

VIVO: Enabling National Networking of Scientists Year 2 Progress Report: July 1, 2010 – June 30, 2011

1 Summary

The VIVO project has had a remarkable second year. Development has produced major new releases of the core software, as well as a new tool for general purpose data ingest, the VIVO Harvester. Ontology has matured the VIVO ontology, aligning it with significant other ontologies and demonstrating the extensibility of the VIVO vocabulary for additional use cases. Implementation has progressed at all seven schools with plans to transition to sustainable operations at each. Six mini-grants were funded to augment development and spur innovation. Over 121 presentations have been made by VIVO team members in a wide variety of venues in support of VIVO adoption. Five papers are in press and an additional five conference papers have appeared. The result has been more than fifty VIVO projects in progress around the world. An open source community has been established to enable collaboration and on-going support of the software and its use in research and scholarship discovery and networking. Four annual VIVO events have been established to further create and sustain community throughout each year. The goal of establishing a national network of scientists has blossomed into a world effort to partner in support of an open information infrastructure for research discovery, collaboration and scholarly work.

Significant challenges remain that will be addressed in future work. Significant improvements are needed in the ability to ingest data and implement VIVO. New capabilities are needed to make use of semantic data stored across the web of data. Connecting applications using this linked data will be a challenge.

This report describes development, ontology, implementation, outreach, sustainability and evaluation for the period July 1, 2010 to June 30, 2011. The report concludes with summary assessments, challenges and prospects for the future.

2 Development

With three months still to go as of this writing, the development team has addressed and is on track for achieving major development milestones for the project. The VIVO software has been updated with the major 1.2 release and two maintenance releases, and the VIVO Harvester has had four releases including the major 1.0 release in March, 2011 and additional updates in May and June.

2.1 Development Accomplishments

Version 1.2 of the VIVO application was released in mid-February after four months of development and several weeks of intensive testing. This release incorporates major visual theme and navigation changes and extends the initial co-author visualizations for co-investigator relationships as well as providing support for comparing temporal graphs of publications among institutions or departments. Version 1.2 also significantly reduces server memory requirements, as confirmed by extensive testing in production at the University of Florida, Cornell, and Washington University School of Medicine in St. Louis.

VIVO's new look and feel with version 1.2 brings a number of usability improvements to in-page as well as site-wide navigation. The new interface has been extensively informed through user testing, with priorities including simplified navigation and configurable menu page options as well as an improved overall browsing experience.

2.1.1 Visualizations

Visualizations now extend the user experience on individual researcher pages as well as providing rich interactive overviews. The VIVO “sparkline” trend

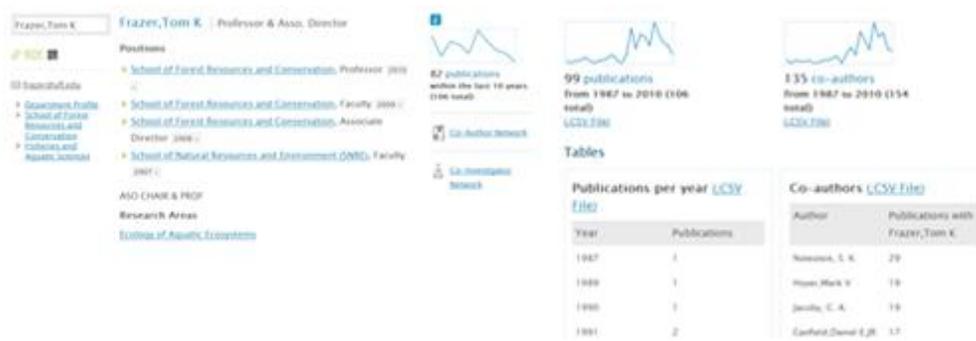


Figure 1 Sparkline visualizations in VIVO 1.2 showing papers and co-authors over time

visualizations have improved since last year's report to show trends in paper publication, paper collaboration, grant reception, and grant collaboration. We have also created several tables that show this data numerically as well (top paper collaborators, top grant collaborators, and more).

The co-author visualization highlights the immediate co-authors of each person in a VIVO instance and has been refined to cluster authors into communities, making the separation or inter-collaboration of a person's various co-authors much easier to see. This same interactivity has been extended in a new visualization allowing users to see and explore the grant collaboration network of each individual in a VIVO instance.

