

Increasing the value of information: Putting content in context: is that enough?

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Abstract. This paper presents our views concerning the use of context as a part of the participatory approach in order to provide content in context to increase the value of information. Our aim is to decrease the “ontological gap” that exists between users and information systems. Our focus is to close this gap by using contextual information. We introduce a three layer perspective view to context that takes into consideration location / environment, activity / task, as well as personal / interpersonal attributes and instances. Using this structure, we present how we shaped and designed content that is contextually related to the users, in two of our cases. In the first case (Växjö Library) we make use of the activity/task layer of the context information while in the second case (BoardFamily and FreerideHub) we make use of location/environment and personal/interpersonal layers. In both cases, we experienced increased usability thus higher value of information.

Introduction

Over the last four decades the purpose and perspectives regarding the design and implementation of information systems has remained the same, to support and facilitate human intellectual activity. This was the main aim of the first designers of computer based information systems (Langefors, 1966). These computer based systems are mainly used for production, processing and transmission of information. Initially the cost for producing the information was rather high and as time passed this cost has been radically reduced, due to the rapid development

of hardware and software. One of the main current challenges according to Davis and colleagues (2006) is how to increase the value of information. In this paper we will explore the possibilities for increasing the value of information using contextuality.

The aspects of value of information were addressed by Langefors (1966) with his infological equation. The purpose of his equation is to synthesize human centered and computer centered perspectives in information systems' design. Based on this equation and using a simple mathematical representation, we can formulate this equation (see below). This representation is based on the concept that the value of the information can be expressed in economical terms, as it can be described as the difference between the value gained from information, the value spent for producing and transmitting the information and the value of time spent in the interpretation of the received information.

$$V_i = V_g - V_{pt} - V_t$$

Where V_i represents the value of information, V_g represents the value gained from use of information, V_{pt} represents the value spent for producing and transmitting the information and V_t is represents the value of the time needed for the interpretation of the information. As already mentioned, the value of V_{pt} is continuously decreasing and it should tend to minimum (close to zero) in the coming years. In order to increase the value of information (V_i) we need either to increase the value gained from information (V_g) either to or decrease the value of the time needed to interpret V_t . We will explore and describe in this paper our current efforts while trying to increase the value of information for supporting everyday activities. Thus, we will illustrate and analyze the results of our projects MUSIS, BoardFamily and FreerideHub. The main objectives of the MUSIS project (www.musis.se) are to design and deliver innovative multicast mobile service to the smartphones (Milrad et al., 2005, 2006). The Boardfamily (www.methodmag.com) and FreerideHub (www.freeridehub.se) project objectives have been to visualize the flow information between groups of people in online communities. These projects specifically looked at the social relationships between locations and people.

The paper is structured as follows; in the following section we will describe the problem domain that guides the research efforts presented in this paper. In the next section, we will present how different participatory design instances have been used in the development of a couple of examples presented in later sections. These examples are defined as contextual information services. We will continue with a section that describes two empirical examples that used the participatory design in two different design activities. This section will be followed by some

analysis and reflections based on our results. In the last section we will present our conclusions and the directions of our future research.

Problem definition

Based on the ideas discussed in former section the value gained from information can be increased if some aspects of the context in which information is used are taken into account in the design process. In this paper we describe the contextual design aspects integrated with participatory approach. Our claim is that contextuality should be considered a key aspect of participatory design.

There have been numerous attempts trying to define what context is.. Hull and colleagues (1997) defined context as “*aspects of current situation*”. Another definition is given by Brown (1996) where he defines context as “*elements of the user’s environment which the computer knows about*”. One other more precise definition of context is given by Dey and Abowd (2000) where they define context as “*any information that can be used to characterize the situation of entities (i.e. whether person, place or object)*”. Our view of *context* slightly differs for those definitions. We define context as “information and content in use to support a specific activity (being individual or collaborative) in a particular physical environment”. Thus, our definition of context relies upon a three layer structure consisting of the following attributes; *location/environment attributes, activity/task attributes and personal/interpersonal attributes*. The attributes of this structure are interdependent. Meaning that information about who the user is, where the user is, what the user is doing and the interplay between these activities need to become valuable inputs to the design process.

