

# Final Usability Report for the M-Screen Database

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This report is the Final Report on Usability of the M-Screen Database Web interface. M-Screen is used by scientists to conduct High Throughput Screening, and is housed in the Life Sciences Institute's Center for Chemical Genomics. The usability research techniques described in this report were implemented by two School of Information graduate students in Human-Computer Interaction, Jessamyn Smalenburg and Neha Kumari.

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## Executive Summary

Two University of Michigan School of Information graduate students, Jessamyn Smallenburg and Neha Kumari, carried out a set of usability evaluations on the Center for Chemical Genomics database, M-Screen. M-Screen is a database designed for utilization in High-Throughput Screening, a method used in drug discovery to determine the properties and reactivity of organic substances and compounds. The projects undertaken were user interface-flow diagrams, and the evaluations conducted were heuristic and comparative evaluations, usability tests, card sorting, and a Web survey. The results of each evaluation are summarized in this report, which is intended to be the final report for the graduate students' 2009 internship with the Center for Chemical Genomics.

The interface-flow diagrams were constructed in order to provide a high-level overview of the system. Through these exercises we gained an understanding of the system's components and structural elements, and this process helped inform our research by highlighting areas of navigational and content organization that could be improved upon.

We each conducted a heuristic evaluation (HE) independently. The purpose of conducting independent HE's was to give each evaluator the opportunity to make her own observations without being influenced by another person. The observations we produced were partially overlapping. For example, we both found the placement of the number of search results to be in violation of standard heuristics.

The comparative evaluation was a joint project. Its purpose was to identify specific features and functionalities, aesthetic components, and organizational facets that a competing system has that can be implemented in the client's system. The competing program to which M-Screen was compared was the Collaborative Drug Discovery (CDD) website interface. Observations and recommendations are summarized in this report, and full details can be found in the comparative evaluation submitted to the analyst in July of 2009.

The purpose of conducting usability testing with the M-Screen database was to observe users while they interacted with the system. To conduct this test, we constructed a list of relevant tasks that users conduct using the system. During the six usability testing sessions that were held, we observed the way users reacted to certain aspects of the interface; for example, we observed that multiple users find some of the terminology used in the interface unfamiliar. It was also found that the navigation menu lacks clarity in several respects.

The card sorting exercises provided detailed information concerning the perceptions of M-Screen users, in particular their perceptions about the navigation menu. Based on the card sorting session results and usability testing, we constructed detailed navigation menus to submit to the CCG analyst.

The survey was conducted in order to acquire additional information concerning users' perceptions of M-Screen. The survey queried users about the frequency with which M-Screen facilitates successful task completions, and asked them what additional features they would find most valuable. In other words, it was useful for understanding users' priorities, perceptions, concerns, likes and dislikes pertaining to the system.

## **Description of the System**

M-Screen is a database and Web interface used by CCG staff and external clients to complete tasks associated with high-throughput screening and data analysis. The CCG database facilitates tracking substances and compound libraries, and provides tools for the analysis and visualization of primary screen and dose response screens data. The M-Screen database and its accompanying web interface allow users to search libraries, run screens and assays, manage plates, and generate reports on target activity. The overall purpose of M-Screen is to aid in the drug discovery process.

## **General Descriptions of Methods**

### **Interaction Maps and User Interface-Flow Diagrams**

Interaction maps and user interface-flow diagrams are useful for identifying relationships and interactions within the M-Screen user interface. Interaction maps are also used for showing the paths users take through a site in order to accomplish tasks. Developing these maps helps to reveal certain points where the task completion process might break down. Diagrams enable researchers to develop a high-level overview of the user interface, and a solid foundation from which to move into usability evaluations, discussed below.

### **Heuristic Evaluation**

The heuristic evaluation is a usability evaluation procedure used for assessing the database according to a set of ten standard heuristics. The heuristics were developed as guidelines for the design of usable systems and software. Heuristic evaluations are typically conducted individually, rather than jointly. This is in contrast to the other evaluation techniques, such as comparative evaluations and usability testing, both of which are more often conducted with teams of professionals. The heuristic evaluation is conducted by expert evaluators who apply a set of industry-accepted usability heuristics during their assessment of the website. There are ten primary heuristic standards: visibility of system status; match between system and the real world; user control and freedom; error prevention; recognition rather than recall; flexibility and efficiency of use; aesthetic and minimalist design; help users recognize, diagnose, and recover from errors; and help and documentation. (Nielsen, 2005)

The heuristic evaluation criteria define several dimensions along which to assess the website or web application under study. A principle category is the visual display of information that the system provides to users. "Visibility of System Status" falls into this category, which requires that usable sites alert users and keep them informed about the current status of the action the user has chosen to undertake. Also in this category is the heuristic "Recognition rather than recall," which requires that systems provide users with enough information to allow them to proceed through the system without excessive taxation on their memory. Next, helping users recognize, diagnose, and recover from errors is also part of this category. The system needs to provide information that is easily comprehensible to all users. And finally, the help and documentation heuristic is about communicating to users with enough information that is both easily and quickly accessible, and that is sufficient for their needs.