A new temporal graph visualization also introduced with VIVO 1.2 allows users to explore and compare the publication and grant histories of schools, departments, and people side by side within a VIVO instance. The temporal graph visualization can also be used to visually check publication and grant data coverage within a VIVO instance.

All visualizations and tables now include options for downloading the data that they are based on, which enables users to further explore this data using spreadsheet or network analysis tools. We have also completed a system for basic VIVO visualization data caching, which allows us to pre-calculate data for visualizations and which results in significantly improved load and response time for users.

2.1.2 VIVO Harvester

The VIVO Harvester answers the most frequent inquiry from prospective adopting institutions about VIVO -- how to load institutional and publications data. The Harvester team at the University of Florida adopted an open, iterative approach to software design involving extensive testing and feedback from implementation sites within and outside the project. A set of modular tools deliver the Extract, Transform, and Load (ETL) functions common in enterprise data management applications. These tools are extended by functions specific to RDF and additional support for data matching and ongoing update after an initial ingest.

The Harvester provides a configurable framework that supports a wide variety of input options including XML, Open Archives Initiative Protocol for Metadata Harvesting¹ (OAI-PMH) harvesting, direct download from relational databases, and upload of spreadsheets and common bibliographic formats.

The Harvester design has evolved rapidly in supporting the three most commonly requested content types -- human resources data, grants, and publications. The Harvester team has also provided extensive consultation and training, both on-line and in person, including recorded webinars.

2.1.3 Open Source Community

The single biggest change to VIVO development is the transition from development within the project to participation by a growing community of VIVO adopters beyond the current *VIVO: Enabling National Networking of Scientists* project. The Harvester has been developed and documented on SourceForge from the beginning, and the VIVO application itself was moved to SourceForge in early March, 2011. Documentation is transitioning from the project-based Confluence wiki to the public SourceForge site with assistance from the University of Florida Library team.

The development process has been very well served by this increased openness and visibility. An Internet Relay Chat (IRC) channel frequently provides near real-time responses, and postings to the VIVO development list on SourceForge have increased steadily, with over a dozen developers from within the project as well as a growing number of people at newly adopting sites participating in answering questions. Adoption and development list participation have been heavily influenced by the new voices at the table through the VIVO mini-grants competition; these grants will be described individually later in this report, but directly engaging additional programmers outside the project has had a major benefit in bringing new ideas to the original development teams as well as encouraging other developers to participate.

2.1.4 National Networking Visualization

We created a first version of the National Researcher Networking Visualization². The NRN visualization aims to visually represent the state of various national researcher networking efforts by showing the data holdings of major researcher networking systems in the U.S. The visualization allows users to see the number of people, publications, patents, funding and courses in each of the publicly accessible instances of VIVO, Elsevier SciVal

experts, Harvard Catalyst Profiles, and Stanford CAPS. Users can animate the map to see growth of these national researcher networks over time.

2.1.5 The VIVO Community Search

The ability to search across multiple VIVO installations has been a key premise of the *VIVO: Enabling National Networking of Scientists* project since its inception, and the 2009 Recovery Act U24 Limited Competition specifies that “a national prototype must be operational at the end of the project period.” The VIVO project has from its inception targeted a distributed approach to search that allows each institution hosting VIVO full control over the information exposed for indexing. Managing the information at each source VIVO installation allows the indexing and search delivery functions to be independent of any single point of aggregation; any interested party can elect to adopt the VIVO indexing tool and/or the VIVO search service across any set of participating organizations. The only requirement is that participating applications produce RDF data expressed using the VIVO ontology.

Keeping the indexing and multisite search delivery software separate from VIVO itself provides a number of key advantages. We anticipate that searching the national or international VIVO network will be of significant interest beyond the VIVO community alone, and the separation of indexing and search delivery from each other and from the VIVO code base provides a modular way to participate in and leverage the resulting indexed data. The search indexing processes RDF harvested using standard linked data requests to the applications (VIVO or other) at each hosting institution, with a configurable target frequency of updating set initially at 24 hours. The indexing process converts the harvested RDF into an Apache Solr index; Solr is a major open-source search tool that extends the Lucene search software presently used by VIVO for search indexing within a single VIVO instance. Solr offers additional options over Lucene for managing very large search indexes, including support for distributed index generation and for replication across multiple sites for maximum performance. While the size of the VIVO index will be small during the scope of the project, Solr provides a robust growth path for the future.