Bridging the ontological gap

In general we think that basically there is one path with two directions to decrease the “ontological gap”¹ (see figure 1) and increase the value of information. The first direction is to contextually relate the information (i.e. content) to the user while the second one is to educate/train the users to make better use of information. Both directions tend to close the “ontological gap” that exists between the user and the information system. The first way basically tends to close this gap by moving information systems closer to the user (context awareness) while the second way tends to close this gap by moving the user closer to the information system (user education/training). In this paper our focus will be

¹ The term is borrowed from philosophy where according to Michael Silberstein it defines is the gap between fundamental ingredients/parts of reality that are not conscious (such as particles and fields) and beings/wholes (such as ourselves) that are conscious (Freeman, 2001)

just in the direction of using contextual information instances in order to close this ontological gap.

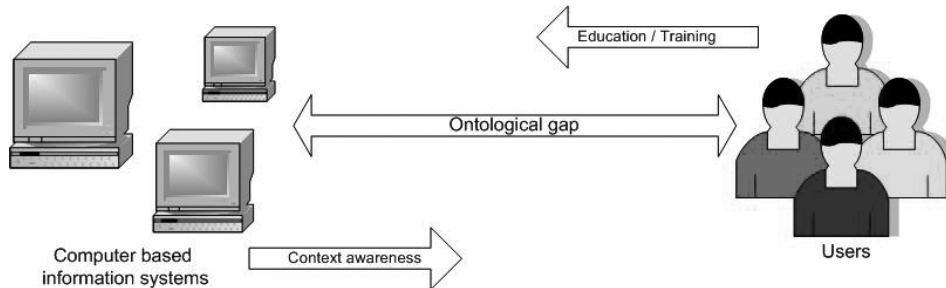


Figure 1. Ontological gap

Over the past years, context awareness has become a research approach for closing this “ontological gap”. This research is mainly focused on the technology aspects mainly due to the rapid development of technologies and their use in pervasive and ubiquitous computing environment (Lyytinen & Yoo, 2002). These environments tend to bring the information system closer to the user. This was also the aim of pervasive computing as it has been defined by Weiser (1993); “*Enhance computer use by making many computers available throughout the physical environment, but making them effectively invisible to the user*”. Within the field of computer science, contextual computing is the discipline that explores the design and implementation of systems to provide new features for information systems. The main idea is to provide content that is aware of the user’s location and/or aware of the user’s activity/task and/or aware who the user is; resulting in more benefits for the users.

Multiple contextual computing systems have been developed by making use of one of the attributes of the three layer structure previously described (Benford, 2005). The most prominent representative of such systems are location based services that make use of the location/environment attributes of context. Other examples are recommender systems that are today available on the web (like Amazon.com, Google etc.) exploring users’ activity/task attributes. All these systems are based on the idea to provide content that is contextually related to the user, enhancing the value of information (Flensburg, 2002, 2003; Flensburg & Milrad, 2003; Gappmaier, 1997; Greenbaum, 1979; Greenbaum & Kyng, 1990)

The ideas presented in the previous sections provide a brief overview describing how contextual information can be used to augment the value of information by increasing its relevancy toward the users. The problems we are addressing in this paper are what methods and ways should be used to include those aspects related to contextual information as input to the design process.

Different perspectives of using the participatory approach in contextual information system design have been introduced by Scandinavian authors since the 70s (Ehn, 1979, 1988; Greenbaum & Kyng, 1991; Greenbaum, 1979; Greenbaum et al., 1990). Their claim is that involving the users in the design process will lead to a higher acceptance and usability of the system. This involvement resulted in the users regarding the new information system as their own product. These new systems support the way users want to work and reduce their frustration with high level of automation (Beyer & Holtzblatt, 1998).

