GSBL: Giving Germany's Most Comprehensive Chemical Substances Data Pool a Convincing Face

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Abstract

This paper describes the concept of the user-oriented redesigning process of the Joint Substance Data Pool of the German Federal Government and Federal States (GSBL). The GSBL contains at all relevant information on 63.000 pure chemical substances, 320.000 mixtures of substances and 207.000 concerning legal regulations. Redesigning is necessary, because current and potential users are not satisfied with the usability of the retrieval application and the search result presentation. The substance search is partially so complex that trainings courses and detailed instruction manuals are inquired. In order to achieve a tailor-made solution for current and potential key users as well as for user that have or have not been used the GSBL's retrieval application before, a promising redesigning process is introduced and established usability techniques are utilized.

1. Introduction

Imagine there is a database that holds tens of thousands of chemical substances, mixtures of substances and substance groups as well as relations and coherences among them and even searchable chemical structures. Furthermore, that database contains for every single object a wide range of verified features involving information on physical and chemical properties, on ecotoxicological and toxicological parameters, descriptions of environmental hazards, health dangers, fire and other technical hazards and could give information on relevant chemicals-related legislation as well as on environmental fate. A database like this could be used by all people, including governmental authorities, emergency forces and the general public that have an interest in properties and the harmfulness of certain substances, their environmental fate as well as degradation.

And now imagine all of the information and functionality contained in the database cannot be exploited due to a misleading user interface. To be honest, the described scenario is not fictional, rather, it is an exaggerated description of the current status of the Joint Substance Data Pool of the German Federal Government and Federal States (GSBL). Exaggerated in way that in practice of course governmental authorities and emergency forces use the GSBL for several intensions, but some of them are not satisfied with the usability of the front end (resp. retrieval application). In addition, new or infrequent users with chemical background complain that, in their point of view, the substance search as well as the search result presentation is partially to complex and trainings courses and/ or detailed instruction manuals are demanded. However, they recognize the value of the contained data, whereas users with basic knowledge in chemical substances are rather overcharged than enthusiastic by trying to find the information which is the aim of their visit. Thus,

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it can be concluded that GSBL's retrieval application is not that attractive on the first glance. But without research, there is no opportunity to clearly quantify whether and how damaging the partially misleading user interface is and accordingly, how to do better.

The concept presented in this paper is devised by an internal project team of the Federal Environment Agency – in the sequel denoted as SIFT team – that organised themselves to analyse potential solutions and to advice GSBL's executive committee with this perceptions. The aim of this redesigning concept is to improve GSBL's usability by evaluating and scheduling further procedure as well as depicting which methods and techniques should be used.

2. Evolution of GSBL

First of all, it is necessary to mention that the GSBL as a data pool has been offering his data for almost twenty years now. More precisely, between 1991 and 1993, GSBL was developed based on a former information system named INFUCHS [1] that held data about environmentally relevant chemical substances and mixture of substances. The aim of INFUCHS was the provision of instructions and supporting measures in the event of accident related to chemical substances (health risk, environmental threat, legal regulation). Since, INFUCHS was only developed by the Federal Government and several Federal States were running their own systems, Federal Government and Federal States agreed to join forces by supporting a joint substance data pool (GSBL). Up to 1998, data of the GSBL were only accessible via a locally installed client-server application that was then replaced by an online-accessible retrieval application. In 2007, this more or less spartanic retrieval application, in consequence of limited design possibilities, was replaced by the retrieval application that is still in use. Nevertheless, during whole time the system architecture changed only slightly by adding some more extensions or fixing malfunctions partially with fallback solutions. Furthermore, almost all parts of the system are proprietary developments, because twenty years ago ready-to-use solutions out of the box did not exist. As a result of this, all components of the system are hardwired and based on each other which did not make the overall situation in the field of enhancements any easier. In consequence, there is almost no opportunity to redesign parts of the systems and a complete reconstruction seems to be the only feasible way. However, in this paper we are focussing only on the user-friendly redesign of the online retrieval application (user interface).

3. Redesigning Process

To be able to examine and characterise the redesigning process itself as well as motivations and causes to do so, uniform definitions of process phases have to be determined for further use. We come up with five phases as well as our own phase definitions due to incompleteness or non-existence of matching alternatives [4,5].

Decision phase: We call that part of the redesigning process as *decision phase* where decisive events occur in a way that the satisfaction with the system (slightly) changes up to the point where the entirety of occurred circumstances are back-breaking and it is unavoidable to redesign. This happens, for example, if more and more user start complaining about the system and single users finally resign.

Evaluation phase: In the *evaluation phase*, we bring together and analyse all reported deficiencies and evaluate them with tools to measure usability. The aim of this phase is to expose which functionalities and components are annoying and need to be altered, but also those ones that should continuously enrich the system functionality.