### **Comparative/Competitive Evaluation**

Competitive (or comparative) evaluations are conducted to compare the client's system with that of one or more competitors that offer the same or similar services. The competitive evaluation is useful for producing a clear picture of how one website compares to a competitor's. The final results inform clients of the areas in which the site is strong, and where it needs improvement. A key function of the competitive evaluation is to garner from the competition several good ideas about possible enhancements that should be implemented.

### **Usability Studies**

Usability studies are conducted with actual users of the system, and there are a number of goals with this type of evaluation method. The primary purpose for conducting usability studies is to watch users as they interact with the system under study. These observational sessions point out where the users need assistance in order to complete tasks. When users need help with completing a task, this is likely an instance of breakdown in the user interface. Data collected during usability testing sessions include facial expressions, comments, questions, and expressions of confusion and frustration on the part of the users. Usability tests show usability specialists where the program or website confuses users and why. Recommendations generated from usability testing sessions include those concerning the navigation system, labeling and organization of information, content structure, help documentation, and suggestions for feature and/or functionality additions.

### **Card Sorting**

Card sorting is a method used in usability evaluations to elicit information from users about their mental models. It generates an overall structure for the information contained in a site. Users have ideas about the organization, composition, and content of the website under study, and card sorting asks people to organize cards based on their mental models. Card sorting analysis can help usability professional understand whether users want information grouped by subject, process, or information type (Spencer & Warfel, 2004). There are often several dozen cards, the ideal number being approximately 50.

### **Survey**

The role of the survey in usability evaluations is in part to ascertain what users think, perceive, and feel about the system under study. It is a way of eliciting useful information from users that can be used to inform the redesign process. Information about desired features and functionalities, ease of learning and ease of use are important topics to touch on with the survey. Surveys can provide information about frequency of use, baseline satisfaction with the current system, anticipation of future needs, prioritization of issues and areas in need of improvement, relative criticality of issues, insights about preferences, measurement of reactions to potential modifications, and general assessments of overall attitudes and perceptions.