Since then, different patterns of user involvement have been introduced. Those patterns were mainly developed for more “passive” user involvement. Examples of these patterns are scenario based design (Carroll, 2000), prototyping (Floyd, 1989) and recommender system methods (Shardanand & Maes, 1995). Scenario based design represents an approach for contextual information system design. The user’s participation in this method is simulated while the recommender system approach utilizes the user’s participation to improve the system output based on the users’ context. We describe these instances and show the similarities with methods used in our two case studies. The scenarios are used to define the requirements of the system while in our cases we use a method with more active user participation. The recommender system methods automated ways to shape the content that is contextually related to the users. In our cases we actively involve users to help shape the content.

Inspired by the ideas presented in the former sections, we designed and implemented a couple of experiments in order to validate our claims with regard to how to design services that provide users with relevant contextual information. In the next section we describe the results related to the design and implementation of contextual mobile and web services.

Case studies

Below we present two case studies that explore how we applied our layered model of contextual information together with participatory design techniques to increase the value of information. The first case describes our activities at Växjö Public Library where the goal was to develop contextual mobile service to support users’ daily activities. The second case describes two web communities used to explore how large groups of people share and value artifacts in the context of location and activity.

Växjö Library case

The purpose of this trial was to investigate and identify how contextual information extracted from everyday activities can be used to generate the content of a mobile service to be delivered to smart phones. The trial took place in Växjö Municipality Library (<http://www.vaxjo.se/bibliotek/>). The Library has 70 workers that serve the community of 75000 inhabitants. It is a network organization and has several branches in order to have better communication with community. Our target was specific user group (i.e. knowledge workers) and specific context attribute (activity/task).

Since the users' context consists of three different attributes (location/environment, activity/task and personal/interpersonal) is not a constant but very changeable variable defining it was the hardest part. Different data gathering tools were used in order to grasp the user context (Jones & Marsden 2006). We used triangulation view on the users' daily activities. Initially we started with a questionnaire that allowed us to get some raw data concerning the users and their context. Those data served as input for questions in interviews that were conducted later on. The last tool used for data collection was observation. All these three methods provided with good empirical background concerning user context. The second phase was basically a constructive research with a building process in it (Järvinen, 2004). The methodology used in this project is illustrated in the figure 2.

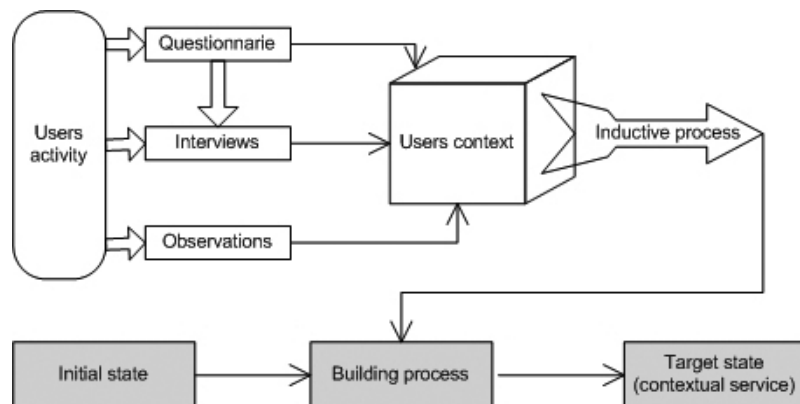


Figure 2. Methodology

Since we define the context information as a three layer structure, we illustrated it as a 3D structure. Each of the data collection methods defines one dimension of such structure. Based on our observations, we were able to identify the daily user's activities while with questionnaires we were able to define the domain of

their activities. The interviews served us as tool to get in depth information about the user activities in the specific domain and discuss with them potential content of new contextual service. All data gathering tools enable us to have solid foundations to define the user context. This contextual information was used as an input in the building process, since it helped us to define the requirements and the content of the new service.

