Bringing environmental data to the web

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Customer Centered System Design
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About Contextual Design

Contextual Design is a design process that is customer centered in the sense that it designs products that by different activities addresses both customers’ and business’ needs. This is done by collecting and examining data about the context of use e.g. the workplace and the prerequisites the customers have to accomplish their goals. The needs, task, intents, and processes of the customers plays an important role in determine the context of which they operates. In the Contextual Design process, the user is referred to as the customer and this notation will be used from now on.

The process offers a complete set of techniques, guiding design from gathering initial data about what matters to designing the system’s function and structure that works for the customer. Contextual Design suggests the steps that are needed to be covered in a framework that hangs together. Steps can be removed or added to tailor the process to fit a specific project and in this way Contextual Design serves as a backbone in designing customer centered processes.

Contextual Design is grounded on three principles, which are used throughout the entire design process. The first principle is the principle of data which clarifies that all design should be based on a trustworthy understanding of the customers and how they work. Observing the customers environment is a hard task to accomplish not just because of complex work environments but also because of the workers inability to explain their work processes. Here it is beneficial to use a process like Contextual Inquiry that reveals hidden aspects of work. Contextual Inquiry is an activity that is based on one-to-one observations and interviews of a potential customer in its actual work environment. All interactions are based on the customer’s own work situation in their own language to make sure that the process has collected trustworthy data.

Performing a Contextual Inquiry doesn’t only provide hidden aspects of work but also helps the team to determining key values in work processes. The results are discussed throughout the progress with the customer to develop a better and shared understanding of work tasks and desired goals. Here paper prototypes serves as a valuable testing tool to reveal how a particular design solution plays out in a specific work context. Because of the complexity of data, a concrete representation that reveals how work hangs together is used that highlights the aspects of work that are most critical to be considered during system design. The data drives the design process and it will provide information about determining which activities to consider, how to structure the system and how to build it.

Another important aspect to consider while conducting a contextual oriented design is the team, which also serves as a second principle. Design is done by people, and managing people is an important part of the design process. Managing conversations, meetings and communication assures that the team work coherent and efficient and minimizes time spent on useless activities. This is done with help from representation, diagramming technique, and putting people in the right roles.

The third principle is about design thinking. Sequential design needs a following step to look at the whole and check for appropriate structure, consistency and completeness where it could be possible to alternate between doing and reflecting. It keeps the design moving forward while remaining coherent and the system that is designed needs to fit together as a whole, or it won’t provide coherent support for the customers’ work.
About the project

Background

The project's goal is to create an accessible, web based tool that can provide a good overview (both geographical and temporal) of the environmental data. It is based upon the environmental database in possession of the Swedish University of Agricultural Sciences (hereafter referred to as SLU). They have been collecting environmental data about Sweden for the past 10 years. This data is saved in extensive databases which are accessible via a web interface on their website. Both SLU and SJV hope that this availability will contribute to the understanding of the society’s effect on the environment.

The web interface has been criticized during a long period of time by the part of the general public which is interested in it’s available data.

The data has multiple areas of use; one is to see the current environmental conditions in Sweden, and the other is to function as an historical overview of changes of the environment over time (for the last decade).

Since both SLU and SJV are financed by the public sector, and share interests in this area, it is in interest of both parties to make this data easily accessible to the general public.

Specification

The project, which goes by the working name Sveriges Miljödatabas (Sweden’s Environmental Database), destines to make the existing environmental data easily accessible for the general public so that anyone can make use of it. The project is a collaboration between SLU and SJV. The project is funded by SJV and governmental aid.

The project is planned to run for nine months in 2009, with start at the beginning of the second quarter. The budget is estimated to 15 Mkr, according to the agreement during the public procurement during the third quarter of 2008.

For further information, see Appendix A.

The teams

The design team will consist of the following people:
1 usability designer
2 interaction designers
1 interface developer
1 interface designer
1 SLU expert

The implementation team will consist of the following:
The team will consist of three developers and one project manager/developer. One of the developers should be the same interface developer who was involved during the Contextual Design phase to further assert that the implementation shares the same goals and vision as the Contextual Design phase did.