The VIVO project will also make available an exemplar multisite VIVO community search application built using the Drupal open-source content management system and the Apache Solr plug-in module for Drupal³. Extensions to the Apache Solr module will be contributed to the Drupal open-source community to fully enable other parties wishing to implement searches that leverage any desired consortium of sites producing VIVO data.

Searching across multiple institutions rather than a single one provides a number of new interface requirements, especially when users wish to easily alternate between a search with a local scope and searches across an entire network. The VIVO community search interface has been tested using fully



Figure 2 National Networking Visualization showing geolocation of aspects of research activity

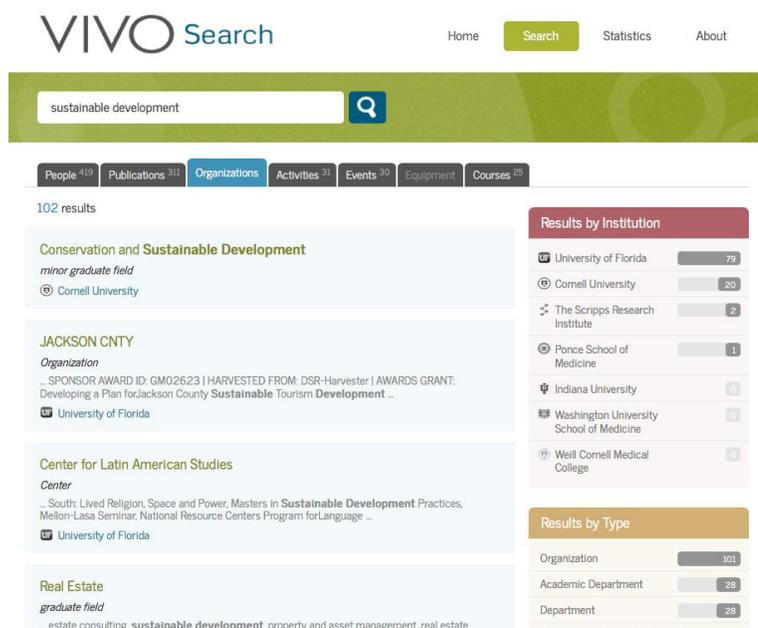


Figure 3 Development view of VIVO community search providing semantic faceted search across sites

functional prototypes with data indexed from the seven project partner sites, both as a single landing page integrating data from multiple sites and as an extension of the search capability at any single VIVO installation. Feedback has stressed the importance of clear organization and reinforcement of current search limits through visual cues, and the User Interface Team is working to provide as consistency between local VIVO and whole VIVO community searches.

2.1.6 Release 1.3

The development team has scheduled the release of VIVO version 1.3 for late July to allow top partner sites and adopting institutions a full month for updating before the VIVO Conference in late August.

The visualization team has implemented a Science Map visualization, which allows users to visually explore the scientific strengths of a university, school, department, or person in the VIVO instance. Users will be able to see where an organization or person's interests lay across 13 major scientific disciplines or 554 sub-disciplines, and will be able to see how these disciplines and sub-disciplines interrelate with one another on the map of science. Wireframes and design documentation for upcoming enhanced versions of the Science Map visualization have already been developed; the Science Map visualization will most likely be in the form of a PDF that a user can download.

VIVO 1.3 will feature notable improvements to the local search, primarily to improve relevance ranking but also to boost the influence of semantic relationships in the search. This will improve recall by including text from related resources (e.g., adding a person's grant and publication titles to his or her search entry) and by boosting overall relevance ranking based on the number and nature of connections from one individual to others.

Release 1.3 includes significant changes that bring the VIVO infrastructure closer to where we believe it needs to be for optimal open source community participation and contributions. In addition to a large number of bug fixes and improvements to the major changes in the 1.2 release, 1.3 provides an entirely new model of authorization within the VIVO application to allow more granular control over system configuration and editing. This work is a necessary prerequisite to the much-sought after proxy editing feature, whereby one person (typically an administrative assistant) can be designated as a proxy editor for another (typically one or more faculty members or a research center or other organization). The authorization system also allows VIVO webmasters to better control editing rights to the ontology and display features of VIVO, and it provides an internal user account for all self-editors as the locus for future implementation of personal preferences for limiting display or controlling ordering of publications and other information within VIVO pages. The interface for changing and supplementing VIVO's new menu page system is also being upgraded with version 1.3.