Subjective redesigning phase: Within our *subjective redesigning phase*, a redesign draft is created that already involves most system functionality specified in the *evaluation phase*. The redesign

draft is then realised as a prototype. System functionalities that are either too expensive or too complex to integrate in a prototype, should be suggested and are detailed described in the redesign draft. This approach is related to paper prototyping [8], but performed in a much more practical, realistic and user oriented way.

Agreement phase: In the *agreement phase*, key users need to assess the prototype also by using tools to measure usability. The exclusive choice of key users is intended, because they are the majority of all users and we cannot meet all needs down to the last detail. Suggestions to improve the redesign draft are desired, whereby, the transition to the objective redesigning phase is fluid.

Objective redesigning phase: We call that part of redesigning process as *objective redesigning phase* where the redesign draft with included objections of key users is finally implemented. If the prototype is already developed in applicable manner, a further development should also be considered. Because minor change requests will repeatedly arise, in this phase, it is possible to step back to the *agreement phase*.

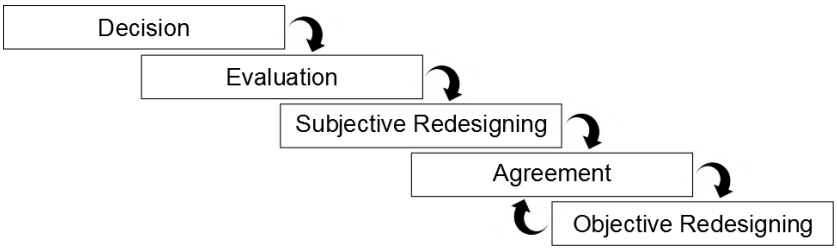

Figure 1: Phases of Redesigning Process

For a better understanding of the sequence of all phases, see figure 1. In the following, we are mapping the above described phases to actions of GSBL's redesigning process.

3.1. Decision Phase

As stated before, the entire GSBL exists almost twenty years, whereas GSBL's retrieval application was developed "only" seven years ago. Nevertheless, we have to admit that the retrieval application was not independently designed from structural conditions of the existing system. Since, a web framework was taken that was on the one hand safe against tampering and theft and on the other hand compatible to the existing database management system (*Fulgor*). Furthermore, the web retrieval application was not developed on the basis of user requests that have been approved and evaluated by usability tests. Instead, some parts of the well-known design of the former web retrieval application were adapted, which was again with respect to design, almost a copy of the prior locally installed client-server application. Because usability test and some few stakeholder interests have not been taken into account, initial dissatisfaction and related improvement suggestions started occurring shortly after completion of the retrieval application. Over the past years, several improvements and enhancements of the retrieval application have been performed, but they were limited by the frameworks abilities. In addition, most improvement suggestions were submitted by specialist users who are the main user group. But they primarily wanted more detailed functionalities what led to a rather complex than intuitive ease of use. For named reasons, the length of the *decision phase* is a little different than what might be expected, because it already began with the completion of the retrieval application seven years ago.

3.2. Evaluation Phase

After the decision will be made to rebuild the GSBL's retrieval application from scratch, all deficiencies to improve as well as all strengths that should continuously enrich the system

functionality are figured out. Furthermore, all kinds of users are involved that might be interested in getting information about chemical substances out of the GSBL:

- *Group 1*: Users with deep chemical knowledge (e.g., key users, chemists, data manager, etc.).
- *Group 2*: Users with chemical interest or background (e.g., employees of public authorities, universities or research institutes, etc.).
- *Group 3*: Users with basic knowledge only searching for specific information (e.g., journalist, general public, affected people, etc.).
- *Group 4*: Users who have not been used GSBL's retrieval application before.
- *Group 5*: Users who are familiar with GSBL's retrieval application.

Moreover, the consideration of all these kinds of users with potentially different ideas of searching, navigation and result presentation, dependent on their varying backgrounds, is necessary. Hence, there is no single method to be able to cover all these kinds of user in deep.

In detail, we introduce four rounds of reviewing as sub-phases of the evaluation phase to obtain all achievable statements of advantages and disadvantages of the current system (resp. retrieval application) as well as suggestions for enhancements of the new system.

In the 1st round of reviewing – *consolidation* –, as a first step, members of the SIFT team bring together and unify all issues and benefits that have been reported so far. This potentially yields information from all above named groups, but mostly from group 1, 2 and 5. Furthermore, an external contractor is commissioned to run and evaluate a user and acceptance analysis which is performed in personal interviews with key and long-time users (group 1, 2, 5) as well as an online survey with access to everyone. With this procedure, information from all above named groups without a specific expression for a certain group can be obtained. Lastly, pre-formulated search scenarios are released to subjects that are contemporary members of group 3 and 5 to gain more detailed information from users that are obviously daunted at present time. By doing so, SIFT team could rely on the cooperation with Anhalt University of Applied Sciences and draw on students.

