Visualizing environmental data on the web
— A study based on “Usability Engineering Life Cycle” by Mayhew —
Abstract
This report is a project plan proposal for the Swedish University of Agriculture on how to create an portal containing visualization and information of environmental data that anyone can use. Today you need to be an expert to understand and interpret this data and also there is no consistency or standard in the different visualizations. We have used Deborah Mayhew’s book The Usability Engineering Lifecycle to present a possible way of conducting this kind of redesign-process. The first step is to do an requirements analysis by identifying the possible users, conducting observation interviews and forming usability goals. After these requirements are done you proceed to the Design/testing/development phase where you iteratively conduct mockups, prototypes and evaluate them. They become more and more high-fi for each iteration. When this phase is finished and all usability goals are met you start with the installation and after a few weeks you can start collecting user feedback and revising the web-site based on that. The total amount of time spent on the project is around 5 months to implement and then maybe 2 months before starting to collect user feedback after installation. The process might not be suitable for this project since some of the steps are quite time consuming and could be skipped since this is medium size project.
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1. Introduction
This report aims to give instructions to the University of Agriculture how to make environmental data on the web more accessible to the general public. Today the information is not accessible if you are not an expert within the fields and even then it is difficult to find information. The SLU now wants to redo their environmental data portal to make it more user friendly and accessible for

1.1 Background
Swedish university of Agricultural Sciences (SLU) has for a long period of time received feedback about their data base and the fact that it is inadequate and difficult to navigate. Today they have information about the environment which is difficult to understand if your not a professional in the field. They aim to make these data more accessible for everyone through a environmental data portal.

The problems today according to SLU is:

1. The different data bases are not accessible.
2. Lack of information on what different kinds of environmental data that is available
3. Variation in documentation and quality of data.
4. Inconsistency in visualization of data and lack of standardization.

The SLU wants a joined entrance for everyone who aims to access any kind of environmental data, hence giving a brief overview of what the user can expect to find on the portal and how to access it. To modify the system the government has given SLU 1 MSEK.

1.2 Purpose
The purpose of this report is to provide a plan for the Swedish University of Agricultural Sciences on how to make environmental data available for the general public based on Usability Engineering Life Cycle by Mayhew. The result is supposed to be an easy to use environmental data portal with visualizations that are understandable even for a person with practically no knowledge about these kind of data.

The deliverables that this report is supposed to result in is an estimate for cost and time that will be spent on the project and also a plan on how to carry out the project.

1.3 Method and Material
The material used in this report is mainly the book Usability Engineering Life Cycle by Deborah Mayhew. Its methods have been applied to a project were the goal is to make Environmental data such as pH in lakes, forests and soil. Amounts of minerals and limestone in the ground. We have also used a paper from SLU on their plans for the years 2007 and 2008.
(personalportal.slu.se/digitalAssets/2764_Programplan_alla_070611.pdf)
1.4 The Usability Engineering Lifecycle by Deborah J. Mayhew

The Usability Engineering Lifecycle consists of several steps that should be performed in order to create a user centered system. It is a top-down approach for designing user interfaces divided into three main parts.

The first step in the process is to conduct a requirements analysis which results in Usability Goals. Step one is to create User profiles, perform contextual design analysis, apply platform capabilities constraint and general design principles. The result of this phase is Usability Goals that will be used throughout the process. When the Usability goal are formulated you move onto the next phase which is Design/Testing/Development.

In the Design/Testing/Development phase there will be several iterations with similar tasks. The difference between them is how deep and detailed the tasks are. There will be three levels in this phase, where the first formulates the high-level design aspects and how to reengineer current work situation to adjust it to the design process and make it more efficient. In this level no interface design is done. The result after this will be a high-level sketch of interface. After each level an evaluation will be conducted to adjust the usability goals and validate the model. In the second level of this phase standards for the design is formed. First define Screen Design Standards such as color, terminology and fonts that will be applied throughout the design process. After these standards are formed prototypes based on them are...
made and at the end of this level an evaluation is conducted to see if the usability goals are met. If they are not another iteration of the level will take place. The last level in this phase includes making a detailed design on the user interface based on the results from the previous levels. This is then tested and evaluated to make sure it meets the usability goals and that the functionality is addressed. If not there has to be another iteration from the requirements analysis all the way through phase one and two before moving on to the last phase.

The last phase of the Lifecycle is **Installation**. When entering this phase the interface is ready to be installed and used. After having it installed user feedback is collected and adjustments are made this iteration can be repeated and when all issues the user feedback gave are resolved and the system is enhanced you are done.
2. Project Plan
In order to do the system developing according to Mayhew we suggest that you proceed as follow. We suggest that you form a team including a usability engineer, a user interface designer, user interface developer and. So around five people in the actual group and then in the different tasks these people take different roles depending on the task. Also other people should be involved in different stages of the process such as management, users and technical staff. But we will mention for each task who should be involved and who is in charge.

2.1 Requirements Analysis
The first thing to do is to conduct a requirements analysis and it is easiest performed by following the steps in order.