While less directly visible to the public, version 1.3 also includes additional changes focused directly on supporting open source community involvement in extending and customizing VIVO. The development team began a year ago to transition VIVO's code base away from Java Server Pages to the FreeMarker page templating system that much more cleanly separates internal application programming logic from page display, with dramatic results in version 1.2. We have seen the payoff in the success of other adopting sites, most notably the VIVO mini grant projects, who have been able to step in and modify or extend VIVO to meet their

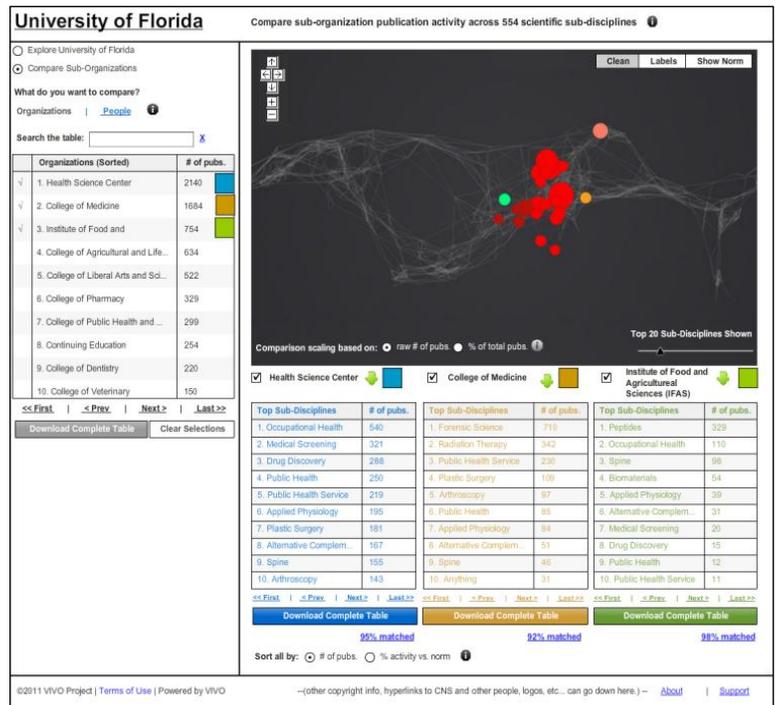


Figure 4 Science Map visualization for VIVO version 1.3

own needs. What would have required extensive background knowledge and familiarity with Java as well as HTML and JavaScript has been made much more transparent and accessible to web developers not steeped in semantic web principles and the intricacies of back-end Java application structures and logic. While the range of new functionality visible through the mini-grant projects and from the VIVO Hackathon undoubtedly reflects primarily on the talent and effort of the developers involved, the infrastructure improvements in VIVO have enabled the rapid development that we have seen and will do much to support open community development in the future.

2.2 Development Plans

The development road map produced early in the project and updated for the 2010 VIVO conference⁴ provides a graphic overview of the scope of work charted for VIVO. While almost every area of the road map has been addressed in core VIVO infrastructure, and many significant new features have been delivered, it is clear that VIVO will continue to actively evolve and grow beyond the end of the original two-year project period in response to new requirements and opportunities. The Implementation Fest recently held at Washington University in St. Louis highlighted how much some of the adopting institutions outside the project have been able to achieve in creating production VIVO instances of their own, as well as illuminated new challenges from internationalization to new more complex data feed and user management requirements. The advent of new tools such as Google Refine indicates how rapidly the semantic web landscape and tool options are evolving to meet the growing popularity of Linked Open Data.

Features scheduled for VIVO 1.4 include the extension of each VIVO institution's local search to the full VIVO multi-site search described above; and user testing is underway to assure users will be aware of the scope of their current search and that limits and results faceting are intuitive. The VIVO multi-site index will also enable linking people, publications, organizations, grants, or events from within one VIVO to another through enhancements to VIVO's standard editing interfaces. The external vocabulary services developed under the Stony Brook University mini-grant effort will be integrated into VIVO as another step toward fully generalized support for active data linking across institutions and freely available data sources as envisioned in the original U24 Request for Applications.

2.2.1 Visualization Plans

The Science Map visualization slated for an initial release with VIVO 1.3 will be improved and enhanced with several new features, including the ability to compare the scientific strengths of up to 3 people or organizations side-by-side on the map of science, and the ability to evaluate an organization or person's research strengths in comparison to the average global activity in each scientific discipline or sub-discipline. This full version of the Science Map Visualization is expected to be completed by August 2011.

