

## User-centred Design



Photographs from lab visits

### Step 1. Interview

Using the contextual design methodology<sup>1</sup>, interviews were conducted with scientists across all SEURAT-1 consortia, and generally lasted around 1.5 hours. These interviews covered a variety of tasks including cell banking and handling, cell differentiation, cell engineering, biomarker identification, dose response analysis, understanding mechanisms, toxicity testing, 'omics experiments, and chemical analysis. The interviews were focused around specific tasks being performed and discussed the context for the work, what events triggered the task, what the individual steps were required to accomplish a task, what the reasons were for performing each step, and if it was necessary to collaborate on different parts of the process and with whom. These interviews were usually performed in the scientist's office, sitting next to the scientist who was performing the actual tasks, allowing the interviewer to observe and ask questions throughout. During the interview various artefacts used by the scientist, such as spreadsheets, reports, etc. were collected and annotated with information about how they were used.

### Step 2. Interpretation

Shortly after each interview there was a debriefing session with at least three ToxBank team members. During these sessions, the interviewer tells the story of the field interview and discusses its implications. Notes were taken by other team members, where one note taker recorded the user role and characteristics, a profile of the organization, the physical environment, and wrote a series of notes (viewed by entire group) that recorded observations, issues, breakdowns in the work, questions, holes, insights, and design ideas. This usually resulted in between 50-100 notes per interview. The second note taker captured the steps for each task (*sequences*), which included the ordered steps necessary to complete a task, the triggers (how the event was initiated), and the intent (reason behind the steps). These steps were annotated with artefacts used by the scientists in the interviews.

### Step 3. Consolidation

The tasks or sequences recorded in step 2 were then consolidated, where common tasks were performed by different scientists. These consolidated sequence models serve as use cases summarizing the work across the cluster. This task was performed by lining up the different sequences for the same task side-by-side and deriving a superset of activities. A second consolidation used the notes recorded from the interview to create an *affinity diagram* (a hierarchical view of all notes collected). In addition to the notes from the interviews, additional notes from other requirements gathering activities such as the data analysis working group and an analysis of the proposals were also collected. Each note was printed on a separate post-it note to allow the affinity diagram to be built on the walls of the meeting room.

### Step 4. System design

Initially the affinity diagram and consolidated sequences were reviewed by the ToxBank consortium. They were carefully analysed and design ideas generated to annotate the affinity diagram preferably for the higher-level concepts. This session generated a list of key issues and ideas. Following this session, a discussion to conceptualize the bigger picture was conducted which included the User Interface elements as well as interactions with the different types of users and other systems. This was an iterative process where multiple scenarios were considered and critically evaluated to determine whether it was technically feasible, and whether it supported the identified tasks at the same time as being a manageable or usable process. A series of storyboards were then created to outline the details of this vision developed. These storyboards were analogous to a freeze frame movie based on the core tasks identified, using both pictures and words.

### Step 5. Paper prototyping

The system was then mocked-up as a hand drawn paper prototype, based on the storyboards. It was generated by hand since testers would have little concern to modify the interface where problems were identified. These paper prototypes were then further tested with the SEURAT-1 scientists with multiple rounds of interviews. The paper prototype was "used" to actually perform a series of tasks (User Interface components on paper were presented in response to the actions taken by the user). Changes were made on-the-fly to ensure the user interface performed the tasks the users expected. These changes were consolidated with the ToxBank team to form the blueprint for the ToxBank data warehouse user interface.