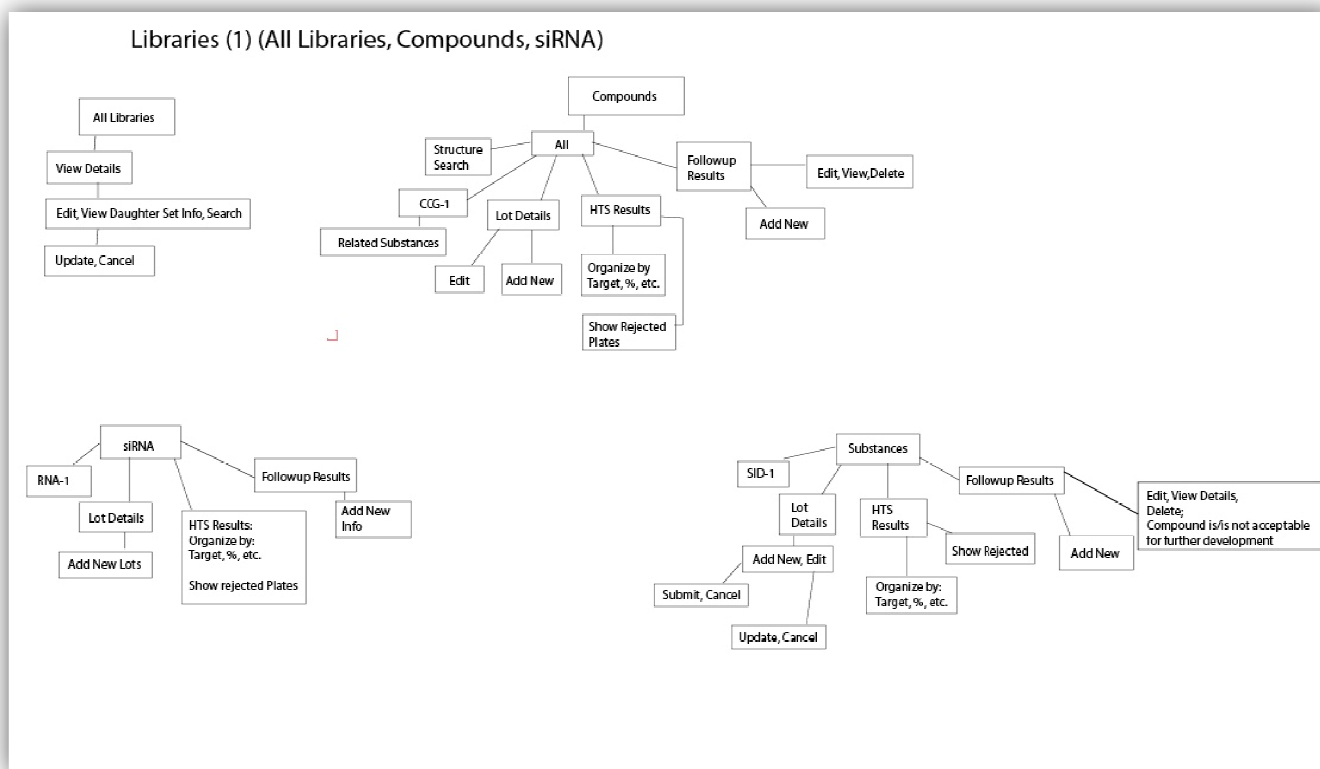
## **Results & Findings**

The first two projects undertaken in the analysis of the M-Screen database interface were interaction maps and navigation flow diagrams. Interaction maps are created in order to display visually the paths users take through the system to accomplish specific tasks. We found the interaction maps and

navigation diagrams to be most useful as tools to understand the layout of the site. In creating these deliverables, we both learned what the site contains, what functions it's used for, the relationships between topics and links, and the routes by which specific tasks can be accomplished. For example, we learned that accessing information concerning off-target activity is accomplished via the "Generate Reports" link.

We created a set of eight navigation paths for different aspects of the website; two for "Libraries," two for "Miscellaneous," two for "Plate management" and two for "Screens." Two of the navigation illustrations developed for this Web interface are included below, both for the "Libraries" navigation menu item. We authored descriptions of and recommendations for a number of usability issues uncovered during the creation of the navigation flow maps. These descriptions and recommendations were intended as points to attend to for CCG staff.

## Libraries (1)



### All Libraries

We made several observations about the aspects of the interface that are not self-explanatory. First, we stated that the "View Details" link is not descriptive of the information that is found on that particular page. "View Details" alone does not supply information for users to operate based on. To address this usability problem, we recommended that the icon itself be converted into a brief phrase that indicates to users what is found via that link. A pop-up box should also be added, which should include details about the components of a particular library, about past screens run on that library, and about the

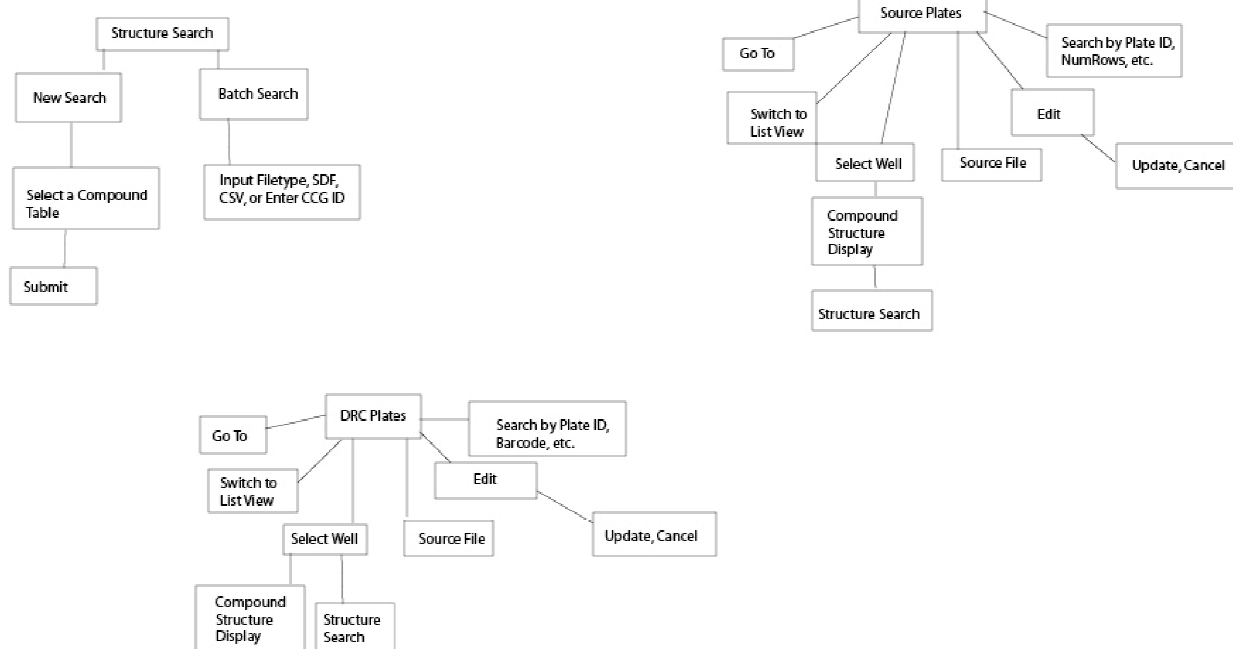
contents of the library for which one is intending to view details. We also noted that the phrase “Daughter Set” is not a clear indication of what the set contains and how it was derived. Our recommendation is to add a pop-up box that explains what the daughter set is, how it was derived, and how it was and is used. The full definition and creation process should also be described in a glossary of common tasks and functions.

