Sanna Peltonen, Tommi Siljamäki & Miia Lammi

Systemic service design on voluntary water monitoring

Case study: Water ecosystem information as a source of user-centered services

MUOVA

Design research 1/2014

Publisher
Design Centre MUOVA
Vaasa University of Applied Sciences
Wolffintie 36 F 11
66500 Vaasa
Finland
www.muova.fi

MUOVA Design Research 1/2014
Published: December 2014
ISSN: 2342-7337
ISBN: ISBN 978-952-5784-28-2 (PDF)

Layout and graphics: Design Centre MUOVA

Table of content

Table of figures

Abstract

In Finland, the process of gathering information about water systems has been heavily dependent on public organizations. Decreasing resources as well as the implementation of environmental directives, such as the EU Water Framework Directive, have called attention to the need for new and more cost-effective ways to produce the relevant information. The voluntary work of citizens has been raised as one potential resource for supplementing official water quality monitoring in the monitoring strategy of the Ministry of the Environment in Finland.

Voluntary water quality monitoring has not been comprehensively studied in Finland. However, a deeper understanding of volunteers is urgent because organizers of voluntary activities, both public and private partners, share the concern of finding and keeping committed and skilled volunteers. Reliable volunteers are important when aiming to build a service system, which uses the data provided by volunteers. An efficient service system for water information requires a sufficient quantity and quality of data, a fact which is the basis of the organization of the service system.

This publication presents the results of an explorative case study, focusing on studying, developing and testing methods for service design on a systemic level. Voluntary water quality monitoring was used an as empirical framework for the study. The case project built upon an academic conceptual design process where the research phase preceded conceptual design. As a result of the user and trend research, four main themes were identified for the development of new services. These themes formed a driving framework for service concept development. The identified themes were: (1) easy data gathering, (2) interfacing with everyday life, (3) learning and understanding, and (4) entertaining fact and fiction.

The first theme included a cluster of concepts for improving the current monitoring activity. These concepts provide new tools for gathering and documenting the data in a digital and up-to-date form. Concepts were designed to solve problems in the current monitoring activity and to provide useful and rewarding information for the user. The second cluster of concepts included service concepts that aim to connect water-related information into the wider context of the everyday life of users. The third cluster of services, provide solutions for the support and improvement of the understanding and interpretation of the collected data. Concepts provide a platform for sharing and commenting on the data gathered nationwide by other volunteers. And finally, the fourth cluster of services includes concepts, which bring the water-related information closer to the general public (especially for younger generations).

For the first time, service design methods were applied within the context of voluntary water quality monitoring. The service design approach brought user-orientation to the development project. A new understanding of volunteers as users of services opened up new ways for citizens to participate in the gathering, sharing, and using of water ecosystem information. User-orientation concretized service value for users and explained the contexts of using services. Especially, a value-driven service system design opens new services, which offer means to gain meaningful content in a volunteer's world.

Keywords: Service design, Systemic approach, Voluntary work, Water quality monitoring

Tiivistelmä

Vesistöihin liittyvän tiedon kerääminen on Suomessa perinteisesti ollut julkisten organisaatioiden tehtävä. Tulevaisuudessa vastuuta ympäristötiedon keräämisestä on kuitenkin hajautettava myös muille toimijoille. Julkisten resurssien väheneminen sekä lisääntyvät vaatimukset esimerkiksi EU:n lainsäädännön myötä pakottavat hakemaan uusia, nykyistä kustannustehokkaampia tapoja tuottaa tarvittavaa informaatiota. Kansalaisten vapaaehtoisuuteen perustuva työ on nostettu esiin yhtenä lisäresurssina ympäristöministeriön vesistöseurantaan liittyvässä strategiassa.

Vapaaehtoista vesistöseurantaa ei ole Suomessa kattavasti tutkittu. Vapaaehtoisten vesistöseuraajien motiivien ja toiveiden ymmärtäminen on kuitenkin kriittisen tärkeää, sillä vapaaehtoistoimintaa järjestävät tahot, niin julkisella kuin yksityiselläkin sektorilla, ovat riippuvaisia sitoutuneista vapaaehtoisista. Luotettavat ja osaavat vapaaehtoiset ovat erityisen tärkeitä silloin, kun vapaaehtoisten keräämä tieto on keskeinen osa kokonaista palvelujärjestelmää. Vesistötietoon pohjautuva palvelujärjestelmä voi toimia ainoastaan, mikäli se voi nojata riittävään määrään laadukasta informaatiota.

Tämä julkaisu esittelee kokeellisen tapaustutkimuksen tuloksia. Projektissa tutkittiin, kehitettiin ja testattiin erilaisia palvelumuotoilun menetelmiä järjestelmätason suunnittelussa. Vapaaehtoinen vesistöseuranta muodosti tutkimuksen empiirisen viitekehyksen. Tapaustutkimuksen kohteena oli akateeminen konseptimuotoiluprosessi, jossa tutkimusvaihe edelsi konseptointia. Käyttäjä- ja trenditutkimuksen pohjalta tunnistettiin neljä keskeistä teemaa uusien palveluiden kehittämiseen. Tunnistetut teemat olivat (1) vaivaton tiedon kerääminen, (2) yhtymäkohdat muuhun arkeen, (3) oppiminen ja ymmärtäminen, sekä (4) viihdyttävä asiasisältö.

Ensimmäisen teemaan kuuluvat konseptit tähtäsivät nykyisen vesistöseurannan kehittämiseen. Konseptit sisältävät uusia työkaluja tiedon keräämiseen. Konsepteja yhdistävänä nimittäjä on ajantasaisen tiedon tuottaminen digitaalisessa muodossa. Konseptien tarkoituksena

on ratkaista nykyisessä vesistöseurantatoiminnassa havaittuja ongelmia sekä tarjota käyttäjälle hyödyllistä ja palkitsevaa informaatiota. Toiseen teemaan kuuluvien konseptien tavoitteena on integroida vesistöön liittyvä informaatio osaksi käyttäjän muuta arkielämää. Kolmanteen teemaan kuuluvat palvelut tukevat käyttäjää ymmärtämään ja tulkitsemaan kerättyä dataa. Konseptit luovat alustan kerätyn datan jakamiselle muiden vapaaehtoisten vesistöseuraajien kesken. Neljänteen teemaan kuuluvat palvelukonseptit tuovat vesistöistä kerätyn tiedon lähemmäs suurta yleisöä, erityisesti nuoria.

Palvelumuotoilun menetelmiä sovellettiin tässä tutkimuksessa ensimmäistä kertaa vapaaehtoiseen vesistöseurantaan. Palvelumuotoilu toi suunnitteluun käyttäjälähtöisen näkökulman. Vapaaehtoisista luotu ymmärrys palveluiden käyttäjinä, loi kansalaisille uusia mahdollisuuksia osallistua vesiekosysteemitiedon keräämiseen, jakamiseen sekä hyödyntämiseen. Käyttäjälähtöisyys auttoi konkretisoimaan palvelun luomaa arvoa käyttäjille sekä tunnistamaan palveluiden käyttökontekstista suunnittelun kannalta merkityksellisiä tekijöitä. Arvoperusteisen palvelujärjestelmän muotoilun keinoin pystyttiin löytämään uusia käyttäjille merkityksellisiä palveluita.