Analysis of the tasks



Building the affinity diagram



Example of storyboard

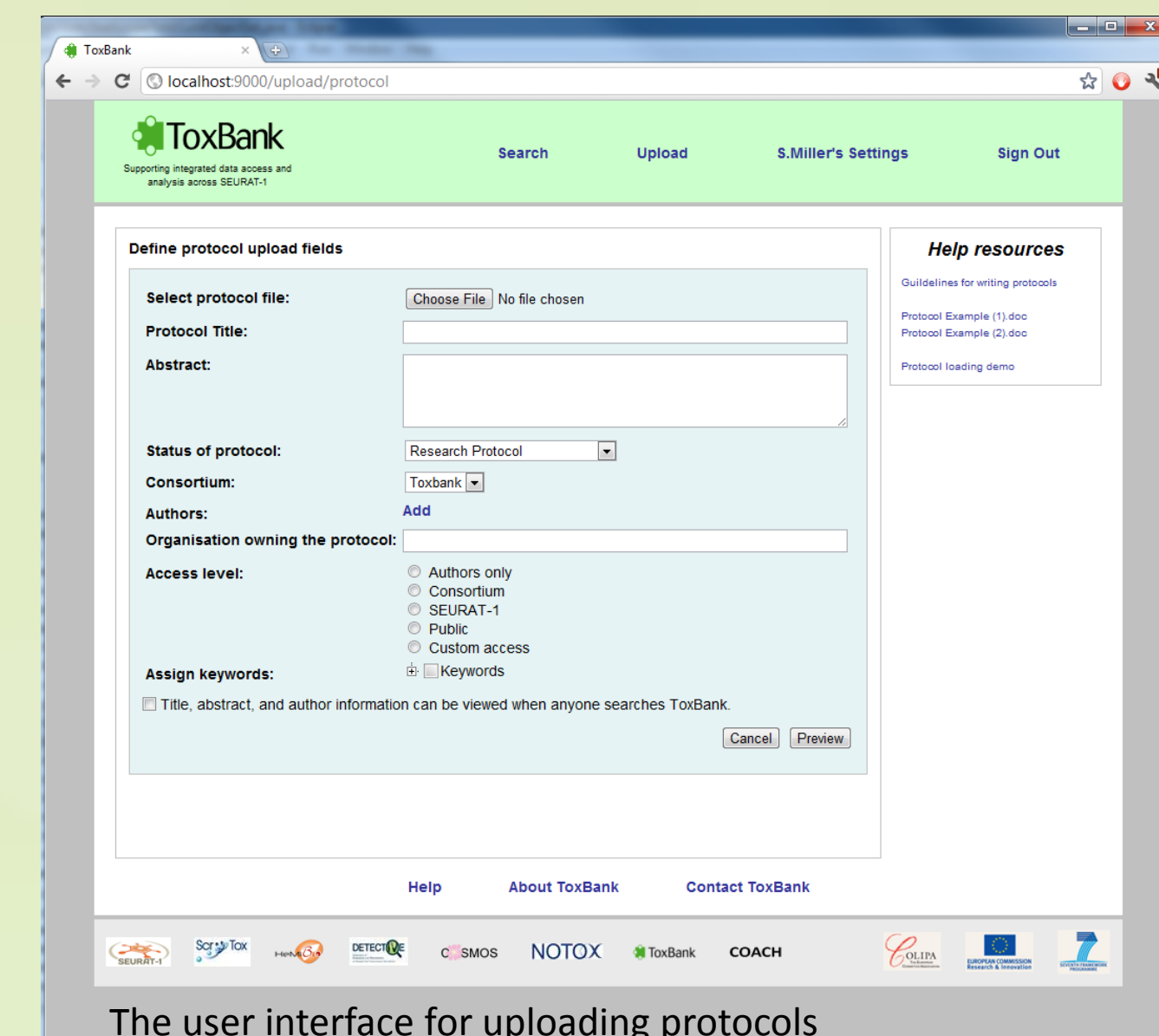
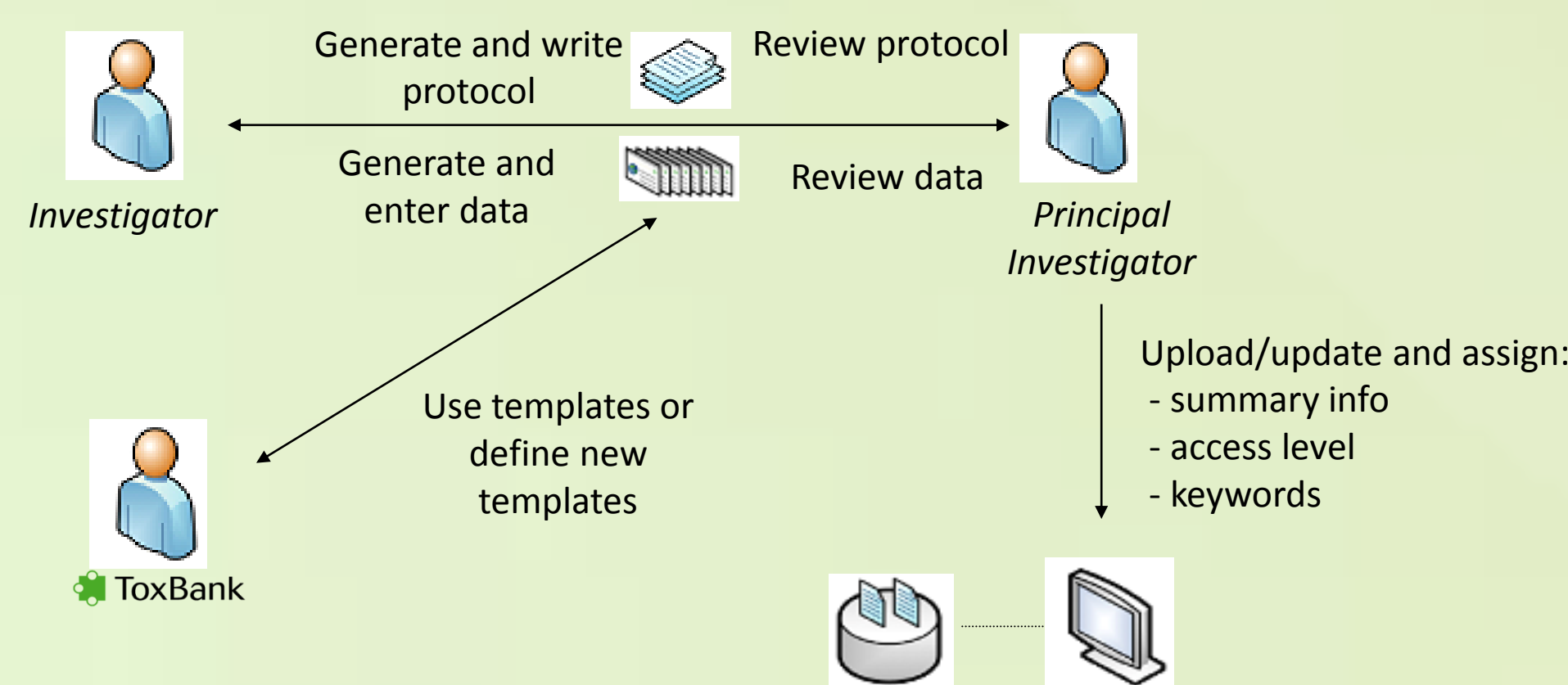