The customer team:
In the project we decided to do a field study on 18 potential customers from 6 different occupational groups, with 3 people from each.
The project process

Activity 1: Contextual Inquiry - Talk to the customers

The aim for this activity is to understand our customers, and study them in their own environment, in their context. What do they want from the system? For what purposes will they use it? How will the system fit into the customer’s whole work life? We will try to understand in what part of their day-to-day work they can have use of this data and system.

We want to find out what matters to the potential customers in their work, and how the system can be of help. How can technology be used to improve their work?

Because there are now existing system to study, we will define the work our new system will replace. We will define the intent people are trying to achieve, and gather data on our potential customers achieving their intent with current information tools about environmental data.

We will perform this activity by:

- Conducting one-on-one interviews with 3 potential customer from each of the 5 different customer groups. Through discussion, the interviewer and the customer develop a shared interpretation. It is really important to listen to the customers carefully.
- Observing these customers while they work, with focus on how they retrieve information relating to the data available in the system. We will observe the potential customers while they use computers and internet in aim to grasp their knowledge and experience about computer related applications. We will pay attention to small details.
- Observing the potential customers while they use the database available at SLU, with aim to get a understanding for their comprehension of the existing data. We will try to get information about what they think is important and interesting for their own work. The design team will set up the basic tasks which they will ask the customers to perform.

When doing this activity the development team will follow these four principles:

Context; Where the customers are doing it

Partnership; Make the customers explain what they’re doing

Interpretation; Determine what actions mean and discuss with the customer if our understanding is correct or not

Focus; Focus on things we don’t understand and ask questions about it.

Input to activity: The project brief, developed together with JBV.

Involvement of customers: The customers are the main source for information in this activity, and are involved in all parts of the activity.

Roles responsible for the activity: All members of the design team, except for the SLU expert will participate in the Contextual Inquiry.

Result products/artifacts: The notes and/or recordings from the interviews and the observed work. Every interviewer will build his or her own understanding of the work flow based on the observations. We will discuss these with the customer to make sure we have understood them right.

Time line: 7 work days, 21 calendar days (together with Activity 2).
Activity 2: Interpretation session - Share what we have found with the rest of the team

After having gather customer data, we will bring the design team together to hear the whole story behind each interview and capture the insights relevant to the design. Everyone in the team gets to tell their unique perspective on the data. Through discussions, the team captures issues, draws work models, and develops a shared view of the needs of customers for the new system. We will do one separate interpretation session for each customer group.

Input to activity: Data, notes and recordings from the observations and interviews with the potential customers.

Involvement of customers: Some of the customers are participating in this activity.

Roles responsible for the activity: The design team who gathered the customer data and who will design the system.

Result products/artifacts: Graphical work models, which are created for each interviewee, and are used to understand our customers work process. These will be used for the Consolidation session.

Time line: 3 work days, 21 calendar days (together with Activity 1).

Activity 3: Consolidation - Consolidate data across multiple customers

Consolidation is the inductive process of bringing all the individual data (graphical work models) together and building an affinity diagram and one set of consolidated work models that represent the whole customer population. In this session we use the data from the customer population and look for common aspects of the work various people do. What are the common patterns? structures? At this point, customer experience have been captured through interviews and interpretation sessions, and the outputs of this session will produce a single picture of our customer population our design will address. What will be the system focus? What will the features be? How does our customer population hang together?

Input to activity: the graphical work models from the interpretation session

Involvement of customers: No involvement of customers in this activity.

Roles responsible for the activity: the design team

Result products/artifacts:
1. Affinity diagram (first consolidation step): organizes the individual notes captured during the interpretation sessions in the hierarchy revealing common issues and themes. Shows the scope of our customer difficulties with the data as it is presented today. Also defined the key quality requirements on the system. The affinity diagram is customer data arranged as a story, made of post-its.
2. Consolidating sequence model: reveals the structure of a task, showing the strategies common across our customer population. For ex. showing how a person accomplish a task. Bring together many instances of many individuals accomplishing the same task, revealing what is important to doing the work. It shows the overall structure of the task, which may be mirrored in the system to make it useful and intuitive. It also shows where the task is needlessly complex today and could be simplified by the new system. The key is to learn to see the common structure in actions people take: the common activities, intent, and strategies for accomplishing a task.
3. **Consolidating artifact model**: Reveals what artifacts our customers use today to accomplish different tasks.