2.1.1 User Profiles
First of all it is important to know who your users are and therefor conducting a user profile is a good way to start. Since the users of this portal is supposed to be the greater public it might be a bit difficult to determine exactly who will use it. But it is important that it is suitable for anyone who might want to use it. The most accurate way to construct user profiles is to use questioners to collect information from the intended users, that is the ones who will use the product in the end. From these questionnaires you will get information about the users characteristics, such as psychological and physical characteristics, jobs and task characteristics and also information about knowledge and experience of the respondents. Since this new system is not too radical it should not be too difficult to identify the users. Use already defined categories of people to start with and revalidate if necessary. Examples of categories for your product is farmers, scientists and people working with agriculture.

After this information is gathered you need to determine which of these characteristics are import and not before you proceed to the next step. Now you will create a questionnaire draft that the management can have a look at and after receiving their feedback you should revise it. When you have a revised version of the questionnaire it can be good to do some tests with it. Get a few users to fill in the questionnaire and then based on the feedback from them revise it again. When this is done you can start distributing it to sample users. When you have enough filled in questionnaires summarize, analyze and try to interpret the data to document the user profiles.

The people that you should involve in this task is of course the intended users, helping to design the questionnaire and answering it. But from the companies side you will need the following. A usability engineer that is in charge of the task and other team members and maybe a user interface designer to perform the steps.

If you want to take an easier way and might not have money to spend on user profiles it is also possible to interview people who might be knowledgeable about the user population. The results might not be as good but it will be a more efficient way. However I would recommend interviewing intended users. Since the end product of this process is a web site it might be difficult to get in touch with the users so
you should probably consult some marketing personal to help finding them.

The results of this task is the user profiles which will be used both in the contextual task analysis and usability goal setting. However it is important to keep in mind that if the project will take too long to you should update and redo these profiles every five years. But if you want to reuse the profiles before that time

2.1.2 Contextual Task Analysis
The goal with this part of the process is to collect information about the users that was not found at the user profile step. Users might have certain things around them when trying to use the product or use it in other ways than the developer thinks and here is were you can find these things. However for the environmental data portal there is no product on the market yet and therefore this step might be difficult to conduct. However we would suggest to perform this task with the people using the current product and thereby maybe get some inputs for the new one. Contextual task analysis means that you observe someone who is working with your product and

The contextual task analysis starts with gathering information about the task. Meetings with the user representatives and project team members in order to know some more about how to produce key actors and use cases. After that you conduct the interviews and observations. And make sure to document the scenarios and task analysis. You might need around 3-5 users in each main category to observe. After this step you need to make sure that you have collected all the data that you might need otherwise just do another round of observations/interviews and gather the missing data. While interviewing make sure to document things that the user does that are not part of the web-site. What other artifacts might they use and do they have lost of windows open on their computer? If you videotape the interview make sure that the interview object agrees to it. Also when performing this task on a web-site project you might need to focus on what the users want and not how they are currently working to. Make sure to collect information about the user such as background. When you have performed the observations/interviews you document task analysis which identifies users and tasks, task scenarios and also analysis of the current task (task complexity, error rate etc.)

The output from this task is current user task organization model that contains information about the users work and artifacts. Involve some users that can help to sort these information based on what they find important. Once this model is complete you can use it for another project on the same type of users if you want.

People involved here is usability engineer to manage the task and pretty much all other team members in order not to skip any important data that needs to be collected. The results are used when forming the usability goals but also in work reengineering were the current user models are reengineered. The results are also documented in the style guide.
2.1.3 Usability Goal Setting
This task mainly has two purposes, first specified goals helps the user interface design process to be more focused on theses certain goals. Second it is used throughout the evaluation process of the system developing process that we will present later. There it is used as an acceptance criteria in each iteration until these goals are met and you can proceed to the next level.

These goals should be based on User profiles and the contextual task analysis but also general business goals. You might need to form qualitative and quantitative usability goals. For example a quantitative goal in this case could be that a novice user should be able to get information about the pH in a certain lake within a specified time. And a qualitative goal for this project could be that someone who uses the system should not have to know anything about the technology underneath or that the design of buttons must be consistent.

When performing this task it is important to refer to the user profiles, such as what browser they use. You should also use the outputs from the contextual task analysis in order to get the key user tasks and or use cases produced in Since this project is going to result in a environmental data portal ease-of-learning goals are more useful that ease-of-use goals. The reason is that people might not use the page frequently. So you will need to form goals about navigation and maintenance for the web-site. Once you have formulated goals you will have to prioritize which usability goals are more useful and which could be ignored. This review could involve both management and users in order to see what goals they have. When this is done you should have a prioritized list of usability goals.

The roles in this part should be a task leader which is a usability engineer and also a user interface designer, management and you might also want to involve the other team members and maybe also project stakeholders such as tech staff and users.

The output from this task is usability goals that will be used throughout the process and serves as an an acceptance criteria throughout the process.

2.1.4 Platform Capabilities and Constraints
Since this system is supposed to be used by pretty much anyone it is important to take in consideration what platforms it should run on. For your project which is a web-site portal you need to make sure that it runs on multiple browsers as well as a big variety of hardware and software platforms.

To perform this task you first identify all the different hardware- and software platforms that might be and then review the constraint of these. Decide if you want it to be executable on all platforms and browsers or not.