Paper mock-up of user interface

# Co-creation of a User-centered Design for SEURAT-1 Data Management and Analysis

## ToxBank Data Warehouse

### Generating and uploading protocols and data

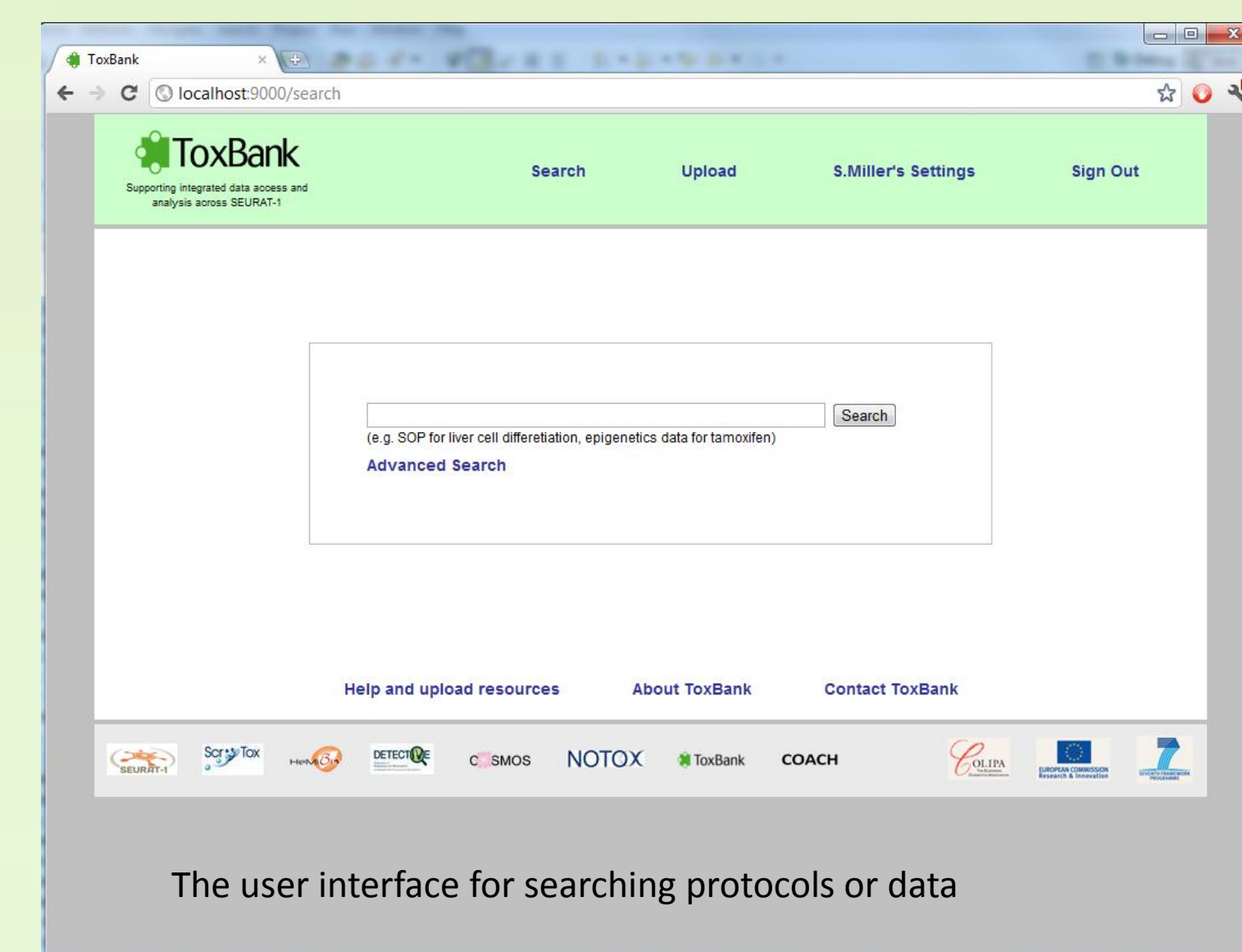
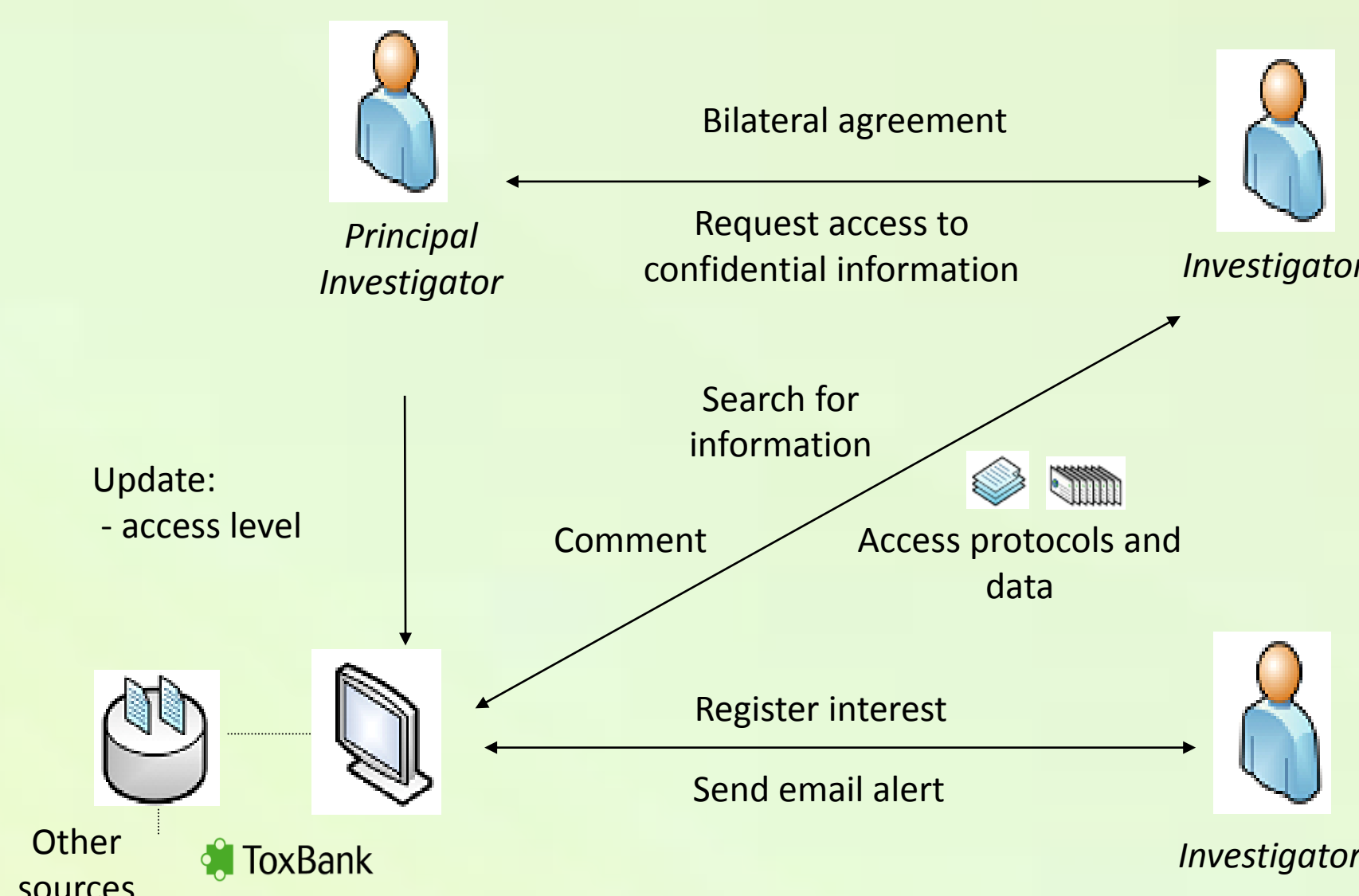


