The Simons Scientific Information Management System: Supporting scientific decision-making in autism research using a lightweight web-development methodology

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Background
Making decisions about scientific direction, such as funding of research programs, requires a variety of information sources. Science officers require knowledge of multiple internal sources about grants, as well as multiple external sources about grants and publications. Access to a wide range of systems can increase costs and reduce the speed of decisions. Different kinds of tasks (use cases) often result in very different software solutions, such as customized "dashboards." These attempts usually fail due to long delivery times, measured in months or years. By the time the dashboard is delivered, decisions and data have changed. Our approach is to produce a platform for rapidly configuring decision support dashboards that can be delivered in a matter of days or hours.

Objectives
Our goal was to produce a decision support platform with the following capabilities: 1. Build a typical dashboard in hours, with more complex dashboards taking a few days. 2. Build most dashboards without any programming, using configuration by science officers or business process analysts. 3. Use standard components and web technologies to simplify maintenance and improve interoperability. 4. Provide flexible access to data for new software modules. 5. Support sophisticated and intuitive searching, with support for querying by terms meaningful to users.

Methods
We designed a data warehouse with an extensible data model for storing a wide variety of data about scientific research, and defined lightweight methods for extracting and loading data from internal and external sources. Next, we added a robust, web-native data-access layer (HTSQL), a rapid web-application development framework (HTRAF), and, finally, a visual application builder (the HTRAF VAB). The first pass at semantic search was handled via AlchemyAPI development framework (HTRAF), and, finally, a visual application builder (the HTRAF VAB). The system combines data from multiple sources and makes it available to decision makers via rapidly developed web-based tools.

Results
We developed the platform using an agile methodology over 10 weekly iterations. We then took two weeks to configure the first prototype of a decision-support tool suite: a set of interconnected dashboards for reviewing grants and grant applications and making decisions about their status. The prototype included the following screens: application dashboard, grant dashboard, publication dashboard, scientist profile, collaboration dashboard and home/search page. We were able to deliver three complete designs of the suite (a total of 21 different screens) for a usability review. Data provided by the prototype was judged useful for helping science officers make decisions about grant applications, and one design was selected as the most intuitive. Preliminary semantic search functionality showed some promise, but was too immature to evaluate.

Conclusions
A well-designed generic platform can facilitate inexpensive and rapid delivery of tools to support a wide range of decision-making tasks. The largest challenge was successfully integrating data sources with various degrees of cleanliness and completeness. Data cleaning and normalization are likely to remain challenging, as the number of data sources pulled into the platform continues to increase. We expect to make the results of this project available to the research community and believe it will help inform decisions about scientific directions in autism research.