The roles in this task is a user interface designer as task leader and usability engineer can be involved in assisting the designer. It is important to consult the technical staff to identify what platforms might be accurate. This task can be performed anytime during the requirements analysis as long as its done.
2.1.5 General Design Principles
In this task you need to identify design principles that could be applied in the Design/Testing/Development phase. The results from this task works together with the re

This can also be conducted anytime during the requirements analysis since it doesn’t feed into any of those tasks. You first review high-level style guides available that you find interesting and after that you try to find information about guidelines that can be used later on. So you make a list of book, web-sites and papers that could provide good information for the next phase. To be taken in consideration for this project is that since it that response time on the web varies depending on what computer is used, and your internet connection. And also there are no user interface standards for the web. Also be aware that the appearance is largely controlled by the users and the browser they use and not by the designers and developers. So what you might see when you design is not what will show up on the users computer.

The leader for this task should be the user interface designer that can work together with usability engineers to produce the principles.

2.2 Design, Testing and Development
2.2.1 Work Re-engineering
When we enter this phase we should have a somewhat clear understanding, on how the users currently think and work. We should also, from the work environment and user analyses, understand the user requirements that's required.

The main purpose and goal of Work Re-engineering according to Deborah J. Mayhew, is to:

• “Realizing the power and efficiency that automation makes possible.”
• “Re-engineering work to more effectively support business goals”
• “Minimizing retraining by having the new product tap as much as possible into users' existing task knowledge, and maximizing efficiency and effectiveness by accommodating human cognitive constraints and capabilities within the context of their actual tasks.”

She also states, to be able to achieve the stated goals above you perform these basic steps:

• Produce a new re-engineered version of the “Current User Task Organization Model”, and the “Task Scenarios and Use Cases”.
• We should also validate and refine the “Re-engineered Task Organization” and the “Re-engineered Task Sequence Models”
• The finalized “Re-engineered Task Organization” and the “Re-engineered Task Sequence Models”, should in the end also be documented.

The meaning of these steps, is that in the first step, you should only re-engineer the current work models if the change helps out to achieve the top 2 goals, automation and support of business goals. This will in the end, make sure all of the three goals are achieved. The next step is to validate the re-engineered work models with the end users and make changes, if needed. Last step is to document the finalized models.

For our project, step 1 would mean by analyzing the “Current User Task Organization Model”, and the
“Task Scenarios and Use Cases”, we could find opportunities on how to streamline and improve the usability of the website. One aspect of this process, is that we have to truly understand the user's work and tasks when they are utilizing the website. We also need to figure out what's wrong with the current model, what “key aspects” that missing, for it to be able to support the users in a good manner.

One big aspect when re-engineering the current models, is that other then the current “professional” users, the new models has to support the new user groups found in the requirements analysis. We would have to figure out the most natural and user friendly way of accessing the data, so that it will be possible to quickly get access to it but also make sure its still possible to access it in all the different ways you could before, but also in a more accessible and user friendly way. This might seem as a hard task, because we have to add features that might not have been supported before. But by analyzing to the users, we can find out how they think, use, name, and talk about these things, and add the support by having these things in mind.

In step 2, we could use different techniques to validate the “Re-engineered Task Organization” and the “Re-engineered Task Sequence Models”. One simple technique for validating the sequence models, according to Deborah J. Mayhew is to simply go through them with several representative users. To validate task organization, you create index cards with labels of all the groups, subgroups and low-level tasks. The users should then sort the tasks into the “correct” group and subgroup. The users resulting overall hierarchy shows the expectations they have and is a validation if the system is sound.

In step 3, we will document both the “Re-engineered Task Organization” and the “Re-engineered Task Sequence Models” in the Style Guide. Both will be used later in the life-cycle, the Task Organization in “Conceptual Model Design” and the Sequence Models in “Detailed User Interface Design”.

2.2.2 Conceptual Model Design

It might have been said earlier, but Deborah J. Mayhew thinks that the its really useful to “divide the process of actual user interface design into three levels”. The first of these, on level 1, that's covered in this phase is “Conceptual Model Design”. On the other two levels, you set the Screen Design Standards, and the then you do a complete Detailed User Interface Design.

In “Conceptual Model Design” you utilize the “Re-engineered Task Organization” model that was created in the previous task, as a foundation. To create the Conceptual Model Design we use the task organization as the base structure of the “user interface architecture” and all the information from the Requirement Analysis. This task only deal with high-level presentation rules, things we might look at according to Deborah J. Mayhew are:

- A product- or process-oriented design
- How to define them
- How to present them and so on.

For this part of the project, its probably wise to get some help from graphic designers. These would help out with the visual presentation and the numerous visual cues, and how to make these consistent. This task in the project, should start by deciding if our Conceptual Model should be a product- or process-oriented design. Because the main task of the website is to access information stored and not create new information, we will use a process-oriented model. In this model the “Re-engineered Task Organization” model gives us the information on what processes the application needs.
The next step is to “design presentation rules for processes” model, this is done by again consulting the “Re-engineered Task Organization”, and from it extract the different levels in the process hierarchy. These levels will be assigned rules on how they will be visually represented. The idea behind this, is that each level of the same weight will represented in the same way and on the website displayed in a uniform manner.