Avainsanat: Palvelumuotoilu, Systeeminäkökulma, Vapaaehtoistyö, Vesistöseuranta

Acknowledgements

The article is based on a VET Combo research project (2011-2014), which was a multidisciplinary research collaboration between University of Helsinki, The Department of Environmental Sciences and Lammi Biological Station, Finnish Environment Institute (SYKE), University of Jyväskylä, The Department of Biological and Environmental Science, and Design Centre MUOVA (before 2014 Aalto University and University of Vaasa, after 2014 a collaboration platform of Vaasa University of Applied Sciences, Aalto University and University of Vaasa). The project was co-funded by Water program of Tekes, the Finnish Funding Agency for Technology and Innovation, the universities and participating organisations: JPP Soft, Kemijoki Aquatic Technology, Länsi-Uudenmaan Vesi ja Ympäristö ry, Vanajavesikeskus, The Lake Vesijärvi Foundation, and Yle.

We would like to express our gratitude to Tekes and the project partners for the inspiring project and truly eye-opening collaboration. Water information services have begun their journey in the crossroads of forerunning organisations. There is still a lot of potential to be harvested in the field of environmental information services. We believe the future will surprise us with innovative solutions that change value systems and hopefully also create a more sustainable world.

1. Introduction

In Finland, the process of gathering information about water systems has been heavily dependent on public organizations. Decreasing resources as well as the implementation of environmental directives, such as the EU Water Framework Directive, have called attention to the need for new and more cost-effective ways to produce the relevant information. The voluntary work of citizens has been raised as one potential resource for supplementing official water quality monitoring in the monitoring strategy of the Ministry of the Environment in Finland (Ministry of the Environment, 2011).

In Finland, the key organizers of official voluntary water quality monitoring are currently the Centers for Economic Development, Transport and the Environment, the so-called ELY Centres. However, the water monitoring activity lacks nationwide systematic organization as well as continuity, functioning merely on a project-by-project basis. This creates a contradiction with the long-term nature of commitment to voluntary monitoring. In addition to the public ELY centers, different local societies addressing water conservation complement official water monitoring and therefore they play an important role in the field.

Voluntary water quality monitoring has not been comprehensively studied in Finland. However, a deeper understanding of volunteers is urgent because organizers of voluntary activities, both public and private partners, share the concern of finding and keeping committed and skilled volunteers (Peltonen et al., 2012). Reliable volunteers are important when aiming to build a service system, which uses the data provided by volunteers. An efficient service system for water information requires a sufficient quantity and quality of data, a fact which is the basis of the organization of the service system.

At the moment, voluntary water quality monitoring has not received intensive attention in public discussion. However, some preliminary ideas for developing voluntary water quality monitoring have been introduced. For example, web-based platforms have been identified as a means of promoting and maintaining civil monitoring activity in the future. Community networks published by users, social media, and cooperation platforms not only could link and guide data collectors, but could also provide a channel to give immediate feedback to voluntary data collectors from the organizers (Ministry of the Environment, 2011). Communication tools for users could enhance a sense of community and increase communication between volunteers and the organizations arranging volunteer activities. Additionally, the cooperation platforms could increase the attractiveness of voluntary water monitoring in case it brings additional value for users.

Previously, voluntary activity was researched in the field of citizen science, which entails enlisting the public in gathering, creating or processing scientific information. Citizen science has considered suitable approaches to studying large-scale natural patterns, which require a vast amount of data to be collected across an array of locations over an extensive time span (Hill et al., 2012; Bonney et al., 2009). It studies the participation of volunteers from the conservation strategy point of view and engages a network of volunteers to assist in professional research using methodologies developed by or in collaboration with professional researchers (Cooper et al., 2007).

Additionally, the focus on environmental volunteering research has covered the motivations, barriers and benefits of volunteering in environmental issues (Gooch, 2003; O'Brien and Ebden, 2008). Research in environmental volunteering acknowledges that more intensive reliance on volunteers creates a need to find tools to elicit and maintain the motivation of volunteers (Anderson and Cairbcross, 2005).

However, the current research on environmental volunteering and citizen science seems to lack the business and systemic perspectives. The service business approach highlights the need for identifying the service value of future customers and for creating meaningful services for them. When business is regarded comprehensively, the systemic view is inherently included in the business perspective. Business is a system of actors, value creation and the transfer of information and money. Provision of services requires a collaboration of various players, such as private firms, public institutions, voluntary associations and, directly or indirectly, the end users themselves. The actors interact with each other in order to produce a commonly recognized value (Manzini, 2004, 2009). Identification of key network partners and their roles in the value network is essential when creating new services on a systemic level.

1.1 Systemic services and service design

The societal development towards service economy creates a demand for new services, which are more complicated and contextualized than before (Manzini, 2004, 2009). Service systems consist of service providers and customers working together for co-production of value in complex value chains or networks (Spohrer et al., 2007)

The network approach means that organizations need to focus on business development not only at the company and the industry levels, but on the value-creating system itself. In the system, different actors, for example suppliers, partners, allies, and customers, work and produce the value together (Peppard et al., 2006). In these multidimensional value networks, providers and clients may refer to individuals, firms, government agencies, or any organization of people

and technologies (Spohrer et al., 2007). The number and variety of people, technologies, and organizations linked in the value creation network describes service system complexity (Maglio et al., 2006). However, the complexity of service value networks depends not only on the number of actors but also on the activities that these actors actualize in delivering the service to the customers (Basole & Rouse, 2008).

Service value is driven and determined by the end customer and delivered through a complex web of direct and indirect relationships between value network actors (Basole & Rouse, 2008). Building a network of actors for a service solution development and creating a shared vision, are new challenges that must be faced at different stages of systemic development (Krucken et al., 2006). The role of service provider is to support the value-creation of customers with resources and interactive processes such as goods, service activities and information. Even though services are regarded as mediators in the value-creation process of customers, value needs to be created through a business engagement among suppliers as well. (Grönroos & Ravald, 2011)

A service design is often described as a holistic approach, which studies and develops systems and subsystems of relationships and interactions. It takes the context of service into consideration, being aware that services are living systems (Mager, 2009). Design contributes to the development of systemic solutions, when different actors, for instance companies, institutions and end users, join their effort in order to solve common problems and achieve shared goals (Morelli, 2006).

Service design addresses the functionality and form of services from the perspective of a user. It aims to ensure that services are useful, usable, and desirable from the client's point of view and effective, efficient, and distinctive from the supplier's point of view (Mager, 2009). Designers bridge business, technology and design perspectives when creating solutions that do not exist today (Mager, 2009). This is the competence of design that could be utilized more effectively in the context of service systems (Nieminen & Mattelmäki, 2011).

Even though service design is dedicated to a holistic approach, so far the primary focus has been on singular services. (Nieminen & Mattelmäki, 2011) This means that designers have no methodologies available when a design process focuses on systemic aspects and aims at a final result co-produced by a network of social actors (Morelli, 2006). This paper contributes to research on service system design by proposing methods and tools that have been effectively applied to a systemic level of design.

1.2 Purpose of the paper

This paper proposes a practice-based framework for an extension of user-centered design to a service value network. The study describes the process of creating user-centered service systems in the context of voluntary water quality monitoring. The main activities cover the phases of identifying service value for the user, transferring the knowledge into concept design and applying the systemic perspective to service concepts.

2. Systemic service design for volutary water monitoring

This paper builds upon an academic concept design project conducted 2011–2013 in Design Centre MUOVA. The project studied and developed a user-centered service ecology vision for the services related to water ecosystem information. The study was based on the hypothesis that value creation for customers is a perquisite for creating meaningful service concepts as well as spotting new business opportunities. This assumption raised a question: How can both user-centered and systemic approaches be engaged in creating service ecology vision in the context of voluntary water quality monitoring?

The research question is twofold. Firstly, it implies the need to understand volunteers as users of new services in order to propose value-creating factors. Secondly, it raises the need for a systemic perspective to the scene. Especially, in the case of user-centered service ecosystem development, it was found important to understand how this kind of a service ecosystem would appear to the end user.

