

# Provenance in Business Applications with Visualization

Ken Beckett, Oshani Seneviratne

Oracle Corporation

## Abstract

We propose that the Provenance Recommendation [1] might be useful in tracking changes to business objects over time in enterprise software applications. We also discuss the importance of a good visualization tool to help users understand provenance information more easily and rapidly.

## Business Objects and Provenance

Business applications generally make use of “business objects” in the database and business logic layers to represent business entities, their attributes (state), and their relationships with each other. These business objects are not static, but constantly change over time as they are added, removed, have their attributes or relationships modified, are split or combined, etc. Consequently, it is useful to have methods of tracking and visualizing these changes as they are made from one software release to another by various different agents.

We believe that PROV could find a useful niche in tracking the provenance of business objects. Provenance information could be used by business intelligence, big data mining, analytics tools, and general business applications to help deal with and confirm the validity of changes to business objects over time between software releases. In our group at Oracle, we have been using provenance information to track changes to the business objects used by many different enterprise software systems, which then are in turn used as inputs to a Governance, Risk, and Compliance application in order to implement governance controls and risk analysis for compliance with the US Sarbanes-Oxley Act (SOX). This implementation has been in place for several years now, and is working effectively.

## Visualization of Provenance

In our work with the provenance of business objects, we have found a need for a well designed visualization tool that is easy to use, highly responsive, and can animate and display provenance of business objects moving forwards or backwards in time. This would make it much easier for users to understand the evolution of the business objects and would greatly help to promote such a use of PROV in the business world.

We have previous experience with temporal graph visualization in our group [2], and have been experimenting with the use of our existing web-based visualization tools to fluidly render the provenance of business objects. Some of the challenges we have faced include determining how best to model and visualize our business object provenance using the existing PROV vocabulary, how to display and navigate through large amounts of data without clutter or confusion, and how to provide video-like playback of the provenance information with a timeline and speed and direction controls.

One of the key considerations in representing provenance visually is the proper handling of the granularity of provenance data. In business applications, we have collections of records, with each record having multiple data items with their own provenance information. For example, consider the concept "today's workforce" which would be a prov:collection of employees. The higher level object, i.e. the "today's workforce" has its own provenance, which may involve the additions and deletions of employees to the workforce over time. However, each individual employee object may have its own provenance records as well. Therefore, in the provenance visualization, it is imperative that the user can select the provenance of the entire collection of objects or just a single object. The former will let the user gauge how much has changed in a given time period without having to look into the specifics, and the latter will let us drill down a bit deeper to get more provenance information.

Representing provenance information statically is another important aspect of visualizing provenance, especially when the processes that act on the object result in other derived objects. The user should be able to pick an entity at a given point in time, and generate a static representation of the creation of the object, its ancestors, derivations of the object, and other changes to the object in a static graph as applicable to the business scenario or based on the user query. Such a visualization can be very important in auditing applications where the focus is to get an overview of an object's history.

## **Conclusion**

Our work is still very much on-going, but our general impression is that PROV is very useful to track business object changes over time, and also that the fluid and responsive time-based visual display of provenance information for any scenario in which it is used has the potential to increase both its use and its usefulness.

## **References**

- [1] "Prov Overview", W3C, 30 April 2013, <https://www.w3.org/TR/prov-overview/>
- [2] Patent "Temporal Graph Visualization Layout", 28 January 2016, <http://www.patentsencyclopedia.com/app/20160027197>