Settings of the experiment

In this particular effort, 10 librarians from Växjö public library participated in this trial during a period of 30 days. These 10 persons serve as the focus group for our experiment. User involvement was achieved through workshops and data gathering activities as suggested by Jones and Mardsen (2006). From a quantitative perspective this group presented 14% of the workers of the library. The composition of the group was such that it represented a respectful sample to validate our results.

All of them were equipped with Smartphone Nokia 6630 and they had GPRS access (free of charge) to multiple different audio and video materials that were provided through MUSIS servers.

Due to illness one participant after initial stage (first workshop and initial survey) left the group. Therefore the end result of this project has been inducted only from the feedback that we got from nine users.

The context in this trial was related to users' tasks and activities and didn't reflect any location/environment attributes. We limit this definition of the context only to the activity/task of the user in this case since in the location/environment attributes (such as location, temperature, noise level etc.) were constant. The first questionnaire took place on the first day of our trial, the questions were divided into three groups. The groups of questions were concerning user profile, users' mobility perception and user context (i.e. identifying user tasks and activities).

User profile

In this section we present the profiles of the users that participated in this trial. These profiles were derived from the answers we got from the users in the first survey we conducted in the beginning of the trial. In general users in this experiment have had basic IT proficiency and experience with mobile communications. Only two of them didn't previously have a mobile phone.

User mobility perception

This group of questions was related more toward identifying how do users percept mobility and what is their frequency of use. Most of users as main motive when choosing mobile phone selected functionality (8 of them) and as second was price (5 of them) while ergonomic design (4 of them) and brand name (3 of them) were their third and fourth choice respectively. The interesting fact is that they basically in very rare occasions use advance functions rather than making or receiving call or sending SMS (in average two per week). Information gathered served us with valuable insight concerning use of mobile devices form knowledge workers.

User task (Contextual information)

Our focus was to identify the main activity during their work hours working with their clients (readers) that they spent most of the time. Seven of them answered that most of the time they spent in providing the readers with information concerning book content. This means that when they deal with library readers, most of the time they spent in providing them (readers) with information about the book content. The other three users deal with other assignments. For most of the subject (six of them) in this trial the best way to communicate with library readers was personal (live at site) communication. Most of the users (eight of them) thought that mobile technology can enhance their way of performing ordinary tasks, while two of them have had doubts.

Interviews

We made nine interviews with subjects during the second week of the trail. The interviews were structured and were conducted with all users. We used this approach because we wanted to draw the map of the domain under study (Järvinen, 2004). In our interviews we didn't just wanted to get from the users information about new service but we also in our interviews we presented the opportunities of the new service. This is also consistent with Järvinen (2004) recommendations concerning the use of interviews in the building process.

From those interviews we understand that for most of the users it was convenient and fun to use advanced functions that Smartphone offers. For some of the users (four of them) adjustment needed in order to use the advanced functions of the Smartphone (user friendliness problem). For all the users the services provided through MUSIS were interesting and relevant and they find them pleasant to use. They didn't change very much the perception concerning use of mobile phone, but for the experimental purposes they started using the advanced functions more

often. In general they regarded the Smartphone as necessary tool in they everyday life that can facilitate they work and communication with their readers.

Since based on the questionnaire, we found that most of the user (seven of them) most of the time while dealing with the readers spent in providing information about the content of the book. This information served us as input for experimental implementation of new mobile service. The idea was to create a repository of audio reviews of the books that can be accessible via mobile phone. All of the users interviewed were very positive concerning this idea of implementing such service.

Evaluation

After we designed the new mobile service (i.e. audio book reviews), users had the opportunity to test it for two weeks. After those two weeks we organized a workshop with all the users participating and conducted the last evaluation survey.