This paper proceeds as follows: The next section gives an overview of the context of the research of voluntary water quality monitoring. Thereafter, the design process elaborates through the case project and the results of the design process are introduced as service concepts. The concepts represent the service ecosystem from the user's point of view in an illustrative way. And finally, the paper proposes a practice-based framework for user-centered service system design for value networks.

2.1 Voluntary water quality monitoring

In this paper, voluntary water quality monitoring refers to monitoring of water transparency conducted by volunteers using Secchi depth as a tool. Secchi disk measurements reveal how deep sunlight can reach into a body of water, indicating a general reading of its quality. Measurements are typically taken twice per month during the open water season (Hudson, 1998). A Secchi disk is one of the least expensive and easiest to use tools in water quality monitoring. The information provided by the Secchi disk is easily interpreted by volunteers and can be used for detecting water quality trends in water systems (Minnesota Pollution Control Agency, 2008).

Voluntary water quality monitoring was the focus of our study because it is the only way for citizens to participate in organized water monitoring (at least at the moment) in Finland. Also, a more intensive use of volunteers in monitoring calls for an understanding of why and how people

participate in this kind of activity. In other words, we need to understand what creates value for volunteers.

The case study examines voluntary water quality monitoring in the context of leisure time instead of volunteering. Spare time needs to be considered a scarce resource, dispensing with different hobbies and free time activities. Only the most satisfying and rewarding activities win the race. Voluntary work has to find its place in this arena as well. The leisure time context was hypothesized to provide a new perspective for identifying the attractive elements of the activity and creating services for increasing the competitiveness of water quality monitoring. Identifying and understanding the components and evolution of user experience were found to be essentially important starting points for design when creating unique and meaningful experiences for users.

2.2 The design process

The research was explorative case study, because previous studies lack a solid methodology for systemic service design. Voluntary water quality monitoring offered an experimental design project for studying, developing and testing methods for service design on a systemic level. The case project built upon an academic conceptual design process where the research phase preceded conceptual design. The process was iterative in nature and therefore different phases of the project rather overlapped and created sub-processes that followed each other sequentially. However, this article describes the process as the categorization of the main phases: Research, interpretation and creation.

2.2.1 The research phase

The design process began with the research phase, which included the gathering of background information and user data. The areas of interest in the background study were the present context of voluntary water quality monitoring as well as the activities and actors in the field. On the other hand it was critical to create deep understanding of the value creation of the volunteers participating in water quality monitoring.

The construction of user understanding aimed at building a rich knowledge bank for informing the latter parts of the design process and creating the source of inspiration for the design team (Kumar, 2012). Both traditional user research methods such as interviews, a survey and a more design-led research method, design probes were used (Peltonen et al., 2013).

In our case study, the survey was especially important in revealing what motivates volunteers in the current activity. The motivating factors of volunteers were seen as a key starting point for

identifying value. The context of leisure time framed the activity towards outdoor activity instead of volunteering. The new framing broadened the themes for the user studies and produced a holistic database of users, their activities and motivations.

The study uncovered a number of self-interested reasons for volunteers to find participation both attractive and valuable. The motives covered the need for a sense of belonging, personal growth, and experiencing nature, for example. The motives suggest new perspectives for discovering the possibilities to create service value for volunteers. The users were categorized into three types of volunteers, who differ in their motivations and experiences of current activities (Peltonen et al., 2012).

2.2.2 The interpretation phase

The next phase, interpretation, entailed interpreting the gathered data, structuring the findings and providing a manageable abstraction of reality. The main tasks in the phase were processing the data, analysis and reframing the data in order to turn key insights into actionable principles for idea generation and concept development (Kumar, 2012). The interpretation considered describing users, use processes, and the value elements of the activity. These methods facilitated the creative transition from understanding of users into service design solutions.

The motivating factors found from the survey were analyzed and modified to the elements of service value. The value elements were abstracted into design drivers, in order to define the driving forces for the design process. In addition, the visualization of the service journey concretized current user processes and activities provided by organizers of voluntary water quality monitoring.

For service design purposes, personas described and visualized the three clusters of volunteers identified in the research phase. According to Miaskiewicz and Kozar (2011), personas is a good method for representing and communicating customer needs in a way that provides designers with a vivid representation of the design target. Personas are useful for compressing a broad range of information and for communicating the main results of user research (Pruitt and Grudin, 2003).

2.2.3 The creation phase

Finally, the purpose of the last phase of the design process, creation, was to generate solutions for identified needs and service value elements. The solutions were visualized in the form of service concepts. In the creation phase, brainstorming of the design team was used for creating new service ideas. The driving themes for the brainstorming stemmed from the service journey,

personas, design drivers and design probes. The sequenced brainstorming sessions contributed to the design of value-creating service concepts. The service ideas gave way to the service concepts, which were organized into a system of concepts. Service images were used for describing and visualizing the service concepts and their value for the customer. The service concepts were presented as user or use cases of the service.

In order to identify new business opportunities and to expose the systemic level of service solutions, the design of service concepts extended to the development of service offering maps and actor maps. The critical phase for systemic service design was the combination of user-orientation and systemic perspective. Therefore the concepts were presented as a system of concepts.

2.3 The System of Concepts

As a result of the data analysis, four main themes were identified for the development of new services. These themes formed a driving framework for service concept development. The identified themes were: (1) easy data gathering, (2) interfacing with everyday life, (3) learning and understanding, and (4) entertaining fact and fiction (Figure 1).

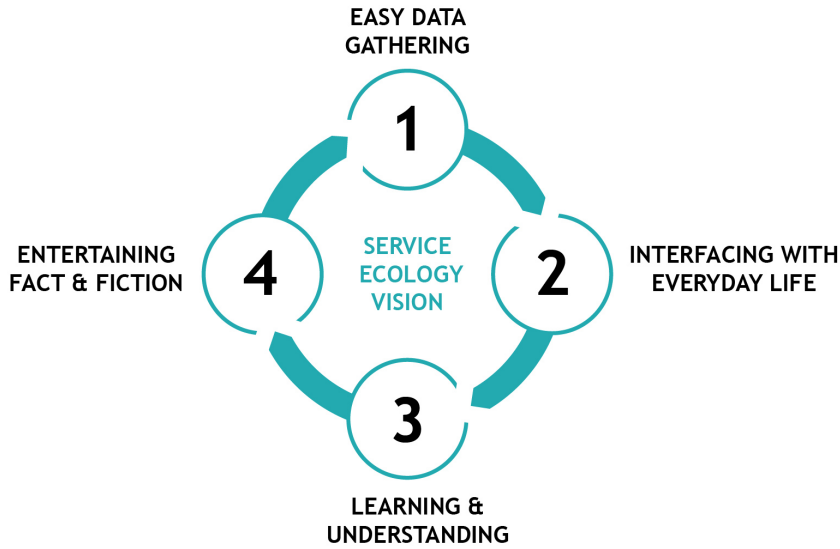

Figure 1. Themes of the System of Concepts

The first cluster of concepts included concepts for improving the current monitoring activity. The concepts within this theme provide new tools for gathering and documenting the data in a digital and up-to-date form. Concepts were designed to solve problems in the current monitoring activity and to provide useful and rewarding information for the user. Concepts and their reasoning are explained in chapter 2.3.1. Figure 2 presents a service picture related to the theme Easy data gathering.