## Compounds

We observed that the meaning of “All Compounds” is not explicit. This observation was also associated with findings in the usability testing session in which a user expressed confusion concerning the lack of explicit differentiation of “Compounds” and “Substances.”

## Libraries (2)

### Libraries (2) (Structure Search, Source Plates, DRC Plates)



## Structure Search

We identified several usability problems associated with the second set of “Libraries” interface-flow diagrams. We observed that the opposite of a “New Search” is not provided. The “Batch Search” is the other search alternative, but “New Search” implies that the opposite of “New” should also be present. The opposite of “New Search” is a “Saved Search” or alternatively a “Repeat Search.” These ideas were later reflected during the Competitive Evaluation, when it was discovered that the competing system,

Collaborative Drug Discovery, provides users with the functionality to save and reuse past searches. We also noted that it is not explicitly explained to users what formats the CSV and SDF files should take.

### **Heuristic Evaluations**

Following the user-interface and navigation flow diagrams, we each conducted independent heuristic evaluations. The evaluations were conducted separately so that one person's ideas did not influence the other person's. Several key findings will be described here, along with their associated recommendations. With respect to the first heuristic, "visibility of system status," we both found that the path indications (i.e. "breadcrumbs") are not always accurate. For example, when users follow the path "Libraries → All Libraries" and then select to view the details of a particular library by clicking on the magnifying glass symbol, the details of the specific library load, but the path displayed is "Libraries → All Libraries → Detail." This does not reflect the fact that "All Libraries" are no longer being viewed, but rather one specific library is shown. With respect to the second heuristic, "Match between system and real world," we both found that the "Edit," "Search," and "Export" buttons are not labeled as such. Instead, these links consist of small images which do not clearly indicate what the functions of the buttons are. The associated recommendation is that the magnifying glass and other non-explicit buttons be replaced with words, namely "Search," "Export," and "View Details."

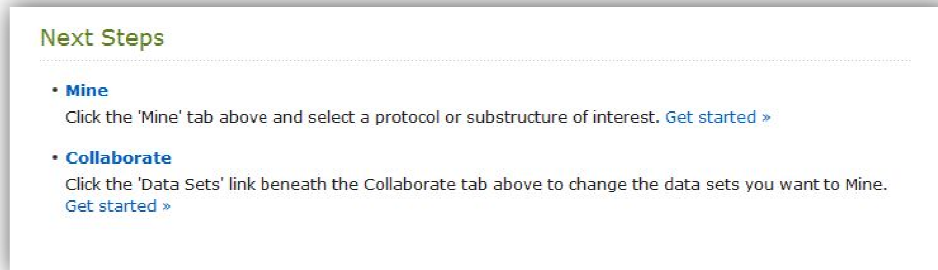
Also associated with the "Match between system and real world" heuristic, we suggested that the link and information under the "Home" tab of the navigation menu be removed and placed in the footer at the bottom of the page. Moving this information to a link at the bottom of the page reflects the real-world practice of locating "About us" information in the footer.