Most of the subjects (five of them) found MUSIS services were very interesting and relevant to their activities. Three of the subjects answered that MUSIS services were interesting but not useful for them while one subject answered that services were irrelevant since the content didn't fits the expectations.

The most important question for us was the question dealing with the usefulness of audio book reviews. The users needed to answer what they think about the usefulness of audio book reviews if this service would be offered in regular basis (couple of times per week) to the library readers. Seven subjects answered that yes it would be useful but they would need more time to explore the service. One subject answered that yes, it is completely useful and this service should be introduced already next year. One subject answered that maybe the service might be useful, but it will be difficult to find time and resources to produce the content. The important thing to mention is that none of the subjects answered that the service can't be useful at all for them even that they had that answer as a possible choice.

Overall from the last workshop and the survey we conducted with library workers we got some empirical backup concerning our initial idea that for developing a contextual service, participatory approach must be used. Despite the short time, the new service was well accepted by the participants of the trail mostly since it was directly related to their task and since they regarded the new service as they own product as well. All this was achieved by defining the requirements of the new systems using and shaping the content of the new service using active participation.

BoardFamily and FreerideHub - Community Platforms

These two projects were conducted at the Interactive Institute² and explored how to create knowledge based community tools and methods for understanding how information spreads between groups of people. We focused on the design and implementation of cross media systems that enabled a community driven approach along the context layers of location / environment and the personal / interpersonal.

The purpose of the trial was to utilize large communities of people with like interests to try to understand how special information (trends) spread through social networks. Our focus was on specific user groups of professionals in the action sport field (media producers, event organizers, athletes, and dedicated enthusiasts). We were interested in the specific context attributes of location and personal/interpersonal. Based on previous test projects we choose to use a human centered approach (Preece et al. 2002). Our gathering tools used to grasp the user context also used in our layered method to gather the users' activities out around the mountain and in front of their computers (Jones and Marsden 2006). Initially we started with workshops with recruited focus groups and this data served as design foundation and served as a foundation for iterative process for the next workshops and interviews later on. The last tool we used was observation during events where the communities where publicly released as ongoing commercial projects.

The observations helped us initially identify the users' daily activities when it comes to sharing information and what information they would be likely to share versus more private information. This was quite location context based, since the activities generally require special landscape features the target group was likely to share exact location attributes. The workshops and interviews gave us in-depth view of how they used the system and what problems and ideas they had about features. These gathering tools provided us with a foundation to define the user context and develop the community platform services.

Settings of the Trials

The Boardfamily community started in August 2004 and the project ran until July 2005. The project was divided up into four parts, concept, development, testing and refinement, and release with hand off. Concept and development where limited to a reference group of 10 people who we worked with as involved parties or the stakeholders. As the project moved to the last 2 phases the stakeholders

² Spikol was affiliated with Interactive Institute from 2003 – 2006 before joining CeLeKT-MSI at VXU in 2006.

where expanded to include community members resulted in about 80 active users about 25% of the total community before the release and hand off.

For FreerideHub the same process was followed but in a condensed manner of 5 months. The project started in April 2005. We started with a core group of 12 people including researchers. For the initial workshop the group decided on the services for the community. The community platform software was further developed to meet the group specifications. Follow up meetings help with the core group with new members. The community was released at an event in July 2005 and through interviews and on-line forum the development continued with a larger group of involved parties.

The community platforms have some key features in the members' section that enable the visualization of their network, the social browser. This tool allows the member to be in the center of his/her egocentric network and by clicking on their friend's icon can begin to browse friends of friend to find like-minded people that they can invite to join their network. From the personal section the users can upload their photos and contextualize them with built-in key words, location (resort) and their own tags.

Utility of Artifacts and Action Research

Using Järvinen's (2004) taxonomy for research methods the work clearly fits into the research stressing utility of artifacts. The projects consisted of artifact building and evaluating approaches in Järvinen's framework it should be seen as action research, where building and evaluating in the same process. In the two projects we worked with a test bed concept where the researchers and developers were also key participants in the target group.