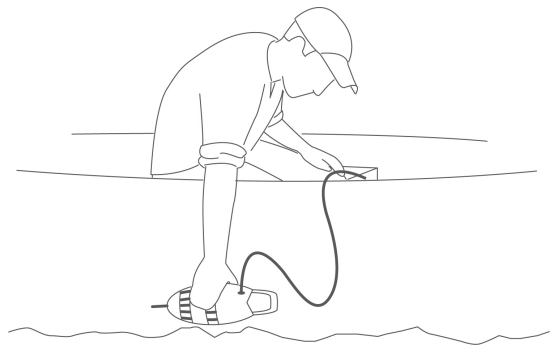

Figure 2. Visualization of the theme Easy data gathering

The second cluster of concepts included service concepts that aim to connect water-related information into the wider context of the everyday life of users. This cluster of concepts is called interfacing with everyday life. Concepts in this cluster are presented in chapter 2.3.2. Figure 3 presents a service picture related to the theme Interfacing with everyday life.

Figure 3. Visualization of the theme Interfacing with everyday life.

The third cluster of services, provide solutions for the support and improvement of the understanding and interpretation of the collected data. Concepts provide a platform for sharing and commenting on the data gathered nationwide by other volunteers. These service concepts are described in chapter 2.3.3. Figure 4 presents a service picture related to the theme Learning and understanding.

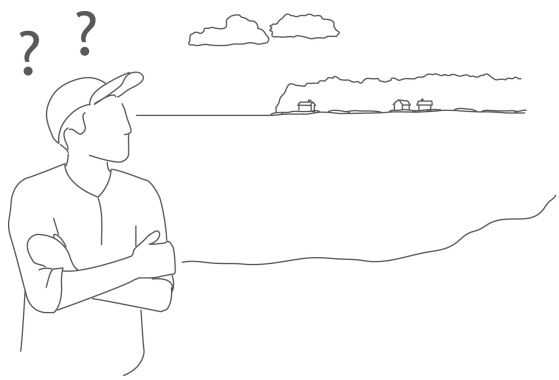

Figure 4. Visualization of the theme Learning and understanding

The fourth cluster of services includes concepts, which bring the water-related information closer to the general public (especially for younger generations). The concepts belonging to the theme known as 'entertaining fact and fiction' are constructed in the form of water knowledge games, which are based on the real data and other information gathered in the monitoring. These games can act as an inspiration for the actual water measuring activity and a motivator for future volunteers. These service concepts are described in chapter 2.3.4. Figure 5 presents a service picture related to the theme Entertaining fact and fiction.

Figure 5. Visualization of the theme Entertaining fact and fiction

2.3.1 Easy data gathering

As a practical activity, gathering water quality data means conducting the measurement once or twice in two weeks. Monitoring is made in a place selected by volunteers with standard monitoring equipment. In many cases, monitoring results are handwritten marks on paper and transferred to the form or spreadsheet once the monitoring period is completed. Filled forms are sent by mail to the organizer after open water season. If the volunteer has used a spreadsheet, results are sent by email.

In the case of official water quality monitoring, the organizer compiles a report including all monitoring results from the whole monitoring period. In this report, the monitoring results are visualized with tables and graphs. The report is sent to all local volunteers during spring. Some organizers feed monitoring results to the GIS portal or the Järviwiki web service, which are the information platforms of lakes.

Based on the understanding created in the research phase, some notions were made concerning the current service journey: (1) collected data is not in an electronic form, (2) sending of the results is delayed because it is made only after the monitoring period, and (3) volunteers do not get any instant feedback from their activity, and (4) understanding and interpretation of data is supported with visualizations which are printed in a summary report.

Regarding the monitoring, it was found that many volunteers felt insecurity when interpreting the results provided by the Secchi device. In the instructions, volunteers were guided to re-run the measurement a couple of times in order to confirm the accuracy of the results. In order to decrease the feeling of insecurity in interpretation of results and increase the quality and

reliability of the results, this problem was taken into deeper consideration. The theme 'easy data gathering' focused on this subject.

The concept called 'Deep Driver' is described in the user scenario where the volunteer conducts water quality monitoring with a new intelligent device, Deep Driver. The device is placed into water to take automatic measurements. The concept of the easy data-gathering service, Deep Driver, is presented in Figure 6.

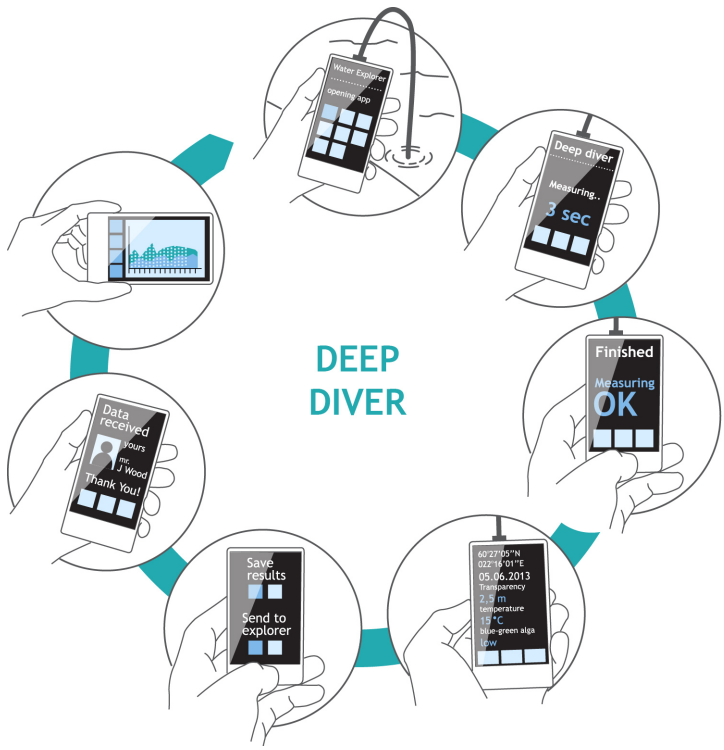

Figure 6. Easy data-gathering device, Deep Diver

The device will automatically register several pre-defined values by using its sensor technology. In addition to water transparency value, the exact place of measuring, time and date registers for each measurement taken. Also other values such as water temperature and occurrence of cyanobacteria could be detected at the same time.

Registered values are sent by the mobile application to the database immediately after measuring is completed. This feature is important when aiming to minimize the delay in receiving

the information. Electronic data format also makes it possible to offer instant feedback in the form of visualizations and comparisons of the data with previously collected information.

2.3.2 Interfacing with everyday life

Previous research (for example Gooch, 2003) has suggested that positive experiences and emotional attachments to familiar places can motivate people to care for them, and learn more about them. This attachment can also lead people to a heightened level of ecological consciousness, and a deep level of personal fulfillment. This phenomenon is called 'a sense of place.' This kind of attachment takes time to develop, and can be enhanced through shared stories, memories and experiences. A 'sense of place' can help to build a sense of belonging, and a sense of community, through the collective efforts of local residents, working together to achieve positive outcomes (Gooch, 2003)

The importance of sense of place was also identified as an important motivating element in our research. The majority of volunteers were monitoring the body of water near their home or summer cottage. Volunteers often expressed positive memories and nostalgic feelings toward the water area. Volunteers in user studies pointed out the importance of improving the quality of water, working on local matters, nature conservation, and information collection for possible restoration activities.

The underlying assumption in the concepts under the theme of 'Interfacing with everyday life', was that entwining water-related information with other pieces of information, form a coherent whole which have more relevance to people than separate pieces of information on their own. All pieces of information are gathered into one portfolio, Water Explorer, which is in fact the heart of the whole system of concepts.

The concepts under the theme 'Interfacing with everyday life' are tools for constructing personal Lake Book, which generates user's own world around the lake or lakes. Both service concepts are based on a user scenario where a father and son are fishing at a lake and using different features of the Water Explorer portal.