4. **Consolidating physical model**: How does the customer's physical workplace look like? For example, how accessible are computers for our customers?

5. **Consolidating cultural model**: Shows the common aspects of culture that pertain across the customer population. E.g. issues that matter to the people doing the work, what they care about, what constraints and policy they operate under. This is crucial to choosing the direction a design should take, and to characterize the market. Understanding the mind-set of the customer points our designers at the important issues to solve and ensures that the final system will fit with the customer’s work and culture.

**Time line**: 4 work days, 4 calendar days.

**Activity 4: Creating a design**

In Contextual Design we want customer data and technology to drive design. The goal in this activity is to design the new system so that it fits the customers. This session focuses on how our customers work can be done with the new system, and how it can impact on our customers’ lives. This is a very creative part of the development process, where the designers ideas about the new system is captured in a vision. The vision is a story of how the future customers will do their work in the new world our design team has invented. The vision included the system and the support structure to make the system successful. It is important that the design team think widely, considering several alternatives including radical solutions, before converging on a single approach. These different solutions are consolidated into one response that incorporates the best ideas into a single unified response. The goal with the work design is to see a unified picture of how the customers work with the new system, and that the design team comes up with a creative design solution.

**The steps in this activity are:**

- **Walking the data**: see different aspects of work and synthesize them
- **Visioning**: invent multiple possible responses to the data
- **Evaluation and integration**: develop a single corporate response

The result of this session is captured in a vision. The vision tells how future customers will do their work in the new system that has been invented. Creativity is the major key in creating visions. Therefore thinking about the practical side and how things will hang together is set aside to let the design team be more creative. A typical visioning session takes the form of an open discussion where everyone is brainstorming and building on each other’s ideas. A very limited amount of people is required in these sessions - otherwise it will be hard for everyone to air their ideas. It’s often a good idea to create multiple visions each with different angles on the task. This allows the process to be more open and more ideas can be pitched in. Working on only one vision will narrow down the result to quickly and lead to a situation where it is hard to change things around for new directions. The next step will be to synchronize the alternative visions into a common direction.

When synchronizing the visions that was created the most common mistake that is done is compromising. When putting together multiple visions - each whom is great from a certain point of view - chances are big that the end result will be mediocre and not very good for anyone in particular. Instead it’s important to enlighten all the work issues that everyone identified and create a direction from that. One way of doing this is by going through and evaluate each vision. List all the positive and negative things with each vision. All the positive listings for all visions will form the core of elements that is fundamental for the project.

**Input to activity**: the consolidated work models are used as a visioning step, in which the team brainstorms new work practices.
**Involvement of customers:** It is tempting to let the customers be part of the visioning (and the brainstorming in particular) but their opinions should already have been registered and used as a foundation for the design team to build on in this activity. During the part of visioning where positive and negatives are listed, a maximum of 10 persons is recommended to participate. Otherwise all opinions won’t get aired.

**Roles responsible for the activity:** The whole design team is needed for this part of the project. Everybody needs to be part in the vision sessions.

**Result products/artifacts:** The vision is captured in scetched storyboards, showing how specific tasks will be accomplished in the new system, explained as scenarios.

**Time line:** 3 work days, 3 calendar days.

**Activity 5: Creating a User Environment Design**

Environment Design (UED) is a modeling technique which is used to get an overview of the system coherence, i.e. how different parts of the system is connected. This creates the foundation for the new system and gives a pretty good view on how the finished product will look. Every part of the system is displayed with an UED and it shows how it supports the customer's work, what functions are available and how you go from one part of the system to another. It also displays what functions are available in each part.