Users / Developer / researcher / profile

The BoardFamily and FreerideHub community projects were approached in the participatory design research context (Muller, 2001). Since the researchers are active part of these two communities our approach was integrated in identifying the problems and working with users. Our profile for the project has been dedicated enthusiasts for snowboarding and mountain biking. For Boardfamily the users are centered on the readers of Method Snowboard/DVD Mag a pan European publication that collaborated in the project. For FreerideHub we approached the community from the local scene and developed the project with them to drive regional development with Åre Mountain Bike club.

For the Boardfamily the core team was made up 10 people with 8 being male and 2 female between the ages of 20-40. All participants had digital cameras, Internet

access at home and work. For FreerideHub we actively recruited more female participants and the core group was 10 people with 4 being female and the ages were from 20-40. For the second round workshops the group was expanded to loose group but the ages and male female breakdown remained the same.

User context

The projects have been designed to work with the user context and support their interests and connect them to other people that share the same. Location and environment play an important role in the practice of these personal/interpersonal connections. The photo galleries and user profiles have location tags that enable automatic placement of photos in the location section of the site and where the user is at the moment. The personal and interpersonal was realized in the social browser where users created profiles and visualized their network of friends. The screen shot of the social browser is illustrated in the figure 3, below.

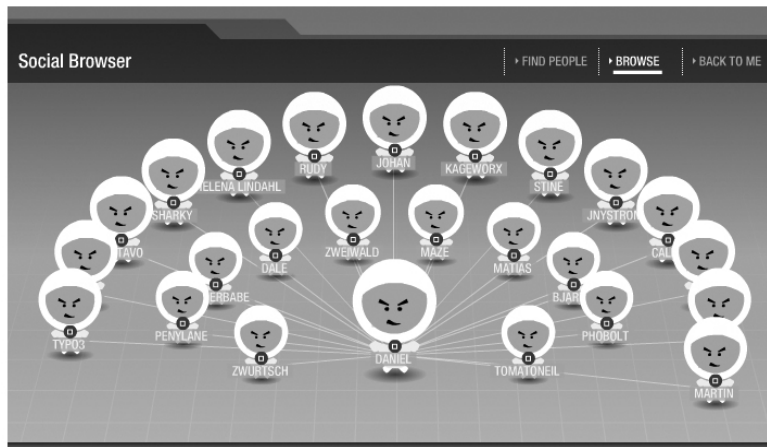


Figure 3. - A screen shot from the social browser

User involvement activities

The projects concept and development process was iterative and started out with a series of workshops between the projects researchers and collaborators. BoardFamily was the first community developed. From these initial concepts paper and screen sketches were developed and refined in larger workshops with community members who were recruited from the local areas. From this point we developed the website and then recruited people from the old community to test the new site with simple questionnaires, face-to-face meetings, and online forum. FreerideHub was developed in the same process but with the exception that the initial workshops started with the BoardFamily site.

Both community platform projects focused on using contextuality and participation across the location/environment, activity/task, and

personal/interpersonal. Since the communities are centered on location and activities and the personal context of the data was the primary focus.

Evaluation

The biggest issue was the lack of interest in users tagging photographs, sharing albums, and utilizing the location keywords. From follow up interviews and statistics we see people uploading in BoardFamily on an average of 1 image per user. When we developed FreerideHub we simplified the photo gallery (increased user friendliness) and the average is 3 images per user.

The social browser has raised issues, as well in terms of it is intended use of the connecting new people versus people just connecting up already know contacts. Similar issues of creating isolated functionality that is limited to the community platform opposed to a more open standard with syndication, examples being the photo-sharing website Flickr.com combined with Google's Blogger web diaries.

