figure 23 Ovi Contacts Net Promoter Score

The Net Promoter Score for Ovi Contacts was the negative -85%, which appears more negative than the overall user experience reported by users. This possibly reflects that the service was experienced as functional and fine by users, but users did not find it useful enough to recommend it to friends. A qualitative follow-up with interviews would be necessary to confirm this assumption.

Finally in the open-ended part of the questionnaire a surprisingly high percentage of users hoped for integration with other existing services such MSN or Facebook. Possibly users would find the service more useful if they had access to their friend connections in other networks.

Some users reported technical problems, few couldn't install the application and make it work and some reported the location sending feature did not work.

4.2.3 Findings

Similarly to the Sports Tracker experiment the amount of data gathered did not meet expectations. This strengthens the assumption made after the Sports Tracker experiment that qualitative methods should be integrated to the service experimentation process along with current methods. Focus groups can be a suitable method to give insight into user experience regardless of how much a service was used.

The biggest challenge for Ovi Contacts appears to be external. Most users seemed to think that technically there was not much wrong with Ovi Contacts; users simply did not have enough friends with Ovi accounts using the service. Users already have accounts and friends in other instant messaging networks. Existing mobile IM services such as Fring already have integration with multiple networks. However, the closest "competitor" of Ovi Contacts is the phonebook in the same phone. Most users have many friends registered there and they can be instantly called or messaged. If Ovi Contacts could benefit from this network already on the phone, there might be considerable opportunity for encouraging user adoption.

The results of the experiment were sent to Nokia. The report was based on the outline presented in section 3.4. In the feedback from Nokia it was regretted that the data plans were not available in time. The company supposed to provide the data plans apparently had problems in allocating enough free data plans in the short time frame. It was also recommended that in future experiments some examples on how the service could be used should be provided. Demo sessions and face-to-face meetings with users should be arranged to try to incite user participation. Finally students from various backgrounds should be included.

5 Conclusion

This final section presents the results and main findings of this thesis, the main limitations and how the findings could be exploited. The thesis is concluded with proposals for future research.

5.1 Results

The establishment of SizzleLab is gradually starting to take place in OtaSizzle. At its core it is a place to do both scientific research and service experimentation by collaborating with users. Ideally users will also benefit from useful new services, developed both in house and externally, both open and closed source. The technological infrastructure, software and methods can even be copied to new locations; only the users cannot be copied leaving the challenge of inspiring users if SizzleLab is ever copied somewhere else.

The objectives of the research were met and research questions were covered in previous chapters. The mode of operation of SizzleLab has become clearer during the work done during this thesis. Value proposition and efficiency issues were also covered although the main focus was on the experimentation framework. In the framework, experimentation proceeds step-by-step; from contact with service developers to screening services for suitability, to interacting with service developers and planning the goals of experimentation to launching the experimentation with end-users, and finally to reporting the results and receiving feedback.

The full framework was tested in the Ovi Contacts experiment and partially in the Sports Tracker experiment. In the Sports Tracker experiment 28 users with GPS-enabled phones were invited and 11 of them participated in device measurements. Seven users provided usable questionnaire replies. In the Ovi Contacts experiment out of 46 users 11

participated in device measurements. Twenty users provided usable questionnaire replies. In both experiments the users were predominantly technical university students, male and in their twenties.

In the Sports Tracker experiment data collection, data analysis methods and reporting was tested successfully. Device measurements enable comparisons with other services and provide insight such as adoption and time context information. Questionnaires provide insight in the satisfaction levels of users and provide a platform for open feedback. Reports for this kind of service studies can be standardized to an extent. A setback with the Sports Tracker experiment was the small amount of usage observed and that it was not possible to test the complete feedback loop with developers.

The Ovi Contacts experiment was as the Sports Tracker experiment, challenged by the lack of data gathered. Data plans promised for users were not available in time resulting in a poor incentive for the users. The type of data gathered demonstrates the need for integrating interview evaluations in to the experimentation process. Apart from the lack of data the results seem promising. Data analysis was efficient; the whole experimentation framework was applied and functioned well. Contact with the service stakeholders was made and common goals were reached within the limitations of the data. Although setting up the panel is cumbersome, launching experiments is lightweight. Reports can be standardized to a satisfactory extent and compiled efficiently.

For the goal of “closing the feedback loop to developer” the current approach is quite slow (due to time in setting up the research panel) and there is the risk of little observed usage. In the final section (5.4) a more direct approach is suggested for experimentation of single services. As for larger scale (holistic device usage) and longer term studies (both of which Living Labs are especially suitable for) SizzleLab seems promising as is. Long term studies on mobile services adoption, social behavior, and mobile social media seem feasible. SizzleLab could also be used as a test market of early adopters.

Following is a summary of the strengths and weaknesses of OtaSizzle service experimentation.