We would then move on to “design rules for windows”, in this step we have to decide rules, on how to use windows/panes and how they should behave. This include rules such as: how the panes should scroll, how dialogue boxes should be displayed, if there should be pop-up windows and so on. By “identifying major displays”, you set the rules, on how the information and functionality should be displayed on the web-site. This is done by identifying the key aspects of the web-site, what is the user after and how will we supply this information for him? The users will also need some functionality to be able to select the information they want to access, this functionality has to be displayed in some manner.

We also need to “define and design major navigation pathways” for the model. The rules here will decide on how the menu system of the web-site will look. We would have to decide on the overall structure on what kind of menu system the users would need to easily navigate around the web-site. The last step in this task is to “document alternative Conceptual Model Designs in sketches and explanatory notes”. Utilizing all the data collected from the previous steps, we will produce sketches over how the web-site looks. One sketch should display the main window of the web-page displaying the menu system. On another sketch, dialogue boxes should be displayed and how you navigate between them. We should also include notes on the structure of the menu system.

### 2.2.3 Conceptual Model Mock-ups

According to Deborah J. Mayhew there is a couple of reasons to create Conceptual Model Mock-ups

- The main reason is for the formal evaluation of the Conceptual Model Design
- Comparing different (alternative solutions to the same problem) Conceptual Model Designs
- For really early evaluation

The mock-ups can also be very useful for helping you decide between competing Conceptual Model Designs. Meaning, if you have two designs that you can not decide between, this can be a tool to help you understand what design solution that can be used for “ease-of-use” or “ease-of-learning”.

The mock-ups you build in this task, is not in any way close to the final solution, it's a very early representation with only a small piece of the total user experience. The only information presented in it, is the information gathered in the previous step. The mock-up will be very minimalistic, with little real content included.

For our project, we would “select the functionality” that we would like to test. The selection we would probably want to do, would probably address the current problems users have with the web-site, so we can as early as possible make changes if needed. But there is a number of different things you might want to test at this stage.

The next step is to “sketch the user interface design” that you picked out in the previous step and have a wish to evaluate. According to Deborah J. Mayhew, we should not include any screen design details,
2.2.4 Iterative Conceptual Model Evaluation

By performing “Iterative Conceptual Model Evaluation” we can evaluate the usability of the Conceptual Model Design Mock-ups that we produced in the earlier tasks. This task yields quick and early feedback on the constructed model.

There is a lot of different ways to evaluate the design. But the first decision is always, based on the User Profile and the Usability Goals; what do you want to focus the evaluation on, “ease-of-use” or “ease-of-learning”? You can of course perform multiple evaluations if you want to focus on both. The User Profile will also help you select the test users for this task, and you can get good test tasks from the "Task Scenarios".

A technique given by Deborah J. Mayhew for evaluating is “formal usability testing”. The test, consists of “a set of core, high-frequency, realistic test tasks” that's performed by three to ten users. The test should, if possible, be performed in a context of use environment, to maximize the evaluation outcome.

A “ease-of-learning” test is performed by supplying a minimal set of instructions for the user, and the “ease-of-use”, after the user has received training and been aloud to practice with the system.

She also states that if its possible, you should try to video-tape the test, this is really good for back and presentation. All the errors, that the users do, should be noted and collected. The users should also be encouraged to “think out loud”, when the users perform the task.

The data collected from this task, is then analyzed and appropriate measures to remove the possible problems should be taken in the Conceptual Model Design. This task should be repeated until all the major flaws in the Conceptual Model Design of the web-site is removed.

2.2.5 Screen Design Standards

This stage is the first, and quite important, of two more stages in the second level of the design and development phase of the project (application).

During this stage a detailed design consistency across the project’s interface shall be achieved by specifying the different standards that are to be followed in all the web pages as well as the interaction between the user and the webpage.

These standards are usually dependent on the platform, but this project’s platform is a web browser, which means that there already are some standards defined (e.g. W3C’s standards such as (X)HTML, WAI,...), though these standards are oriented towards a full support regardless of the web browser’s vendor (unfortunately not all vendors fully support these standards in their web browsers).

In order to define some other standards, such as terminology (quite important in this project if we want anyone to understand the data), symbols, colours, fonts, controls, forms, layout, navigation,… the input data we need (apart form the web standards, which are part of the Platform Capabilities and
Constraints) is the analysis done for during the Requirements Analysis, and specially the General Design Principles.

The result of this stage is a set of standards that will be later validated during the next two stages, Screen Design Standards Prototyping and Iterative Screen Design Standards Evaluation, and also refined during other later evaluations.

Roles
The User Interface Designer must lead this stage. All other team members involved in any task of the Requirement Analysis, Work Reengineering and Conceptual Model Design should participate in the definition of the standards.

Users can be involved because they can provide valuable feedback, especially for the terminology, coloring and all visualization-related issues since they are the end users.

Procedure
The following steps should be written down, and if possible illustrated, once finished. At the beginning, sketches and notes are enough because they are going to be changed a few times, but once the set of standards stabilizes, it must be documented.