These points raise the question about to better utilize context services in the process of design in large-scale communities. Where even with medium size participatory practices users utilized the context features differently then designed. The next step is to run a series of workshops and interviews to understand why and to consider a more open approach enabling users to utilize syndication feeds between different services

Analysis

In this paper we have presented two different cases that involved users in the elicitation and design of a couple of the services to support their daily activities. Both of those cases are presented to look at the usability of the service and artifacts produced. The focus was to apply our layered model of contextual information together with participatory design techniques to increase the value of information. We focused in the use of instances of contextual information with the aim to close the "ontological gap" between the users and the information systems. So far the field of context awareness has been tackled from the computer centered perspective. In our cases we used contextuality with a participatory approach for increasing the relevance of the content provided.

User participation can be used in different ways, from data mining tools to direct user involvement. Initially we argued that one way for increasing the value of information is to contextually relate it to the user. In both of our cases we describe the activities for design of the information systems and for the content shaping.

In our two trials we applied our layered model of contextuality integrated with active user participation and we received better usability of the artifacts produced. In the first trial, we showed that increase of the value of information can be achieved by relating the content to the users' activity/task. In this case it is similar with scenario based design where scenarios are used to define the requirements. Also the content was contextually related to the user activity/task similar to recommender system.

In the second case the increase in value of information was based on the use of location/environment and personal/interpersonal attributes of the context information. The biggest issue that appeared during this trial was lack of interest from users to tag the pictures taken. This aspect was mentioned by Wickens (1992) when he mentioned that manual metadata generation should be avoided because the users might conceive such process as annoying task.

The interesting part is that both cases used instances of contextual information for increasing the value of information. In the first case it was related to the activity and task while in the second case is more related to the location and personal/interpersonal attributes. In both cases the user's participation was based in the data gathering techniques, as it was suggested by Jonas and Marsden (2006). This was very important because in this way we were able to understand the user needs by incorporating them and the contextuality in to the process. For grasping the user context, the participatory approach or at least an instance of it should be used. All this will help us to come closer to design of information system that will enable us to deliver proper information in proper format through proper device in proper location at proper time to proper person.

Conclusions

So far contextual information systems have been designed and shaped using different methodologies like scenario based design, recommender system methods etc. All these methodologies are used aiming at understanding the users and their activities and entail some degree of user's involvement. The participatory approaches have been developed by Scandinavian authors since the 70s in the time that we didn't have such advance technologies as we have today.

We applied our layered model of contextuality together with the participatory approach in both of our cases with the aim to increase the value of information. This was done by using instances of contextual information as a design input. These instances improved the content of the system by making it closer to the user location/environment and/or activity/task. In the library case we made use of the activity/task contextual instance while in BoardFamily and FreerideHub

location/environment and personal/interpersonal instances were used. In both cases we experienced higher usability despite using different instances of contextual information. The usability was raised because of the increase value of the information that the users received. Table I presents the similarities and differences of the cases presented in this paper is illustrated bellow.

	CONTEXT		
	Location/Environment	Activity/Task	Personal/Interpersonal
Växjö Library	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BoardFamily	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
FreerideHub	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Table I. Use of different attributes of context information in our cases

With reference to the equation presented at the beginning of this paper, there are indications that attributes of context information can increase the value gained from information V_g and hence increase in the overall value of information V_i . Increased value of information was based on providing content in context. Increased value of information was manifested in both of our cases with higher usability. The attributes of context information could be taken into consideration either manually or automatically during the design process. This input needs to be done with direct user involvement and without becoming annoying. We think that beside the technology advancement, contextualization as an aspect of the participatory could be used in order to increase the relevancy of the information and thus the value of it. This is mainly because the contextuality is an aspect of participatory approach since the context is defined by the users and is for the users.

Our further research activities will explore other dimensions related to contextual information such as location/environment, activity/task and personal/interpersonal instances of contextual information. These will be part of the efforts that we will conduct in two new research projects.

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