The user interface for uploading protocols

Protocols and data generated throughout SEURAT-1 can be uploaded into the data warehouse. This information should be reviewed within each project and entered directly by the project's principal investigator once approved. Data is uploaded using templates, such as an Excel spreadsheet with pre-defined fields. If no template exists for a specific

type of data, the ToxBank scientists will work with the project team to create one. The data and protocols can be uploaded into the data warehouse where additional information is also assigned, such as access rights and keywords to support searching.

### Accessing protocols and data



The user interface for searching protocols or data

All investigators in SEURAT-1 will be able to search for protocols and data. Where a protocol or investigation dataset has restrictive access, an investigator who does not have permission to view the information will be presented with a summary of the information.

The investigator may contact the protocol or data owner directly to request permission to access. Investigators may also register an interest in topics and get email alerts when new information is added to the data warehouse.

## Summary

Prior to designing the ToxBank data warehouse, we implemented a detailed requirements gathering exercise. As part of this process, we visited around 20 partner sites and conducted interviews with individual scientists. These discussions covered a variety of activities including cell differentiation, cell engineering, biomarker identification, dose response analysis, toxicity testing, 'omics experiments, chemical analysis, and cell banking. The interviews focused on understanding and recording in detail what specific steps were performed across a variety of tasks. This type of analysis can only be accurately recorded by observing the actual work. Detailed notes were taken along with examples of documents used. This information was collected to ensure any system design both meets the needs of scientists across the entire cluster at the same time as fitting within current workflows. The interviews along with other requirements gathering exercises resulted in over 1,000 separate notes and 40 tasks outlined. The ToxBank team organized and analyzed the notes, descriptions of tasks, and associated documents as a group and developed a design for the ToxBank data warehouse directly from this analysis. The design was subsequently tested using a paper prototype where the major components of the user interface were sketched out on paper. This allowed for further testing of the usability of the system, resulting in a refinement of the user interface where problems were encountered using this paper mock-up to illustrate the different scenarios. The final version of the paper protocol was used to develop the ToxBank data warehouse.

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