In the 2nd round of reviewing – *requirement specification* –, requirements are gathered and harmonized that are demanded by end user. This includes users who are using the retrieval application (group 1 to 5), but also responsible administrative staff and data suppliers (editors, researchers, etc.). To be able to ascertain all possible requirements, the task force "GSBL2020" – a project team appointed by GSBL's executive committee – is instructed to figure out system requirements for the new version of GSBL. To do so, an external contractor is commissioned, who introduce the use case method [2] to derive requirements by creating use cases of the future system.

3rd round of reviewing – *expert evaluation* –: To evaluate the usability of the portal "www.gsbl.de" and to give concrete evidence for the relaunch, several methods can be used. Based on the findings, which are obtained from the definition of the target group and from data out of the online survey (1st round of reviewing), an expert evaluation (group 1, 4 and 5) should be performed in the 3rd round of reviewing. For the exact definition and classification of the problem areas, the research method *Heuristic Evaluation* [7] can be applied. Nevertheless, recognized heuristics have already been formulated in 1990 [6]. Until today some revisions of these heuristics were carried out. Currently also *Joy Of Use* and intercultural aspects are included [3]. The application of the heuristic evaluation is helpful for the so-called bottom-up approach, whereby, level of detail improvements can enhance the whole.

In the 4th round of reviewing – *end user test* –, the results of the expert evaluation (3rd round of reviewing) are reused for the preparation of a user-test that can be conducted in the usability lab of Anhalt University of Applied Sciences as one possible partner, e.g., within a student project. To

perform the test, real users of the portal are invited as test subjects. These test subjects have to solve one or more defined tasks with the GSBL portal. This process is recorded and logged using the Rich Recording Software *Morae*[4]. In this approach, statements of the experts from the heuristic evaluation as well as the findings from the real user can be considered.

3.3. Subjective Redesigning Phase

As a next step, a prototype is set up which already contains most system functionality. System functionalities that are either too expensive or too complex to integrate in the prototype are suggested and are detailed described in the attendant design specification (redesign draft). Figure 2 depicts the current version of SIFT team's prototype, whereby, tabs for searching in the GSBL data pool are functional and the other ones are non-functional/ suggested. The layout of SIFT team's prototype is influenced by Google[5] and ChemDB[6].

Figure 2: Prototype of our Online Retrieval Application

In addition to the visible online-accessible retrieval application that is the focus of this paper, SIFT team also has to think about the best possible variant to store and manage the data that constitute GSBL's data pool. Here, especially the kind of database management system and best schema are demanded. However, this is not the focus now and will be discussed in another paper.

3.4. Agreement Phase and Objective Redesigning Phase

In the agreement phase, the on defined requirements and past experience based prototype is presented to key users who have to assess the prototype. Because suggestion to improve the redesign draft and detection of barriers are desired, tools to measure usability are also used. At this point, appropriate mechanisms and tools that have already been presented in the evaluation phase (Heuristic Evaluation, real user-test) are utilized. By reusing such mechanisms, results before and after reconstruction can be compared. During this phase, the requirements that the system has to meet are constantly refined. Due to the fact that most of the system functionalities are already

[4] Morae: A product of TechSmith Corporation; URL: http://www.techsmith.de/morae.html

[5] URL: https://www.google.de

[6] URL: http://www.chemdb.de

defined at this stage and it has pretty much only to be fine-tuned, the final implementation is started. Also because of this, the transition to the objective redesigning phase is fluid.

In the objective redesigning phase, the redesign draft with included objections of key users is finally implemented. In case the prototype is used, it will be further developed. Because minor change requests repeatedly arise in this phase, it is always possible to go back to the agreement phase by simply involving key users or by using usability techniques.

4. Conclusion and Future Work

As described so far, SIFT team is currently working on the user-oriented redesign of Germany's most comprehensive chemical substances data pool – GSBL – which is not finished yet. The primary importance within the redesigning process is the inclusion of as many end user proposals for improvement as possible. In case of the online-accessible retrieval application, the renewal process considers key users, chemists, data manager, employees of public authorities, universities or research institutes, journalist, the general public, affected people as well as people that have or have not been used GSBL's retrieval application before. Because some of them have similar interests and knowledge, users are clustered into five groups that have been examined on preferences. Thereby, the aim is to obtain all achievable statements of advantages and disadvantages of the current system (resp. retrieval application) as well as suggestions for enhancements of the new system. With all these information, SIFT team is currently developing a prototype that will be evaluated with end users by utilizing different methods and usability techniques. Afterwards, the prototype is evolved by an external contractor, who is also responsible for an evaluation up to near-perfection. However, due to the number of employees and policy constraints of a project of German Federal Government and Federal States, the whole process cannot be implemented in the short term. Furthermore, not only the online-accessible retrieval application has to be considered, SIFT team also needs to pay attention to an online-accessible submission and delivery application for data suppliers and to the optimal choice of a well fitting database management system. But as already announced, these considerations are the content of future papers.

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