2.3.2.1 Lake View Diary

Lake View Diary is the application which allows users to document their personal experiences and memories related to nature to the database. Personal notes can be done in the form of photos, text and videos by using a mobile application on the spot. The application uses artificial reality mode, which combines real-life scenery with additional information based on a location or content in an interface of a mobile phone or tablet.

The application composes photos into Lake View, in a similar form as Google Street View. In Lake View Diary the nature, lake views, landmarks and places meaningful for a user, can be explored in a panoramic view. The application provides an easy way to share and save their favorite views and happenings. The application utilizes GPS technology in linking photos and other content to the location.

Photos gradually construct a personal view of the lake. The collected material is stored in the user's personal diary called Lake Book. A user can select the information he wants to keep private and what to share with others. The shared information serves the open public and can be used in marketing, tourism or other businesses. The Lake View Diary is presented in Figure 7.

Figure 7. Lake View Diary

The main value in this easy-to-use and always available application is in providing a tool for making versatile observations of water environment. Observations are not only for documenting the user's personal lake view but also for constructing a wider view, which describes the overall state, experiences and personality of a lake. The cumulative observations taken over the course of

years can be used for example when planning conservation activities or tracing the changes in the state of water quality.

2.3.2.2 Environment ID

The concept 'Environment ID,' describes a user scenario of a father and son fishing at the lake and catching a great fish, which they want to identify and measure. Perhaps they also want to share this great moment with others in the community or with their family. The Environment ID application provides a convenient tool for this personal and social collection of experiences. Photos and identification results are stored in the user's personal Lake Book, which also enables the user to control the visibility of information. This concept is visualized in Figure 8.

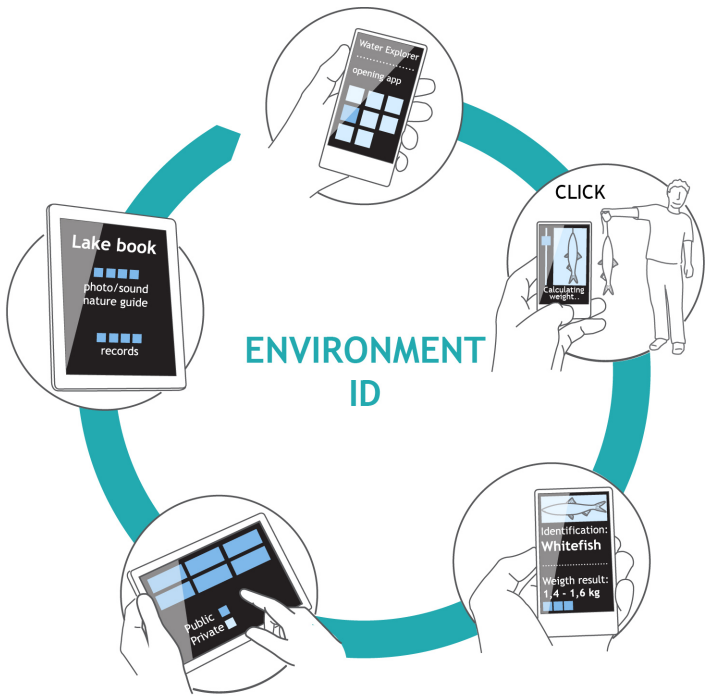

Figure 8. Environment ID

The application can be used for identifying and documenting a wide range of observations such as plants, animals or weather. In addition to photos, audio material can be recorded and used in bird identification or documenting the audio environment at the lake, for example. The features

enable the use of the Environment ID application as a learning tool; it can make some suggestions of what the observations indicate about the condition of the local natural environment. Also in this concept, the application captures the coordinates automatically and links them to photos or audio material.

2.3.3 Learning and understanding

Anderson and Caircross (2005) refers to Willis (1991) when suggesting that volunteers offer their services in exchange for receiving social contacts with others, personal development, skill acquisition and learning. They also can challenge themselves and get experiences of achievement. For some users it is important to make a contribution to society. Also Clary et al. (1998) found that new understanding is an important function of volunteering. In their study the function of understanding included new learning experiences and the chance to exercise knowledge, skills, and abilities.

Learning and personal growth were also identified as important motivating reasons for volunteering in water quality monitoring in our research. The study revealed some typical objectives in learning such as how a lake functions, assessment of general water quality and trends, or diagnostics of lake problems. Volunteers found it interesting to discuss water monitoring and its results with other people and reflect upon the monitoring results and the factors underlying them. They also found that due to the water monitoring, they have been thinking about the condition of the lake nearby more often than before. Exploring their own data and comparing it to their previous data and the data provided by other volunteers and environmental authorities were also seen as interesting and inspiring activities of monitoring.

In her study, Gooch (2003) found that volunteering allowed participants to meet 'like-minded' people, and people who share similar convictions and values. Many of the volunteers gained new friendships and a deep sense of satisfaction and joy from their joint efforts (Gooch, 2003). Also our research provided evidence for the importance of social relationships in participation in water quality monitoring. Volunteers appreciated working together with their families, spending time with people of similar interests and meeting new people. Additionally, sharing knowledge with others and working together with a community for the sake of common purpose were valuable for volunteers.

Two service concepts, Data Viewer and We-Community, were created for enhancing the theme called 'Learning and Understanding.' These concepts, Data Viewer and We-Community, are presented in the forthcoming chapters.

2.3.3.1 Data Viewer

In the user scenario for the service concept 'Data Viewer,' a person is interested to know more about the water quality of the lake nearby. He has some questions and is perhaps concerned about the development of the lake's water quality in the future. He wants to see the connection between his observations and his own monitoring data. The concept is described in Figure 9.

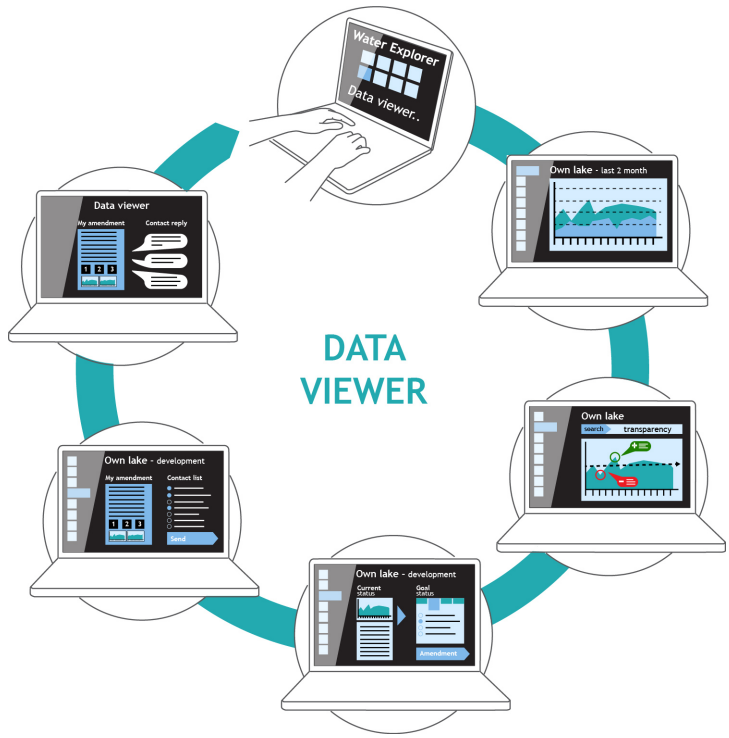

Figure 9. The Data Viewer concept

The Data Viewer application is yet again one tool in the Water Explorer portal. Data Viewer enables people to explore and discuss their own monitoring data. The core feature in Data Viewer is the data visualization tool, which visualizes the data with charts and graphs automatically. These visualizations are available online whenever the volunteer needs them. The form of the data is easy to use and illustrative, which supports the learning process.