• Control standards
Web development is a limited platform when choosing controls to be used (normally) to interact with the user) either to receive some information or to perform some action. Regardless of what kind of controls, option button, check boxes, span boxes, drop-down lists, selectable lists,… it is very important to keep consistency between the set of controls. It is a good idea to use the same type of controls for the same type of input/interaction and the controls should be chosen according to the information to be presented and also gathered (if we let the user choose the year for a temperature map, it might be good to use a select list with the years that the database has information of instead of an input box)

• Product/process window standards
According to the orientation chosen in the Conceptual Model Design, product or process; the layout standards are to be specified in this step (how the parameters for each type of stored map are going to be organized, the map might even be the main layout,…)

• Dialog box standards
This step is very similar to the first one, control standards, but it’s for dialog boxes that are usually used to terminate actions initiated with the controls. However, for web development, dialog boxes and controls are quite linked, and so the standards of these two might be better to be specified at the same time.

• Message box standards
When interacting with the user, regardless of the platform, some information must be provided for errors, status,… and defining how this messages are going to be presented (format, vocabulary, placement,…) is important.
**• Input device interaction standards**
Web development relies on input provided by the web browser, and it is mostly text and interaction with the buttons. No shortcuts can be defined at all, so it is recommended to minimize the path when navigating with the keyboard.

**• Feedback standards**
Feedback in web development is very important because the web depends on the network and a remote server that might not be overloaded when the webpage was loaded for the first time, but might be when we are requesting some data. So, it is important to keep the user informed with the status of all requests, otherwise, the user will get tired of waiting without knowing what’s happening and will leave the webpage (in the environmental project, this is of extreme importance because the amount of data is enormous but the resources to compute and display results based on this data is not unlimited and the user should know if the request is on going or what it is happening to it).

### 2.2.6 Screen Design Standards Prototyping
The aim of this second stage is partially supporting the evaluation of the Screen Design Standards because the full evaluation will be done in the next stage, Iterative Screen Design Standards Evaluation. It is also important because the standards are tested with a subset of functionality, and this prototype can provide new functionality not discovered before as well as users’ categories.

To achieve a functional prototype with a user interface, the team must select the smallest set of functionalities that covers the maximum number of Screen Design Standards. To do so, the Conceptual Model Design and the Screen Design Standards are to be used as guidance.

The result of this stage is a prototype (or multiple prototypes if the complexity and the key set of Screen Design Standards are high). The prototype can be low-fi (paper sketches) or hi-fi (live). Both are valid, though for a web development project like this one, a hi-fi prototype will probably be better as long as it’s enough interactive so the users can look up sample environmental data and the visualization is consistent.

The hi-fi prototype can become the implemented interface, so when designing it, it is important not to make it look like complete because then the users’ feedback will be partial.

**Roles**
User Interface Designer will lead this stage and will lead the specification of the prototype, and will be in charge of the low-fi’s prototype if this type is chosen. All other team members involved in any task of the Requirement Analysis, Work Reengineering, Conceptual Model Design and Screen Design Standards should participate to comment on the prototype specification.

A prototyper must build a hi-fi prototype
Users are not involved at all in this stage because their feedback is much more useful for a built prototype than to help in its specification.
Procedure

• Selection of functionality

Those key functionalities that can test many Screen Design Standards shall be chosen, also the core ones (in the environmental project, these can be maps and graphs generation, databases’ selection,...) and those that are likely to have problems, and those that can be executed in a sequence (in the project, most of the functionality is based on the same sequence of events where the user gets a list of the possible data and format, then some elements are chosen, and the data is presented on a map or a graph)

• Paper and pencil specification

Before building the prototype interface, it is beneficial to draw some sketches to organize the set of functionalities with the Screen Design Standards (in the project, sketches about how the display of information on a map linked to graphs can be interesting)

• Prototype’s construction

This last step is about the construction of the prototype that is recommended that it be in a form of a hi-fi prototype for a web development project.

The sketches and specifications designed in the previous step are very useful to define a precise prototype.

2.2.7 Iterative Screen Design Standards Evaluation

The last stage of the second level of the design and development is focused on providing feedback about the prototype (or prototypes if more than one was built) that was constructed in the earlier stage, Screen Design Standards Prototyping.

This stage will evaluate either ease of use or ease of learning, or both. Timing data can be collected at this stage but it won’t be accurate though it will give a rough idea of how close the application is to the quantitative usability goals.

For a web development like this one, formal usability testing (User Profiles will drive the selection of users) seems reasonable and adequate (in the environmental project, tests should concentrate on visualization’s consistency and standardization, and quality of data’s organization). The tests performed can be adapted from the Task Scenarios, and for this web development environment a remote testing is more can be more than adequate.

The result should be a document with the results and outcomes of the evaluation about the major problems and reachability of usability goals so that problematic Screen Design Standards can be modified and also, the prototype according to these other modifications of the standards.

Roles

Usability Engineer will lead this stage whereas the User Interface Designer will assist during the evaluation.