Findings based on the third heuristic, "User control and freedom," include the observation that options for users to undo actions when they make mistakes are not always present. Specifically, "Debit Compound Volume" has two options available, and if one is clicked by mistake, the action can't be easily undone. In the case of particular actions that have significant consequences for the state of the system if performed by mistake, the recommendations are to present the user with a pop-up box asking if he/she is certain about the action before the page moves forward, and to provide a button to step back to the previous page. These descriptions of findings from the Heuristic Evaluation are a few of the findings described in the Heuristic Evaluation reports, and represent only 3 of the 10 heuristics. The reader is invited to refer to the Heuristic Evaluation reports for further details.

### **Comparative (Competitive) Evaluation**

The comparative evaluation was conducted jointly, and the competing website used for the comparisons was Collaborative Drug Discovery. In the comparative evaluation, the first display was an Excel chart clearly showing the features, functionalities, services, content, aesthetic components, organization, labeling, and recommender systems that each system possesses. We reported, for instance, that CDD has services like a demo video, reviews, simplified search box functionality, repeat searching capability, help and support links, and pop-up explanatory/help buttons for each data entry box. These particular features are possessed by CDD only, and represent areas in which the M-Screen interface could be improved. It was also noted that CDD allows users to share data with chosen collaborators, a function that M-Screen does not yet allow. In terms of aesthetics, it was noted that both systems have a simplified design and structure, though CDD possesses a more balanced visual

layout. It was also determined that CDD has multiple navigation menus and clearly labeled navigational options, neither of which is found on the M-Screen interface. It was also noted that the task flow is much clearer on the CDD site. It was pointed out, for example, that the CDD interface has headings that state explicitly what the next steps are:



### Usability Testing

Usability testing was conducted over the course of two business days at the Center for Chemical Genomics Ann Arbor office. We exchanged roles of note-taker and moderator, and since six usability testing sessions were conducted, we each moderated three. Both of us collected data during all usability testing sessions. The data logging sheets we used captured information about successful task completion rates, level of task difficulty, number of attempts, direct quotes from users, outward expressions of frustration on the part of the users, and additional relevant observations made during the testing sessions.

Overall, users needed a great deal of help to complete the tasks given to them. The majority of users needed hints for a majority of tasks. There were also frequent expressions of confusion and frustration, and users experienced a great deal of doubt throughout the sessions. The doubt that they experienced and expressed frequently concerned task completion: most of the time, users doubted whether or not they had actually completed the tasks which they had been given. Questions and comments such as “Am I finished?” “Is this what you mean?” “Have I done this correctly?” and “I’m not certain this task is complete” were frequent. The recommendation to address this uncertainty is to implement system messages that supply the system’s status to users. For example, when a major task is completed, the users might be helped along if a message indicating successful task completion is shown to them. This could be as simple as feedback stating: “You have successfully located and identified CCG-5058.” Displaying the system status by providing users with feedback about their actions at all stages of the task completion process will contribute to the ease-of-use of the system. Also related to providing system status is the observation that when some actions cannot proceed as planned, error messages appear not only in computer code, but also with statements in read such as, “Cannot update activity in RESULTS tables.” This statement tells what can’t be done, but there is no help with recovery since there is no accompanying explanation that tells users exactly *why* the activity can’t be updated. Also, no information is given to explain how to go about updating the activity successfully.

It was found that navigating the system presents a number of difficulties for users. Many did not realize, for example, that off-target activity could be viewed under “Generate Reports.” One user commented that the doubled drop-down navigation menu contains paths with terms that don’t

necessarily go together in his mind. Users stated that it would be an improvement if similar concepts are placed as close together as possible. The text used for the menu items is not intuitive for users. For instance, users did not know what would be found under the “Miscellaneous” tab, because the title gives no indication about the content. Furthermore, it was found that in many cases users did not associate the display of the number of records with the ability to move forward to the next page. For example, users attempted to move forward to the next record or page, but because indications such as “Displaying 1 of 1 Records” are not located immediately adjacent to the forward and backward arrows, users often missed this indication altogether. Descriptions of this and all other observations from the usability testing sessions can be located in the usability report submitted in June of 2009. All recommendations connected to these findings are also contained in the body of the usability report.

### **Survey**

The survey was conducted on the Internet using the Survey Gizmo electronic survey tool ([www.surveygizmo.com](http://www.surveygizmo.com)). The survey was open between July 7, 2009, and August 7, 2009, and a total of 15 individuals completed the questionnaire. The goals for conducting the survey included the attainment of a clearer picture of users’ perceptions about M-Screen, including their level of satisfaction, task completion rates, reasons for unsuccessful attempts at task completion, and how organized and clear users believe the system to be. An understanding of whether or not users find the terminology familiar and the navigation menu straight-forward to use was also sought.