In Contextual Design UED diagrams is used to show the system's parts, the ones visible to the customer and that are relevant. These parts (or functions) are defined as focus areas, since these parts focuses on doing a specific kind of work. The UED diagram show the relations between these different areas with links. Each focus area has a purpose which tells what kind of work the focus area supports. With this project each focus area will represent a part of the website. The UED model will help the structure of the website and makes it coherent. This is also a good overview of the system and makes sure that no part is forgotten. The links leads the way from one part of the site to another and describes how the whole system is connected.

With an explicit and well structured UED, the design team can make sure the structure is right for the customers, and manage the work of the project across engineering teams. The UED diagrams keeps the system coherent for the customer and eases the implementation and delivery.

**Input to activity:** The vision created in the previous activity serves as this input.

**Involvement of customers:** The customers will not be a part of creating the customer Environment Design but this activity is created with the customers in mind since this step will give them a first view on how the system will look like.

**Roles responsible for the activity:** The whole team will be part in this activity.

**Result products/artifacts:** Use-cases and object models are the artifacts of the customer Environment Design.

**Time line:** 8 work days. This will take more time than visioning since this is more complex than spawning ideas. Everything is put in relation to each other and the system must be coherent. The design team must go through this part carefully and with precision.
Activity 6: Paper prototyping

Iterating is the activity that is done with help from prototypes, used as design tool. This activity involves customers, called customer feedback. This is the part where the new system we have designed a vision to is tested with the customers. This activity ensures that our design team builds the right system, that it fits the customer’s work, and that the interface is usable. Prototyping lets the team complete the detailed design without committing anything to code. We want to start iterating the design early, so that not much money is invested in a design that doesn't work. The starting point of the activity is an initial design concept. The prototyping process start from an initial rough prototype, with post-it notes representing windows, buttons etc. It enables the user to play out the experience of living with the new system. By this, the users can make their unarticulated knowledge explicit. The designer provides options, the user considers matching to their experience. Paper prototyping reduces costs of getting data, by getting data fast.

Input to Activity: The paper prototypes created in this activity tests the structure of the UED. This works as a preview of the customer interface and lets changes be made far more easy then after things are committed to code.

Involvement of customers: customers need a process that will allow them to live out their own work in the new system and articulate the issues they identify. It is difficult to get good feedback from customers, and the design team wants to co-design the system with the customers. The design is going to be tested on customers who have not been members of the design team. Our customers will be made a powerful partner in the design team, and have real influence. Unless it works well for the customers, the product won’t be used.

Roles responsible for the activity: The design team together with the customers.

Result products/artifacts: The result from this activity will be a initial rough prototype in paper. It is not used as a demo, but are a prop in a contextual interview. It is used as a language between the design team and the customers. There will also be additional level of customer data to work out exactly what will happen in each focus area.

Timeline: 21 calendar days

Part of the prototype activity: Running a prototype interview

A prototype interview is similar to a contextual interview in attitude. In the interview the designer writes new data into the prototype to show the data associated with the real event. This keeps customers interacting with the prototype, by changing and manipulating. During the interview, both the customer and the designer will discover problems, and thereby the designer modifies the prototype. The interviews are always run in pairs. In the later prototype interviews, when we trust the structure, we will concentrate more on the UI and the limits of the real system.

Input to activity: The principles that guides Contextual Inquiry also guides the prototyping interview. With the UED behind, designers can tell whether a suggested change affects only the UI or if its challenging the structure of the system.

Involvement of customers: The customers are part of the interview, and helps modify the prototype. The designer has to be willing to change the prototype due to customer’s reaction. The customers can be entirely new, or people the team has already talked to. We will interview 2-3 customers with a prototype, review the feedback and redesign the prototype before starting out again.
**Result products/artifacts:** A modified and improved prototype, which is intended to test the UI.

**Part of the prototype activity: The interpretation session**

This session is focused on identifying issues raised by the interview. We will examine the customer’s actions and words to understand what his/her reaction meant to the design.

**Input to activity:** Data from the prototype interviews. The designers replay the interviews.

**Involvement of customers:** no involvement.

**Result products/artifacts:** Issues raised by the interviews captured on post-its.

**Part of the iterative activity: Going from prototypes to User Interface**

Getting the UI right is an important part of the design process. A way to do this is to map the UED to a windowing UI. It offers the possibility of transparency because all options and changes are visible at once. The next step is to map functions to UI controls. There are different options. Functions can be implemented through buttons, pull-down menus, direct manipulation etc.