Since it is recommend using formal usability testing, users are to be involved as tests users.
Procedure

• Decide focus of testing
  The test should either be focused on ease of learning or ease of use, depending on the Usability Goals and User Profiles (in this project, since use of learning seems to be the most suitable, then, the tests should focus on testing the standards oriented towards a full support of occasional navigation)
  • Decide on user and tasks’ focus
  Choosing the type of users that will be tested and the tasks that the will perform are what should be done for this step (in this environmental data project, given its requirements, users with any kind of computer expertise as well as with any kind of knowledge about understanding maps and graphs should be chosen, the tasks that they will be performing are focused on testing the set of standards decided to visualize the information)

• Design test tasks including any supporting material
  The test tasks shall be based on Task Scenarios from the Contextual Task Analysis and also from the tasks of the Iterative Conceptual Model Evaluation, these tasks should be more specific than those designed for the Iterative Conceptual Model Evaluation because the standards are complete (in the project, the focus is to make sure that users can navigate within a webpage of a map or a graph)
  • Design and assemble environment
  For a web development, the environment can be anyplace where there's a computer since remote testing can be performed.

• Recruit test users, run test, summarize and analyze data, and formulate conclusions
  Once all elements of evaluation are prepared, and users are recruited, the test shall be run. Gathering users' impressions is important in order to be able to analyze the performance so some conclusions about the validity of Screen Design Standards can be formulated (in this project, the tests can be performed at any time, as long as the user is presented with some evaluation after the test, there's no need to be with the users)

• Document results
• Revise test and procedures
• Schedule users for next test

2.2.8 Detailed User Interface Design
The aim of the first stage of the third level is to produce a full and detailed design directly based on the Conceptual Model Design and the Screen Design Standards.

The result (a specification) of this stage should be realized into code, the application itself, but if the project is big and/or complex (such as the environmental data visualization project), it might be a good idea to create a formal specification of the Detailed User Interface Design, for both inexperienced developers and also for later revision.
Roles
User Interface Designer should lead this stage of documenting a Detailed User Interface Design specification. Usability Engineer can assist if needed. Developers will use this specification to write the code of the application and if in doubt, they will ask the User Interface Designer.

Procedure
- Complete identification of pathways between windows, and dialog and message boxes
  The pathways defined during the Conceptual Model Design should be completely identified (in the project, this could be all pathways from the portal to the different maps, graphs and documentation).
- Complete design of menu bar and action controls
  This step depends on the decision taken during Conceptual Model Design about product or process oriented interface. It involves finishing the design of the action controls (also navigational ones), their appearance.
  In a web development project, navigation and action control is very important because web pages are stateless (each page is independent from each other), so the web application must control the state if there’s a need for it (in the project, this is very important because the actions and menus will allow users to retrieve the environmental the data from the database).
- Complete design of content of windows, and dialog and message boxes
  Using the Screen Design Standards and the Conceptual Model Design, the elements of the windows (in the project, the different forms that will allow the user request a graph or a map or some other info), the dialogues and message boxes should be finished according to the previous levels (one and two).
- Complete design of interactions with input devices
  As it was said previously, in web development, input devices might not be as much as in a usual user interface due to the constraints of web browsers. So, it is important to complete the main interaction input device, which is the mouse for navigation and interaction with the buttons and keyboard for navigation and inputting of text (in the project, some more interaction with the user can be achieved, for instance, when a map or a graph is presented, if the user hovers the mouse over an area, a more detailed description can be displayed inside a box, either next to the pointer or in some other area).

2.2.9 Iterative Detailed User Interface Design Evaluation
During the last stage of the third stage and also the last stage of Mayhew’s Usability Engineering Lifecycle process, the previous Detailed User Interface Design is going to be evaluated and then refined according to the evaluation.

Due to previous evaluations (Iterative Conceptual Model Design Evaluation and Iterative
Screen Design Standards Evaluation) this stage should reveal minor defects such as esthetical and basic design issues, and so hey are easy, and quick, to be solved.

The evaluation is to be conducted as the code is being developed and timing data is the key element that must be collected (remember that some rough timing data was collected during Iterative Screen Design Standards Evaluation but it wasn’t aimed to be accurate at all).

For a web development project, this stage is focused on fixing minor issues about location of buttons as well as cosmetic elements within the web pages (in the environmental data project, some issues with how to present information can be changed, though not the amount of information but its format or location on the screen according, also the help about using the forms to request maps or graphs can be tested during this stage).

The result should be a document with proposals about minor redesign recommendations for some parts of the User Interface Design. Usability Goals must be used as minimum acceptance criteria when evaluating.

Roles

Usability Engineer will also lead this stage whereas the User Interface Designer will assist during the evaluation too.

And again, since it is recommend using formal usability testing, users are to be involved as tests users (and they can test remotely).

Procedure

The steps for this evaluation are the same as the steps for Screen Design Standards Evaluation but the focus of the Iterative Detailed User Interface Evaluation is about collecting timing data to make sure that everything works, that is, all Usability Goals are reached. During this evaluation, no major flaws should be discovered (hopefully).

In a web project, timing is quite important, specially when looking for information, if a pathway to get some data is too long, it takes more time and can result into the user abandoning the search, and leaves the site without the information it came looking for (in the environmental data visualization project, timing is quite an important factor because the amount of data is quite large, so it should not be very difficult to gather any data regardless of its complexity).