The National Research Network Visualization will be enhanced to consume streaming data from all VIVO instances and from other National Research Network efforts where possible. The initial NRN visualization dataset was populated by hand, which was viable as a first step but will not be practical in the long-term. This enhancement will allow the NRN visualization to automatically consume information on the current record counts for all public VIVO instances, providing an up-to-date view of the national researcher network.

We plan to create, store, and serve a variety of derived graphs based on core VIVO data as a pre-cursor to further analyses, with a focus on social network analysis and visualizations. As an example, VIVO currently does not contain an explicit collaboration graph: for instance, a person 'A' may be an author on publication 'X', and person 'B' may be an author on publication 'X' as well, but there is no explicit connection between author 'A' and author 'B' in VIVO. We plan to create this and other useful network graphs, store them, keep them synchronized with core VIVO data, and serve them. These derived graphs can be utilized for a variety of purposes: they will be used within VIVO itself to produce enhanced functionality; they will also be accessible to third parties to provide value-added services for VIVO; and the derived graphs will also be available for download by regular VIVO users and researchers interested in exploring VIVO data themselves. As part of this work we will assist the Cornell team in expanding the capabilities of the VIVO semantic data caching system, and assisting in the development of related functionality for refreshing and updating caches on a periodic basis.

The creation of the derived graphs described above will enable the creation of various new visualizations, including but not limited to an automatically generated and interactive view of a VIVO institution's organizational hierarchy, and a visualization that will allow a user to see the strongest connections between any two VIVO users.

We are also exploring a collaboration opportunity with the Gephi⁵ team, which would enable VIVO users to visually explore various networks in VIVO using images generated by the Gephi network visualization tool.

2.2.2 VIVO Harvester Plans

The VIVO Harvester is being tested at a number of existing and prospective adopting sites leading up to the late June Implementation Fest and beyond, and the UF team has been responding rapidly with new documentation and improved scripting interfaces that clarify the many available options, as well as more thoroughly documented examples. Members of the team attended the Implementation Fest and have provided one-on-one remote and on-site assistance to additional adopting institutions.

Several key areas remain for future work and will be represented in tasks proposed as development areas for the no-cost extension period. Data ingest and update processes rely heavily on data matching that can be improved based on the full scope of current information in VIVO as well as information such as previous email addresses and affiliations. Individual ingest and update scripts have been enhanced to improve alignment of organization names, place names, awards, conferences and other events, and subject keywords in addition to researchers themselves, and we propose to incorporate more sophisticated matching techniques in VIVO and the Harvester.

2.2.3 Connecting VIVO with Linked Open Data and Other Applications

The direct connections established between VIVO at Cornell (Ithaca) and the Weill Cornell Medical College VIVO and exploratory work at the VIVO Hackathon provide use cases for closer coupling between any two VIVO instances. Hackathon work found several examples of publications with co-authors at VIVO sites and/or Harvard Profiles, and pointed out how information discovered in cross-site searching could supplement each local site's information, as well as reduce the large numbers of unknown co-authors represented in VIVO. Bi-directional connections in grants, facilities, center and institute affiliations, and degree programs, as well as co-author relationships, provide compelling demonstrations for linking two VIVOS, especially as these multi-faceted relationships evolve over time. The ability to manage information at a person's home institution while actively exposing and updating connections to researchers and research activities wherever else they may exist is one of the most compelling features offered by VIVO's distributed linked open data approach to researcher networking.

The VIVO mini-grants also highlight the potential of extending VIVO in ways that will require new development in the core application. Linking between VIVO instances underscores the importance of consistency in applying controlled vocabulary terms so that data harvested from multiple VIVOS will not have multiple URIs for the same term, but instead reference controlled vocabularies directly via each term's persistent URI. This work will leverage the UMLS work of the Stony Brook University mini-grant, and it relates closely to the ORCID mini-grant as well. Many open challenges remain in this domain, including how to blend locally-defined controlled vocabularies (e.g., university strategic goal areas) with externally defined vocabularies, and how best to establish and maintain coordinated lists of educational organizations, grant sponsors, publishers, journals, and events as well as people in ways consistent with several emerging efforts at global authority databases and services. The VIVO Technical Advisory Board has already been helpful in discussions on URI proliferation and identity management, and project members are actively participating in international workshops on researcher identity and attribution (e.g., the IRISC 2011 workshop⁶).