Data Viewer also supports the knowledge creation of the volunteers by pointing out the major changes in a lake condition or other important aspects in the data. Data Viewer will

increase users' expertise not only in analyzing the water monitoring data but also in making the interpretations and conclusions based on the data.

With the Data Viewer application, the volunteers can even plan the future state of the lake by stating the goal for the future. The goal can be concrete action or a goal for improving the status of the lake, such as an increased amount of fish or more generally, better water transparency. The application enables and supports local activity and cooperation by introducing possible partners, experts and organizations related to the lake and the information.

2.3.3.2 We-Community

For strengthening the social aspects of the volunteering activity, the concept of We-Community was created. We-Community combines all water quality activists or interest groups into the same community, regardless of where they live. Users of We-Community can share their monitoring results with others, discuss topical issues, learn best practices from different areas and share their experiences and feelings. The concept is described in Figure 10.

Figure 10. The concept of We-Community

In our research, one important motivation for monitoring were nature conservation, working on local matters, improving the quality of the water and collecting information for possible restoration actions. An interaction tool, We-Community can also be used as a medium for crowdsourcing project ideas and evaluating the importance of the development projects. The We-community can also be used as a channel for introducing additional information or reports to the dedicated volunteers. It could act as a tool for closer connection with local actors, supporters and financiers for these hands=on activities benefiting nature. We-Community provides different tools for volunteers in finding comfortable roles and opportunities in the field of water protection activity. Project-based communities could be established for specific activities, for example.

2.3.4 Entertaining fact and fiction

In our research, one important yet neglected motivating element for voluntary water quality monitoring was enjoying nature. Volunteers enjoy the scenery and fresh air when monitoring water quality. It served as meaningful activity in nature. Monitoring made it possible to spend time on the water and offered pure refreshment and enjoyment of nature and lakes.

The aim of our case project was not only to create understanding of present water quality monitoring but also to apply the understanding in design process when creating ICT-based services. The role of the concepts was to encourage volunteers' participation in and commitment to the activity. This led to the question: How can an ICT-based solution enhance the enjoyment of nature? How could ICT-based solutions guide new potential user groups to experience nature? Entertaining elements were suggested to increase the interest and willingness of people to engage in activity. They also could bring potential users into the activity, especially children and young adults.

In the user scenario of theme 'entertaining fact and fiction,' a father is shown sharing his interest in nature with his children. The Water Explorer portal provides environmental information-based games for children in different age groups. These games combine fact and fiction in an entertaining and fascinating way. Because games have several activating and practice-based elements, users also learn to do practical exercises in nature.

2.3.4.1 "Ike the Pike"

Ike the Pike is the game aimed at children ages 7-13. In this game children can become involved in the life of game character "Ike the Pike" living in a familiar lake nearby. In the game children can perform different tasks such as finding new friends or creating a better living environment for Ike. The concept is illustrated in Figure 11.

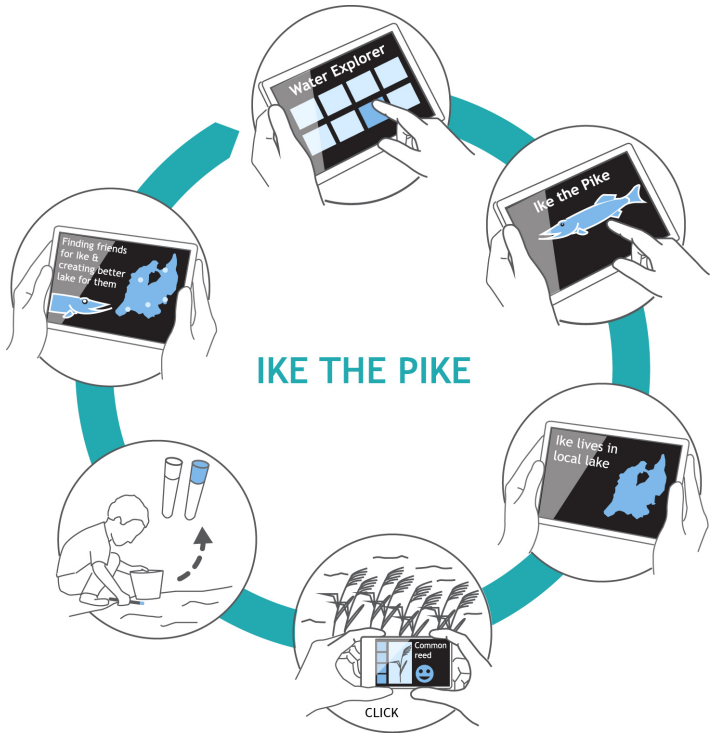

Figure 11. The game concept "Ike the Pike"

This game utilizes the actual water quality data when creating the tailor-made environment and narrative for Ike the Pike. Users of the game can also upload new information to the database by performing practice-based exercises assigned within the game.

2.3.4.2 Water spotting

The Water Spotting game is aimed at young adults. This game application includes different quizzes and adventure games based on water-related information. Elements of social media are supported by providing online games and discussion forums. Water spotting offers information about the lakes the user has visited and the results of the monitoring activity. It recommends lakes for monitoring, which the user has not visited before and which are different in nature compared to the visited lakes. Users are ranked based on their experiences and activities in order to support game-like experience. The game concept of Water Spotting is described in Figure 12.

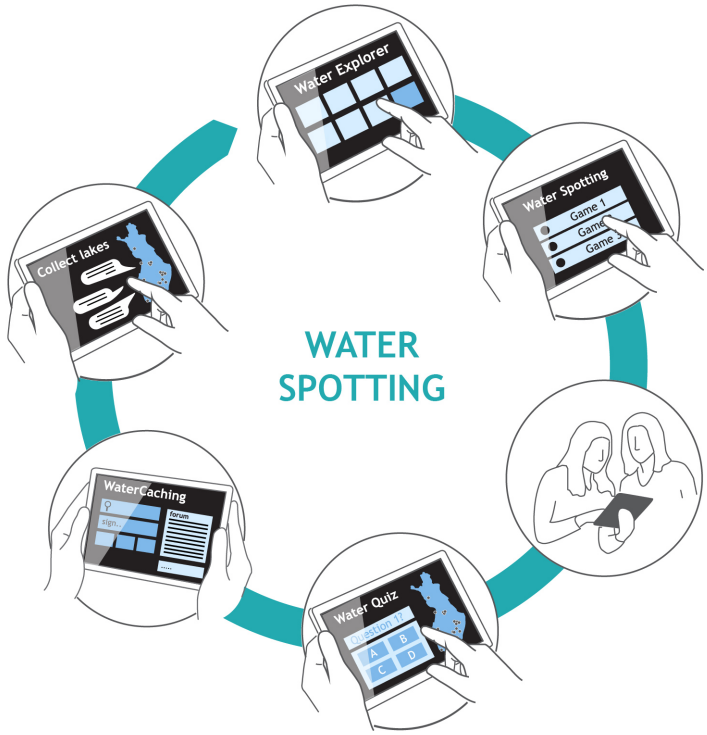

Figure 12. The Water Spotting concept

Games in the Water Spotting application are new ways to utilize, visualize and popularize water-related information. The creation of game-based experiences is expected to create value for the user and increase the involvement and interest toward water-related information as such. It also gives a platform for tourism and marketing, through additional location-based information. The application could be free of charge in an ad-supported mode, but users could pay for a personalized and ad-free version.