2.3 Installation

After all the levels of usability engineering lifecycle the last phase is Installation, in this phase we are going to understand the customer/viewer of environmental data through different techniques of feedback which helps SLU to identify the usability problems that help them in maintenance and enhancement phase of the product life cycle and will be helpful to provide input into the future release of the product. An ideal time to do feedback is when the data is available on the website to the viewers and after some time users will be familiarized with the website and is able to give feedback because they are now expert user of the website. Time to collect user feedback is three to four months after the website is available for the customer/viewers. There are five different techniques of getting feedback
from the customer but we should gather feedback through different techniques and at the end conclude it by drawing all the results.

2.3.1 Usability Testing
In this technique we will focusing on performance data that how website respond to each request made by the visitor you have to watch the customer while he/she is viewing the website, you will interrupt whenever you see something interesting while user is using the website and you cannot interrupt then then its better to use some kind of video device to record the event and the condition and ask him later about the condition what make him thinking at that stage of browsing.

2.3.2 Interview
In this part of feedback users are asked about the satisfaction level while on the website did they feel any difficulty while viewing environmental data on the website and interview is conducted on one on one. For example you want to know how difficult for user to access what he/she wants from the menu of the website.

2.3.3 Focus Group
In this technique we hired a group of users usually between five and eight participant because if there are too few user then they will not tap into the potential diversity of reaction and opinions and if there are too many participant then they will make discussion difficult. Participants are ask to use the website and group discussion is done to define issues to while viewing environmental data at SLU.

2.3.4 Questionnaires
In this technique we involve a large number of users and by using this techniques you can get a large number of feedback form the customer then any other techniques in the getting feedback from the users. usability of the product.

2.3.5 Usage study
In this techniques we observe user from random observation we visit some client that used to visit SLU website for getting environmental data we list down all the functions and features for which we want to measure usage and observer the total number of time user spent during the session using that feature or function and another way to observe users is through software monitor that is installed on the client computer that generate the usage report on some particular function and feature of the website through which we can focus on the functions and features that user don’t use frequently or for short period of time and try to interpret why these feature are not in used.

Roles for User feedback: Usability Engineer and user interface designer are the two roles in getting feedback from client/viewer usability engineer should take lead role in this task and user interface designer should participate as an assistant in both planning and executing the feedback techniques other member of the team should work as an observer and user will participate as a source of feedback.
Usability Project Planning: Planning allow us to more effectively manage our tasks. To plan usability project included in overall project plan increase the chances that it will actually be executed. In this we define a timeline and steps need for apply usability engineering life cycle in to our project first we need to identify the usability engineering lifecycle task that we have to include this depend on many thing.

2.4 Timeline
We have thought about a possible timeline for this project and this is our suggestion. All time estimates are in man hours and are based the estimates made by Mayhew for each task.

Requirements Analysis
User Profiles: 140 hours for the team and 80 for the user information gathering.
Contextual task Analysis: 200 hours and 66 for the users.
Usability Goal settings: 170 hours and 40 for the users and management to set these usability goals.
Platform capabilities and constraints: 40 hours to make sure that the web-site runs on all different browsers for the usability staff. 16 hours spent by the developers to validate these constraints.

For the second phase of the process you perform three iterations. In the first level the time estimate might be:

First level
Work Reengineering: 90 hours for the developer and 20 hours for the user validation.
Conceptual Model Design: 200 hours
Conceptual Model Mockups: 80 hours
Iterative Conceptual Model Evaluation: 140 for the developers and 30 for user evaluation

When this level is done you ask yourself if all the major flaws of the web-site is eliminated. If they are you should proceed to the next level otherwise redo the design and mockups and evaluate again but this time it should only take around 100 hours and maybe 20 for user evaluation.

Second level
Screen Design Standards: 150 hours
Screen design Standards Prototyping: 150 hours
Screen design Standards Evaluation: 140 for the usability staff and 30 for the users.

If this iteration needs to be repeated because it doesn’t meet the usability goals in the next iteration you will need to spend maybe 100 hours on evaluation for the staff and 20 for the user.

Third level
Detailed User interface Design: 200 hours
Iterative Detailed UI Design Evaluation: 140 hours for the usability staff and 30 for users. At the end of this level you need to make sure that it meets all the usability goals set. If not you do another iteration and spend 100 hours on the evaluation for the staff and 20 for the user.

Installation
After 2 or 3 months you will evaluate the web-site thru the techniques mentioned. The time spent here is difficult to estimate since it depends on how much feedback we get from the users.
Total time spent should be somewhere around 2000 hours not including the installation if everything goes smooth. However if you have to redo a step you need to spend some more time. But if you keep up to date on the users wants and needs you should not need to redo very many steps. These calculations are based on man hours and dividing it on five people the project should not take more than 5 to 6 months before the installation phase.
3. Results and conclusions
Since this project is assumed to be medium to big in size we would suggest that you include all the different tasks and levels to ensure that the outcome of the process is as good as expected.
If you need to skip something because of time or money being a scarce resource. One step that might be skipped is the work reengineering. The reason why is because if the current system is too bad it might be a good solution to try and implement a whole new way to solve the problem. But if you skip this step you could still conduct the contextual task analysis since it is useful to see how the system is used at the moment.