The Duke VIVO widgets, Digital Vita Documents, and HUBzero mini-grant projects have also highlighted the need for more flexible and extensible ways to query VIVO and share content directly with other applications. VIVO developers have already provided specialized application responses to return the equivalent of several individual linked data requests through a single request response, and the evolving VIVO community search indexing will likely offer additional options for previewing available content, identifying or following semantic linkages, and providing useful dynamic data compilations such as recent publications by individual, group, or

center. This area of work has many benefits for repurposing VIVO data in other applications as well as dynamic report generation, whether for biosketches, CVs, or recommender systems.

3 Ontology

3.1 Ontology Team Structure and Activities

The VIVO Ontology Team has been organized around three activities initiated in the first year of the project: 1) An ontology implementation team led by the University of Florida's ontology staff member manages the ongoing evolution of the ontology feature set in response to new data sources identified at Florida and needs expressed by implementation sites. 2) The Cornell Semantic Applications group coordinates the production of ontology updates and new ontology modules, implements reasoning improvements and makes other changes in the VIVO application to support ontology editing and management, including ontology imports and exports. 3) Indiana University's ontology team maintains a focus on research into new application features to leverage VIVO's ontology, such as the SPARQL query builder, while also supporting ontology documentation and evaluation.

Each of the seven VIVO project sites has a designated representative on the ontology implementation team, known as the "ontology large team." Through biweekly calls, the sites have provided insights on new requirements for the VIVO ontology, such as representing clinical activities, as well as discussing implications of the ontology on data representation and practice.

Depending on the upcoming release schedule, the three primary ontology team sub-groups meet weekly or biweekly via GoToMeeting to discuss ontology issues submitted through the VIVO tracking system or conveyed through biweekly implementation calls and to prioritize improvements for each release. This "ontology small team" group also meets with the eagle-i ontology team and the larger Resource Representation Coordination group coordinated by Dr. Melissa Haendel at the Oregon Health and Science University.

The JIRA issue tracking system has been instrumental in tracking ontology-related problems and questions, proposing and discussing new functionalities or improvements, tracking user case studies, disseminating summaries of policy discussions, and providing documentation in the context of feature development. During the second year of the project the issue tracking system has been opened for broader participation through links from the VIVO open-source development site on SourceForge⁷.

3.2 Accomplishments

We have released VIVO ontology versions 1.1 and 1.2, with the release of version 1.3 expected in late July.

Version 1.2 of the VIVO ontology includes two significant new modules developed through ongoing collaborations with the eagle-i Project⁸. The two ontology teams held face-to-face meetings at Indiana University in September, 2010, and have continued to meet at regular intervals since then. We first worked jointly to modify the VIVO ontology for alignment with the Basic Formal Ontology (BFO), an upper ontology providing a high-level organizing structure designed for information representation and that can also for use in support of domain ontologies developed for scientific research. An optional VIVO ontology module encapsulates the alignment to BFO and will help inform further alignment efforts.

The BFO alignment work guided the implementation of a Scientific Research module, combining the top-level eagle-i classes and a number of associated properties to link research resources to people and organizations. The goal of this module is to allow an institution hosting VIVO to capture and store information on research resources within the institution in order to demonstrate the potential value of implementing the full eagle-i application, represent a subset of research resources available for broad use, or permit direct interoperability with eagle-i or other semantic platforms for search or data-reuse within the institution. This module is now part of a default VIVO installation.

Significant progress has been made on ontology documentation, with the immediate goal of submitting the VIVO core ontology to the Bioportal in association with the VIVO 1.3 release. The ontology documentation is being developed on the public SourceForge wiki, and the Indiana team has prepared standard-format OWL Doc HTML pages for the VIVO ontology to link from SourceForge. The Florida team is preparing diagrams of

key sections of the ontology to help with data acquisition planning and Harvester configuration at existing and newly adopting VIVO institutions.

The Indiana team tested Cornell data (v 1.1) and UF data (v1.2) with a set of SPARQL queries to identify issues in the ontology's ability to support anticipated queries for researcher profile information as well as how consistently the ontology has been populated at those two institutions.