**Input to activity:** Use the UED and the prototypes as a guide. It does not determine how to design the UI, it leaves choices of technology open. Instead it defines the structure and function to implement. Many focus areas end up being windows in a windowing UI. Also, the consolidated work models should help guide the UI design, for example the artifact model, sequences, the vision, the storyboards. The UI designer can use all of these.

**Involvement of customers:** no involvement.

**Result products/artifacts:** An UI that hangs together as an interface, and is a straightforward translation of the UED.

Mapping windowing UI-documents.

**Activity 7: Going from design to implementation**

Design is only the first step to delivering the new system, but it's the critical step. Once design is complete, our team has a stable, consistent, and useful description of the system to build, and is ready to make the transition to a planned implementation.

The following steps (coding, testing, implementation etc) are not discussed in this book. But in a customer centered perspective, it is the design that is most important. It is in this part where it is where it is the most important to have extensive customer involvement.

**Continuing the project**

The final product that Contextual Design produces is ultimately a very in-depth pre-study, along with artifacts that can be used during the continued development of the system. These artifacts consist of the different diagrams produced and a finished design proposal of the customer interface and customer interaction. To finish the project, a process for the rest of the implementation need to be chosen.
Since Contextual Design follows an open and iterative pattern, it seems natural to bring this mindset along to the implementation phase as well. Since the pre-study is complete and we have lots of artifacts when we enter this phase, the RUP model seems like a bad fit due to it's heavy reliance upon pre-studies.

An agile methodology seem suitable, since they are iterative and encourage openness. Common criticism against agile methods include lack of artifacts and that a system's functionality is often overlooked in favor of features. Both these problems have already been addressed at a large, during the Contextual Design phase.

It is, however, unlikely that any agile methodology will be a perfect fit. However, a modified version of Scrum could be well suited. The sequence model could very well be used instead of customer stories, for example. Since the system is supposed to used in the context of a web browser, adopting the customer feedback philosophy from the "Getting Real" methodology may also be beneficial for the system usefulness, along with the lines of customer centered design.

Continuous customer testing throughout the implementation process is also desirable since this will assure that the final system actually works as the customer expects it to, making sure that the customer experience is reflected in the design prototype.

It's also important to stress that this is the phase where majority of cost for developing the system is likely to end up. The team responsible for the actual implementation of the system is another team than the one carried out the Contextual Design process.

**Estimated time for this activity:** 3 months

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Final time estimate for the project

The combined time estimate of the project can be seen in the following diagrams:

Work days (estimate):

<table>
<thead>
<tr>
<th>Activity</th>
<th>Work days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity 1</td>
<td>7 (*5)</td>
</tr>
<tr>
<td>Activity 2</td>
<td>3 (*5)</td>
</tr>
<tr>
<td>Activity 3</td>
<td>4 (*5)</td>
</tr>
<tr>
<td>Activity 4</td>
<td>3 (*5)</td>
</tr>
<tr>
<td>Activity 5</td>
<td>8 (*5)</td>
</tr>
<tr>
<td>Activity 6</td>
<td>15 (*5)</td>
</tr>
<tr>
<td>Implementation</td>
<td>60 (*4)</td>
</tr>
<tr>
<td>Total</td>
<td>100 (or 160+240 = 400)</td>
</tr>
</tbody>
</table>

Numbers in parenthesis are the number of people needed for this task.
Calendar days (estimate)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity 1 &amp; 2</td>
<td>21</td>
</tr>
<tr>
<td>Activity 3</td>
<td>4</td>
</tr>
<tr>
<td>Activity 4</td>
<td>3</td>
</tr>
<tr>
<td>Activity 5</td>
<td>14</td>
</tr>
<tr>
<td>Activity 6</td>
<td>21</td>
</tr>
<tr>
<td>Implementation</td>
<td>90</td>
</tr>
<tr>
<td>Total</td>
<td>153</td>
</tr>
</tbody>
</table>

It's important to note that because of for example scheduling issues when conducting interviews, the timeline and the actual days of work needed differs somewhat. Another thing that is noteworthy is that activity one and two each have assigned work days, but are conducted at the same time when they are performed.