In the screen design standards prototyping stage you could skip the low-fi prototyping and only do the high-fi one. This is because in the first iteration even the high-fi prototype will be pretty basic and throughout the process it will be refined and more advanced. The prototype in the screen design standards prototyping stage is never supposed to be complete with all functionality because it is as mentioned just a prototype.

You can also save time in the requirements analysis by instead of conducting questionnaires with intended users interview user representatives such as marketing personal or representatives of different user groups. Also you can do the same thing with the contextual task analysis if you are on a tight schedule. Use representatives and fewer interviews/observations. You will still be able to get a good result even if you might miss some parts when taking this shortcut.

When the project is over there are still products that can be reused from the different tasks. The user profiles from the requirements analysis can be reused for about five years before you should redo them. Also the usability goals can be used and modified after the project in order to be able to adjust the web-site based on the feedback from the users. To see exactly what the different outputs and inputs from each task should be consult the appendix attached.

This method is useful as a guide for a large project such as this one, but it may not be that suitable for a small or medium sized project. For this project given the amount of available data to be represented it’s heterogeneous and the lack of standardization and consistency of visualization it seems suitable to apply this lifecycle. However the process seems to repeat itself at least in the design part it is good to split thing up put the proposed organization is quite likely to delay the process since the benefits of this split is not large enough. Intended users of the environmental data portal are both scientists and general population and so the web-site needs to reflect this fact which means that ease-of-us when interacting is a must and consistency should be a crucial factor. The LifeCycle of Deborah Mayhew ensures that the usability is well tested throughout the developing process but it doesn’t mean that it is always practical or necessary to evaluate the same thing over and over to the extent she suggests.
## Appendix of inputs, outputs and roles in different tasks

<table>
<thead>
<tr>
<th>Activity/Task</th>
<th>Responsible</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Profiles</td>
<td>Usability Engineer</td>
<td>NA</td>
<td>User Profiles</td>
</tr>
<tr>
<td>Conceptual Task Analysis</td>
<td>Usability Engineer</td>
<td>User Profiles</td>
<td>User Task Organization Model, Task Scenarios and Use Cases.</td>
</tr>
<tr>
<td>Usability Goal Setting</td>
<td>Usability Engineer</td>
<td>User Profiles, Key User Tasks, Use Cases, General Business Goals</td>
<td>Usability Goals</td>
</tr>
<tr>
<td>Platform Capabilities and Constraints</td>
<td>User Interface Designer</td>
<td>User Profiles, Documentation on platforms</td>
<td>Platform Capabilities and Constraints</td>
</tr>
<tr>
<td>General Design Principles</td>
<td>User Interface Designer</td>
<td>High level Style Guide</td>
<td>General Design Principles</td>
</tr>
<tr>
<td>Work Re-engineering</td>
<td>User Interface Designer</td>
<td>Current User Task Organization Model, Task Scenarios and Use Cases.</td>
<td>Re-engineered User Task Organization Model and Re-engineered Task Sequence Models</td>
</tr>
<tr>
<td>Conceptual Model Design</td>
<td>User Interface Designer</td>
<td>Re-engineered User Task Organization Model Results from all Requirement Analysis tasks, (Task Scenarios, Platform Capabilities and Constraints)</td>
<td>Conceptual Model Design(s)</td>
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<tr>
<td>Conceptual Model Mock-ups</td>
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<td>Conceptual Model Design (Alternative) Conceptual Model Mock-ups</td>
<td>Finalized Conceptual Model Design, and Evaluation Results</td>
</tr>
<tr>
<td>Iterative Conceptual Model Evaluation</td>
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<td>Conceptual Model Mock-ups, But also: Conceptual Model Design, Results from Usability Goal Setting, User Profiles, and Task Scenarios</td>
<td>Screen Design Standards</td>
</tr>
<tr>
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<td>User Interface Designer</td>
<td>Conceptual Model Design, General Design Principles, Platform Capabilities and Constraints</td>
<td>Screen Design Standards</td>
</tr>
<tr>
<td>Screen Design Standards Prototyping</td>
<td>User Interface Designer</td>
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<td>Screen Design Standards Prototype(s)</td>
</tr>
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<td>Iterative Screen Design Standards Evaluation</td>
<td>Usability Engineer</td>
<td>Screen Design Standards, Screen Design Prototypes, Results from Usability Goal Setting, User Profiles, and Task Scenarios</td>
<td>Finalized Screen Design Standards, and Evaluation Results</td>
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<tr>
<td>Iterative Detailed User Interface Design Evaluation</td>
<td>Usability Engineer</td>
<td>Detailed User Interface Design Results from: Usability Goal Setting, User Profiles, Task Scenarios, and Contextual Task Analays</td>
<td>Finalized Product, and Evaluation Results</td>
</tr>
<tr>
<td>User Feedback</td>
<td>Usability Engineers</td>
<td>The Product</td>
<td>Feedback</td>
</tr>
</tbody>
</table>