The Indiana team is also developing semantic web components to facilitate knowledge discovery, including the SPARQL Query Builder included in VIVO 1.2 and a search tool to discover associations between two people in VIVO. The SPARQL Query Builder helps VIVO data curators to semi-automatically build complicated SPARQL queries by choosing candidate classes and properties from dropdown boxes. This work is also being extended by one of the VIVO mini-grants as a means for webmasters to identify content of interest in VIVO and formulate the queries necessary to consume VIVO data on other websites. The association search tool dynamically creates a relation graph based on the VIVO data to help users discover potential semantic relationships among instances in the data, such as between two researchers or between two organizations.

Ontology and outreach team members at Cornell and Florida have worked extensively with the VIVO implementation team at the USDA to review ontology questions and recommend extensions to meet the specific requirements of that organization in adopting VIVO.

3.3 Ontology plans

The ontology team will continue to address issues scheduled for the VIVO 1.4 release as well as new issues and requests being raised by implementation sites within the grant and in the wider VIVO community. These include:

- Developing a new VIVO ontology module for representing metadata about research data sets, based closely on the work of a consortium of Australian universities funded by the Australian National Data Service.⁹
- Building additional support into the VIVO ontology and application for representing corrections such as the reassignment of authorship attribution when standard name disambiguation techniques have produced spurious results
- Implementing the ability for users to link directly from VIVO to externally-hosted controlled vocabularies with stable URIs, in collaboration with Stony Brook University through the VIVO mini-grant program
- Continuing to develop the semantic association search and algorithms to analyze semantic data
- The ontology team will also participate in a number of collaborative efforts:
- Continuing to fine-tune the VIVO core ontology based on the feedback from additional institutions adopting VIVO, including institutions other than universities and medical schools. VIVO implementation personnel at the USDA have requested a version of the ontology less focused on academic institutions, for example.
- Working closely with the eagle-i ontology team to extend alignment and data interoperability to deeper levels of the VIVO and eagle-i ontologies, as well as joint exploration of extensions in clinical and research domains.
- Continuing to explore models of expertise based on the eagle-i and VIVO ontologies
- Working with two 2011 CTSA supplemental awards: one focused on representing intellectual property information at the University of Rochester, and a second expanding linkages from VIVO to the CTSA ShareCenter network, based at the Oregon Health and Sciences University.
- Working with Elsevier and Thomson Reuters to evaluate web services of non-proprietary bibliographic metadata as data sources for institutions licensing either or both companies' subscription database services.
- Working with the development team to troubleshoot data harvesting from Harvard Profiles, including resolving any ontology versioning issues or inconsistent data population.
- Working with the developers of tools including Collexis/Scival Experts and Symplectic Elements to facilitate exporting data conformant to the VIVO ontology.

- Working with partners including Symplectic to identify additional online sources of definitive information identifying journals and organizations, preferably in RDF format, to permit linking to these sources directly or via “sameAs” references.

4 Implementation

4.1 Cornell

4.1.1 Data Acquisition and Repurposing

- Ongoing ingest of HR, grants, and courses data
- Adapted ingest processes to reflect changes to existing data feeds. Changes: type of feed, department identifiers, content mapping
- Ingested 4 GB of faculty annual report data, May 2011

4.1.2 Data Maintenance

- In the process of cleaning up deprecated ontologies and data that existed prior to V0.9
- Remove deprecated disciplinary portal subset code and data, April 2011

4.1.3 Application Updates and Extensions

- Upgraded to V1.1 in August 2010
- Upgraded to V1.1.1 in October 2010
- Upgraded to V1.2 in May 2011 and V1.2.1 in June 2011

4.1.4 Current Tasks

VIVO provides researcher profiles to faculty and researchers across the institution for all disciplines at Cornell. The data is being repurposed for websites and centers that cross department and college boundaries. This service provides search and discovery to facilitate collaboration at Cornell and other VIVO or VIVO-compliant systems that are part of the consortium.

4.1.5 Future Considerations

Our local Cornell VIVO team is partially supported by the University Provost’s office and by Albert R. Mann Library. This will continue for another year during which time further university support will be sought. Our hope is to have the VIVO software hosted by Cornell’s Information Technology services, but continue to administer VIVO from within the Cornell University Library. We also have submitted three grant proposals as possible external funding sources.