Cost estimate for the project

The estimated work days are 400. Given 8 hours per day and an average cost per hour of 4000 SKr, this estimates to $4000 \times 8 \times 400 = 12.8$ Mkr.

Reflections about advantages and drawbacks using the Contextual Design approach

The Contextual Design process is done close to the customer in its actual context and offers many explicit representations about the customers work. In our point of view this way of working is an advantage in getting a closer and more accurate picture about the work, and therefore a better understanding about the problems to be solved and how work tasks can be more efficient. Another advantage with Contextual Design as a design process is the ability to capture aspects about the customer's work that are not directly visible or obvious. In a complex work structure there are many tasks to undertake to get the actual work done. Common HCI methods used in design processes like questionnaires and interviews don’t address aspects about tasks or information that’s not directly known by the customer. Tasks to undertake in a work process can be habitual and never thought of by the customer during the development process which we think could make it very hard for the design team to address these tasks. Even important knowledge that is needed to perform a task can be unarticulated and therefore hard to share with the design team and an approach such as Contextual Design, that is performed in a close environment to the customer, helps to overcome these problems.

Even though the Contextual Design process is a good tool to gather a careful understanding about the customer and in particular their work, it tends to be too labor intensive. The process focus too much on the customer as a large organization with a fixed work environment and where the customers are a limited group of people that you can perform a study on. Many of the activities assumes that the customer have an organizational culture to consider with different roles among the employees, hierarchies to respect when assigning work tasks and a specific work process to use when achieving their goals.

3. Rough but reasonable estimate
The closest we could get to an organization was the Swedish Board of Agriculture (hereafter referred to as SJV) which was the procurer of the system. SJV is independent from the customers that are going to use the information provided, which means that the actual customers' work processes and goals are not controlled by that organization. A difficult part in our project was to use and tailor the activities to fit our specific situation. The circumstances got more complex when the system was supposed to be used by several customers from different work environments and organizational backgrounds rather than developing a system specific to one set of customers.

Conducting a field study on how our potential customer used the existing system wasn't a good approach, firstly because the customer did not use the system originally and secondly because we wanted to design a totally different system than the already existing version instead of improving it. Because the Contextual Design book did not explain how to develop a system the way we were supposed to, we had to make up our own way on how to gather customer data, which involved different kinds of customers with various backgrounds.

This criticism gives the impression that Contextual Design needs to be tailored to suit the needs of your project if it's going to work out in reality, even if this doesn't seem to be the author's intent. This combined with the fact that you also need a process for the implementation part of the project, you end up with something that is likely to be a very hard sell to the company's chiefs, especially if you choose to pitch for activities that may not be suitable for the project's scope.
Appendix A

Project Proposal

Background

The Swedish University of Agricultural Sciences has been collecting environmental data about Sweden for the past 10 years. This data is saved in extensive databases which are accessible via a web interface on their web site. The web interface has been criticized during a long period of time by the part of the general public which is interested in it's available data.

The data has multiple areas of use; one is to see the current environmental conditions in Sweden, and the other is to function as an historical overview of changes of the environment over time (for the last decade).

Since both SLU and the Swedish Board of Agriculture (hereafter referred to as SJV) are financed by the public sector, and share interests in this area, it is in interest of both parties to make this data easily accessible to the general public.

Project

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Target Audience

Since the general public is a vague definition SLU and SJV have chosen to define specific target audiences who are believed to have a greater interest in this data. These include:

Farmers
The degrees of acidity, precipitation is important.

Forest- and landowners
The degrees of acidity, precipitation and the animal wildlife is important.

Hunters
Animal wildlife and meteorological is important during the hunting season.

Fishermen
Acidity levels in lakes and precipitation levels are important.

People interested in outdoor life (ornithologists, hikers etc)
Vegetation and animal wildlife is important.