2.4 Modeling the service ecology

The design process contributed to the service ecology vision, which was based on the concept generation. As the concept description of service ecology has not yet been established, we will present two definitions in order to explicate the term.

Service ecology is a system of actors and the relationships between them that form a service. The service ecology takes a systemic view of the service and the context in which it will operate. Service ecologies include all actors affected by a service, not only those directly involved in its production or use. (http://www.service-design-network.org/content/service-ecology)

A Service Ecology is a system of interactions and actors that, together, create a sustainable and successful service. Service Ecologies often include several companies or organizations that specialize in delivering one part of the total service. These may or may not be specific to the user of the service. Successful Service Ecologies must realistically allow each company or organization to create and realize value for their part in the service in order for the Ecology to be both successful (from a user perspective) and sustainable (from a system perspective). (http://www.livingprinciples.org/service-ecology/)

For the use of this paper we have modified these definitions of service ecology by combining the main elements of the definitions. In this paper, we define service ecology as a holistic system of actors and their relationships for creating a successful (from a user perspective) and sustainable (from a system perspective) service.

In designing the systemic level solutions, the first steps are mapping the service ecology and creating stakeholder maps in order to understand he system that shall be designed (Mager, 2009). Especially when designing user-centered systems, innovations need to start with knowledge about how the service is currently performing from a customer point of view.

In our case, the purpose of value network mapping was to indicate the main activities and businesses that are needed in providing service concepts. Our value network map is built from a user point of view. Service concepts are taken as contact points to the service system, which includes actors dedicated to providing value for the user. ICT-solutions, databases and mobile applications have a central role in service ecology. Co-creation of value (users and other actors) is the foundation of the whole value network. The value network map is presented in Figure 13.

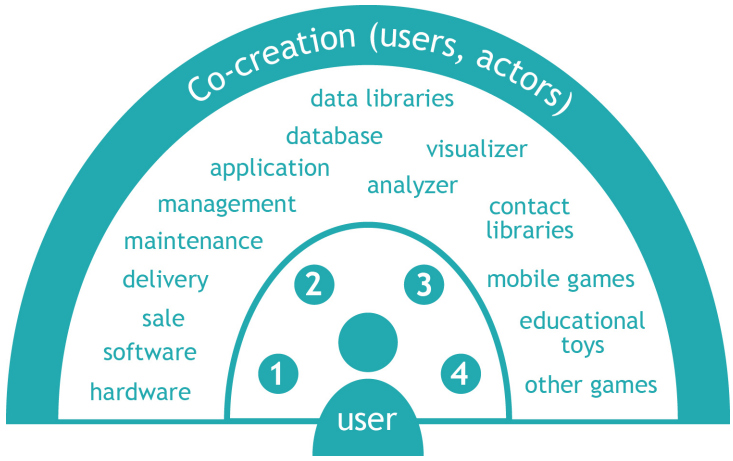

Figure 13. Value network map

Service ecology was especially important in our case because we dealt with a field of business that does not exist yet, at least in large scale. Mapping service ecology was a tool to reveal business opportunities for actors and suggest value-creating relationships between them (http://www.service-design-network.org/content/service-ecology). Unexpected fields of businesses in connection to the gathering and use of water-related information were identified.

2.5 Framework for user-centered design at the systemic level

Based on the analysis of the case study, the Practice-Based Framework for discovering user value-based business opportunities on the systemic level was proposed. The framework consists of four elements: (1) Understand and Identify, (2) Generate Ideas and Explore Possibilities, (3) Frame Solutions, and (4) Apply a Network Approach. The framework is presented in Figure 14.

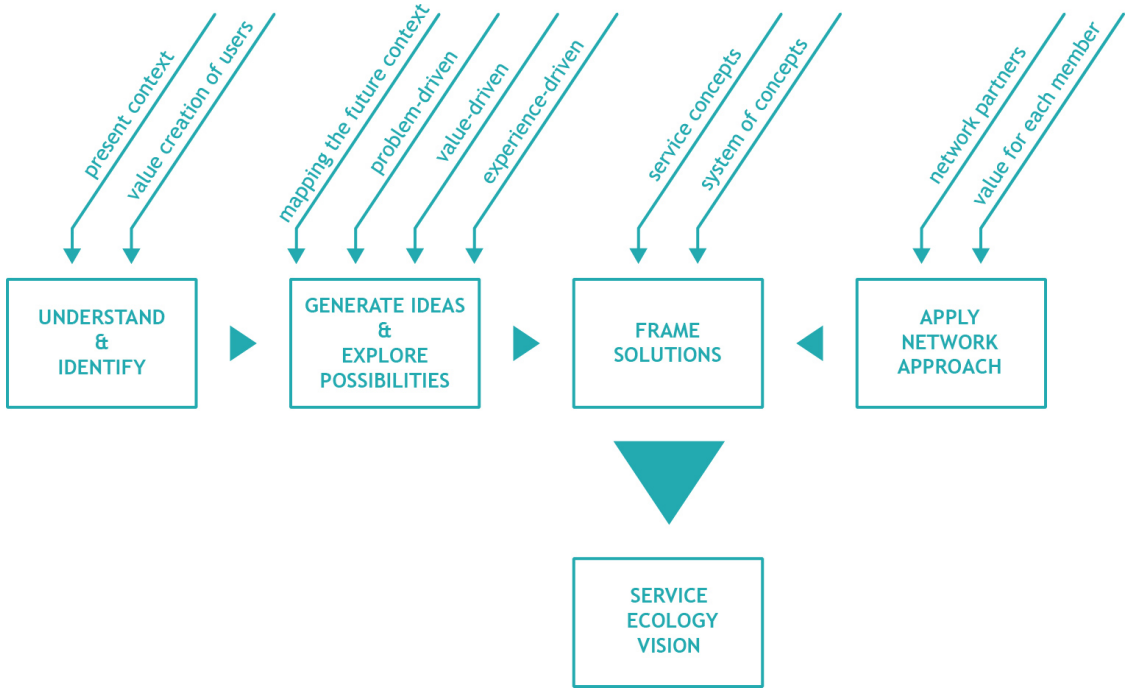

Figure 14. A practice-based framework for user-centered service systems (Peltonen et al., 2013)

The first element in the proposed framework, Understand and Identify, includes the creation of understanding about the present context and the value creation of the users. In the project, the phase explored organization of the activities and the ways the current activity appears to users. We also studied the motivating factors and experiences of participation.

The methods such as interviews, a survey and design probes offered tools for providing vivid and diverse understanding of user's value creation, which is a necessity for creating meaningful services. In our case, the survey was found to be especially important in revealing the motivations

of volunteers in the current activity. The survey was also the main method in identifying value-creating elements for volunteers.

In the second element of the framework, Generate Ideas and Explore Possibilities, different aspects of user value and experience are integrated into the design process. In our case, the brainstorming was carried out in stages by using thematic brainstorming sessions. Problem-, value- and experience-driven themes were selected for the brainstorming sessions. Trend mapping also boosted idea generation by envisioning a future context.

The third element in the suggested framework is Frame Solutions, where service ideas are combined into service concepts and service concepts are organized into a system of concepts. Service images and service-offering maps were used to describe and visualize the service concepts and the value for the customer. In this phase, the main contribution of methods was crystallizing service and business opportunities in a concrete manner.

Finally, the last element in the framework, applying a network approach, contributed to identification of network partners and definition of the value for each potential network member. Applying a network approach to the system of concepts provided a way to create a complete vision of service ecology for the future. In our case, the actor map was used as a key tool for network development.