- Strengths:
  - Usage measured in realistic contexts
  - Efficient after initial set-up
  - Reports can be standardized to an extent
  - Potential for scaling to long-term and large scale experiments
  - Potential for a combination of scientific research with service experimentation

- Weaknesses:
  - Lack of qualitative data
  - Initial set-up cumbersome
  - The whole experimentation loop still quite slow
  - Biased datasets

5.2 Limitations

The main limitation in the results of this thesis was the lack of data gathered. Future experiments should feature interviews to better understand users' experience (see section 5.4, future experiments).

Other main considerations:

- *Undelivered promises:* A limitation concerning the Ovi Contacts experiment was the promised mobile data plans not being available in time. It is believed that many users did not participate because of this. In future experiments, setbacks such as these should be avoided if possible.
- *Setting up and maintaining the research panel:* For the goal of closing the feedback loop to developers, setting up the research panel was too time consuming. Once the panel is established experiments can be conducted rather efficiently, however during this time the risk of users dropping out increases as was also observed by Schuurman et al (2009).
- *Slightly slow experimentation loop:* Considering the competitiveness and fast-paced development needs of current ICT markets, the experimentation loop might be too slow for some needs. Currently it is possible to launch a service in the Internet and gather instant feedback from servers and the Internet within the matter of hours. However there is a tradeoff in being fast and providing long-term analysis. OtaSizzle is probably better suited in providing long-term analysis rather than the fastest feedback to developers.
- *Biased datasets:* The participants are still mostly technical university students, although in theory OtaSizzle now includes members from Helsinki School of Economics and University of Arts and Design. Including groups of users from various backgrounds and doing comparisons could prove valuable.

5.3 Exploitation of the results

The key take away from this research is the insight into the potential value of experimentation environments such as OtaSizzle. OtaSizzle combines technical development, scientific research, service experimentation and open-source development in a novel way. There are various opportunities for researchers, both external and internal developers and end-users.

From service experimentation point of view, OtaSizzle could be an interesting combination of research combined with an economically feasible way to experiment services for external developers. Compared to traditional research done in limited settings and populations, OtaSizzle's advantage is access to the university student body with its various social circles. Methods such as in-device measurements enable experimentation in realistic contexts and at best are quite unobtrusive. The value OtaSizzle can provide is increased with the openness of the service. Services could be integrated with OtaSizzle technical interfaces, so that existing social networks could be ported to new services. The community could develop new functionality and detailed server data could be analyzed. Especially start-up companies could considerably benefit from participating in OtaSizzle as they could leverage the already existing end-user networks.

Apart from targeted service experimentation, OtaSizzle could be used as a test market for selected services. The services and their business models could be tested in the OtaSizzle community before full-fledged market launches. It is also possible to do more detailed experimentation such as usability studies.

From research point of view there are promising opportunities especially in the research of service adoption, social networks, user experience and user behavior. The framework presented in this thesis can be used as a guideline to collect data and get started on research on these various topics.

5.4 Future research

A more direct approach is recommended for future service experiments. To make experiments faster, to incite more *active* usage and have a better understanding of users' experience small group(s) of "*service testers*" could be formed. These testers would have subsidized handsets (with measurement software pre-installed) and data plans in exchange for taking part in service testing. They would be handpicked as groups of friends to make sure social studies are possible. The size of the group would be less than 10 users as users apparently actively communicate with less than ten people on social media, even if they have hundreds of "friends" listed (Economist, 2009). There should be groups of students from various disciplines; including arts and business, to reach a more diverse set of end users than the groups in this study that were mainly students of technical disciplines.

The researcher would go to the campus cafeteria with a bunch of shiny new phones (with measurement software pre-installed), find a group of friends gathered around a table and ask if they would like to have these phones. In exchange, the service testers are expected to participate in service experimentation sessions around twice a month.

For each new service study there would be a starting session where the testers install the service application together and do other configurations such as add each other as friends in case of social applications. After the starting session usage is observed for a week or two. Then another meeting will be held where the testers are group interviewed for their insights. If the service was adopted by the testers and gathered substantial usage, the data can be analyzed for interesting results such as comparison charts, usage frequencies, and time context data. If the service was not received so positively the focus can change to improving the service, for instance the interview can be followed up with usability tests. In either case the developers receive users' insights on their service in less than a month. The problem with little observed usage with both experiments in this thesis would be solved.

The large scale SizzleLab panel with over a hundred users would continue along this smaller group or groups of service testers to provide insight on long term holistic usage of services. Test services can also be launched in the big panel simultaneously to compare how they are adopted between the small and tight group compared to the bigger and less connected group.

In this manner, future service experiments should support gathering of both qualitative and quantitative data to provide good foundation for research under a variety of topics such as service adoption, social networks, user experience and user behavior research.

Now that well over a year has been spent on planning and setting up the OtaSizzle infrastructure and operations, it is the perfect time to start producing results in terms of research publications, services reaching the market and collaboration in various contexts. In the future OtaSizzle will hopefully become a vibrant collaboration space with many companies, researchers and end-users from various backgrounds innovating together to support the emergence of mobile social media.

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