Significant findings from the survey included perceptions of the navigation menu, rates of successful task completions, and reasons for unsuccessful attempts to complete tasks. The survey also addressed desired functionality and sources of help documentation and support. We found, for instance, that the navigation menu is the most frequent cause of unsuccessful attempts to complete tasks; that some users find the navigation menu frustrating; and several think it contains unfamiliar terminology. Recommendations are to create a navigation menu that is informed by user feedback, with the goal of creating an intuitive design that facilitates efficient completion of tasks; to add helpful documentation and tutorials to guide users and allow them to solve problems on their own using on-line documentation; to provide workshops for training system users; and that terminology used in the system be designed to be easily understood by all users. .

### **Card Sorting**

Card sorting sessions were conducted with 4 out of 6 participants, immediately following their usability testing sessions. There were approximately 50 cards used for the sessions, the majority of them containing words, phrases, and terms taken directly from the navigation menu. The results of the card sorting sessions were highly varied, with some users placing cards in piles based on key word (e.g. “Compound”), and other participants placing cards together based on task (e.g. “View Screens” and “View Plates”). For example, one participant placed all “Adding” cards into a single pile, when these cards contained different key word nouns: “Add/modify/delete vendor,” “Add investigator,” and “Add a compound” were all placed together. In contrast, one participant grouped the tasks according to overarching theme based on the key word, such that “Add a vendor” was placed with “Admin” and “Access status,” all terms this user associated with supervisory and administrative roles.

## **Summary and Conclusions**

The different methods used for the evaluation of the M-Screen database identified problems in all of the following areas mentioned below. Some of the major recommendations to improve the usability of the M-Screen are also mentioned.

### **Help and Documentation**

Lack of help was one of the major concerns we found in the Heuristic Evaluation, Comparative Evaluation and Survey. In general, most of the people don't like to ask for help and look for online help to guide them in solving the problem independently. So, M-Screen would benefit in the eyes of the users if it were redesigned to provide the right help at each page in the form of pop-up boxes when terms are clicked on, and if a FAQ section is placed on the website. Also, a help link should be present at the top of all pages, which should contain an overview of all the steps on the website. In addition, a Glossary should be added for looking up the details of any term associated with the user's query.

### **User Systems**

A demo video for new users, forums, and a news and events section can be available as links on the home page. Society has become very technologically social and M-Screen should focus on some of the interaction sections to get updates from users as well as provide them with recent news developments. These recommendations come from studying the competitive system, Collaborative Drug Discovery, and also 50 % of M-Screen user's support forums in the survey.

### **Navigation**

In order to assist with the navigation menu redesign, we designed two mock-ups of potential navigation layouts. One of the proposed navigation structures is included at the end of this report, and is an example of a key component of website Information Architecture documentation. An explanation of the navigation structure is also found alongside the design itself.

**Firstly**, it was concluded from user test sessions, card sorting exercises and the survey that the information users looked for is disorganized and scattered inside different links. It is recommended that all of the related information should fall into the right category. In the user post-test questionnaires, some of the comments were "It is difficult to navigate, but once you are on the right page, it's easy to see your results," and "It makes no sense to me why that is here." People looked for similar information in one place and if the information architecture is reorganized, M-Screen would benefit the most. The interns have outlined a structure that can improve the usability of the system as shown in the figures following the text of this report.

**Secondly**, labeling of menu and sub-menu links is ambiguous and hard to understand. For example, most of the users in user testing found the term "Misc" very confusing, and users could not guess the links inside. It is recommended that the sub-links under "Misc" be distributed over other appropriate links. Some of the sub-links are incomplete in the information provided. For instance, "Search" under "Screens" assumes that it should be for searching screens, but rather it is used for many other purposes. Other link is "Generate Report," from which one could assume that this function means "Generating

Report of Screens.” It is instead used to find active substances or compounds for any Target. More meaningful links will help users to improve their completion of tasks more easily.

**Thirdly**, information on the current position of the user is missing on the website. Missing breadcrumbs on some of the pages make navigation difficult because users don’t have any idea about their location. This result is also evident in the Heuristic Report. Adding missing locations on different pages would be a simple solution and add to the usability of the system.

**All the recommendations above will help in creating user-centered M-Screen system.**

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