3. Conclusions

For the first time, service design methods were applied within the context of voluntary water quality monitoring. The service design approach brought user-orientation to the development project. A new understanding of volunteers as users of services opened up new ways for citizens to participate in the gathering, sharing, and using of water ecosystem information. User-orientation concretized service value for users and explained the contexts of using services. Especially, a value-driven service system design opens new services, which offer means to gain meaningful content in a volunteer's world.

Service design methods supported and facilitated idea generation of new service ideas. Especially, problem, value and experience-driven idea generation methods contributed to finding service concepts. The concepts build an integrated service portfolio as a service ecology vision. The services operate as features of a service system on an information portal. On the other hand, mapping the future context contributed to both idea generation and opportunity identification as well.

Based on the case analysis, we suggest that the business opportunities can be discovered through the service concepts, which also indicate the potential for business. We argue that service value can act as a driver for the design process in finding service ideas as well as in identifying business opportunities. The value-based approach connects the creation of meaningful services and identification of business opportunities. User-oriented concept generation produces concrete examples of future services, which, on the other hand, open possibilities for value networks and the roles of actors in the network. (Peltonen et al., 2013)

In our case, the framework was developed and tested in the context of water-related information. However, we suggest that it can be used also in other fields of business as long as the purpose is to identify service value-based service and business opportunities on a systemic level. The framework proposes a concrete model for discovering new service business opportunities for traditional voluntary activities.

The primary contact point for a consumer is the service provider. This actor is vital for the whole service system. At the moment, there seems to be a lack of service providers, at least in Finland, which can lead to major barriers in creating business in the field.

References

Anderson, E., Cairncross, G. (2005) Understanding and managing volunteer motivation: Two regional tourism cases. Australian Journal on Volunteering. Vol. 10, No. 2.

Basole, R. C. & Rouse, W. B. (2008) Complexity of service value networks: Conceptualization and empirical investigation. IBM Systems Journal, Vol 47, No 1, pp 53-69

Bonney, R., Cooper, C.B., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K., and Shirk, J. (2007) Citizen Science: A Deveioping Tool for Expanding Science Knowiedge and Scientific Literacy. BioScience 59: 977-984. doi:10.l525/hio.2009.59.11.9

Clary, E. G., Snyder, M., Ridge, R.D., Copeland, J., Stukas, A. A., Haugen J., and Miene P. (1998) Understanding and Assessing the Motivations of Volunteers: A Functional Approach. Journal of Personality and Social Psychology. Vol. 74, No. 6. pp. 1516-1530

Cooper, C. B., J. Dickinson, T. Phillips, and R. Bonney (2007) Citizen science as a tool for conservation in residential ecosystems. Ecology and Society 12(2): 11. [online] URL: http://www.ecologyandsociety.org/vol12/iss2/art11/

Gooch, M. J. (2003) Voices of the Volunteers: an exploration of the influences that volunteer experiences have on the resilience and sustainability of catchment groups in coastal Queesland. PhD thesis, Australian School of Environmental Studies.

Grönroos, C., and Ravald, A. (2011) Service as business logic: implications for value creation and marketing. Journal of Service Management. Vol. 22, No. 1. pp. 5-22

Hill A, Guralnick R, Smith A, Sallans A, Gillespie R, Denslow M, Gross J, Murrell Z, Conyers T, Oboyski P, Ball J, Thomer A, Prys-Jones R, de la Torre J, Kociolek P, Fortson L (2012) The notes from nature tool for unlocking biodiversity records from museum records through citizen science. In: Blagoderov V, Smith VS (Ed) No specimen left behind: mass digitization of natural history collections. ZooKeys 209: 219–233. doi: 10.3897/zookeys.209.3472

Hudson, H. (1998) Common Lake Water Quality Parameters. Lake notes. Illinois Environmental Protection Agency. http://www.epa.state.il.us/water/conservation/lake-notes/quality-parameters.pdf

Krucken, L. & A. Meroni (2006) Building stakeholder networks to develop and deliver product-service-systems: practical experiences on elaborating pro-active materials for communication. Journal of Cleaner Production 14 (2006) 1502-1508

Kumar, V. 2012. 101 Design Methods: A Structured approach for driving innovation in your organization. Wiley.

Mager, B. (2009). Service design as an emerging field. In Miettinen S. and Koivisto M. (Eds.), Designing Service with Innovative Methods (pp. 28-43). Keuruu: Publication series of the University of Art and Design Helsinki, B93; and Savonia University of Applied Sciencies.

Maglio, P., Srinivasan, S., Kreulen, J., and Spohrer, J. (2006) Service Systems, Service Scientists, SSME, and Innovation. Communications of the ACM, 49(7): 81-85.

Manzini, Ezio (2009) Service design in the age of the networks and sustainability. In Miettinen S. and Koivisto M. (Eds.), Designing Service with Innovative Methods (pp. 44-59). Keuruu: Publication series of the University of Art and Design Helsinki, B93; and Savonia University of Applied Sciencies.

Manzini, Ezio (2004) Solution-oriented partnerhip: introduction. In Manzini, E., Collina, L., Evans, E. (Eds.), Solution oriented partnership: How to design industrialized sustainable soutions, Cranfield University, UK. Available at http://issuu.com/strategicdesignscenarios/docs/download_solution_oriented_partnership

Miaskiewicz, Tomasz and Kenneth A. Kozar. 2011. Personas and user-centered design: How can personas benefit product design process? Design Studies 32: 417-430.

Ministry of the Environment (2011) Monitoring Strategy of the State of the Environment 2020. Reports of Ministry of the Environment 23/2011. http://www.ymparisto.fi/download.asp?contentid=128477&lan=fi (in Finnish)

Minnesota Pollution Control Agency (2008) Citizen Lake Monitoring Program, Instruction manual. www.pca.state.mn.us/clmp

Morelli, Nicola (2006) Developing new product service systems (PSS): methodologies and operational tools. Journal of Cleaner Production 14 (2006) pp 1495-1501

Nieminen Johanna & Mattelmäki Tuuli (2011) Navigating in the world of services – Visualizing a system of systems. Nordic Design Research Conference 2011, Helsinki, www.nordes.org

O'Brien, L., Townsend, M., Edben, M. (2008) 'I like to think when I'm gone I will have left this a better place' Environmental volunteering: motivations, barriers and benefits. Report to the Scottish Forestry Trust and Forestry Commission.

Peltonen Sanna, Tommi Siljamäki and Miia Lammi. 2012. Huvia, hyötyä vai työtä? Kuluttajatutkimus vesistöstä saatavan tiedon tuottamisesta ja hyödyntämisestä. Aalto-yliopiston julkaisusarja Taide+muotoilu+arkkitehtuuri 1/2012
https://www.taik.fi/kirjakauppa/product_info.php?cPath=23&products_id=228. (in Finnish)

Peltonen, Sanna, Siljamäki, Tommi & Lammi, Miia (2013) Journey from Service Value to Business Opportunities: Re-designing Voluntary Water Quality Monitoring. Conference proceedings in Sustainable Innovation 2013, Collaboration, Co-creation & New Business Models. Towards Sustainable Product Design: 18th International Conference, 4-5 November 2013. University for the Creative Arts, Epsom, UK. pp 172-179

Peppard, Joe & Rylander, Anna (2006) From Value Chain to Value Network: Insights for Mobile Operators. European Management Journal, Vol. 24, Iss 2-3, pp 128-141

Pruitt, John and Jonathan Grudin. 2003. Personas: Practice and Theory. Proceedings of the 2003 conference on Designing for user experiences. New York: ACM.

Spohrer, J., Maglio, P., Bailey, J. and Gruhl, D (2007). Steps Toward a Science of Service Systems. IEEE Computer, 40(1): 71-77

http://www.livingprinciples.org/service-ecology/

http://www.service-design-network.org/content/service-ecology