4.2 University of Florida

4.2.1 Data Acquisition and Repurposing

- Acquired and ingested data from UF Human Resources (~10,000 UF employees and ~40,000 non-UF collaborators), UF Division of Sponsored Programs (~15,900 grants), and PubMed (~8,000 publications)
- Acquired data from UF Business Services (images) and Registrar (courses)
- Entered data manually from approximately 1200 CVs across all departments and divisions. Data elements included awards, previous positions, research interests, photos, educational training and additional email addresses

4.2.2 Data Maintenance

- Remapped data in the deprecated “overview” field
- Created new class to separate faculty from courtesy faculty
- Worked with UF International Center to identify fellowship and other international data
- Added local geographic data

- Refined organization structure at the highest two-digit organizational level
- In the process of adding role data. Roles did not exist prior to version 1.0

4.2.3 Application Updates and Extensions

- Created a SPARQL endpoint for the UF VIVO system
- Tested release candidates and submitted feedback to Development for version improvements
- Installed VIVO application 1.0, 1.1, and 1.2 versions (as available) – including migration to SDB and local branding – and Harvester 1.1 version
- Migrated VIVO to new server administration structure
- Designed extensions to support the UF International Center – its programs and international agreements
- Installed Harvester Implementation 1.1
- Implemented Shibboleth authentication for VIVO 1.0. Turned on self-edit for all faculty and staff.

4.2.4 Current Tasks

- Refreshing DSR grant data
- Documenting bugs and providing feedback to national development team
- Integrating VIVO support into the Library service model
- Discussing with CrossRef the use of publication data for VIVO

4.2.5 Future Considerations

- Transition from implementation to operations
- Continue to support VIVO system and apply upgrades and patches as available
- Apply new features as available
- Create a Technical Advisory Board
- Stabilize our ingest refresh cycles
- Continue to identify data sources
- Ingest course and image data into VIVO

4.3 Indiana University

Indiana University's team collaborates with the University of Florida, Cornell University, and representatives from the other four VIVO institutions who are involved with local production implementation of VIVO at their respective institutions.

4.3.1 Data Acquisition and Repurposing

Worked with the Indiana CTSI Administration to approve the use of and announce to CTSI researchers and get CTSIhub participant input to enhance their profile data. This data was then harvested and imported to the production VIVO@IU¹⁰ site for approximately 169 IUPUI faculty and 60 IU Bloomington faculty.

Prototype coordination for use of VIVO with the IU Pervasive Technology Institute: team is working closely with the Drupal CMS managers at IU PTI to determine if VIVO will serve as citation management system for their research center.

4.3.2 Application Updates and Extensions

During the past year, the IU team has installed VIVO versions 0.9, 1.1, 1.1.1, and 1.2 in our test and production installations which we refer to as VIVO@IU. Additionally we have installed the VIVO Harvester version 1.1.1 in order to use as an automated broker between our IUIE (Indiana University Information Environment) data warehouse and our production VIVO instance for synchronizing administrative information from trusted sources at IU with the VIVO production instance.

- Implementation of VIVO 0.9: implemented VIVO 0.9 and migrated all production data to the new version of the software for VIVO@IU.
- Implementation of VIVO 1.1: implemented VIVO 1.1 and migrated all production data to the new version of the software for VIVO@IU.
- Implementation of VIVO 1.2: implemented VIVO 1.2 and migrated all VIVO@IU data to the latest version of the software including development tie-ins for system-wide authentication through the IU Shibboleth installation.
- Implementation of Shibboleth Authentication for VIVO 1.2: implemented shibboleth authentication for all IU community members in conjunction with our upgrade to VIVO 1.2.
- VIVO Harvester Implementation 1.1.1: implemented the Harvester 1.1.1 with our IUIE data warehouse in order to provide automatic synchronization between our official administrative data sources and VIVO@IU.
- VIVO Harvester Enhancements 1.2: During the course of our work in implementing Harvester 1.1.1 with our IUIE environment we contributed several bug fixes to the development team at UF for Harvester 1.2.

4.3.3 Current Tasks

Our team is also working on 1) extending IU policies for auto-populating researcher profile systems for the IU system, 2) enriching data between VIVO@IU and other profile systems in place at IU like the Indiana CTSIhub and the soon to be implemented profile system for the IU School of Medicine, 3) prototyping models for VIVO use by other research centers at IU like the Pervasive Technology Institute and IU NetSci VIVO Instance, 4) working with other peer institutions to provide information about VIVO implementation such as the University of Illinois (I-CHASS) and the University of Nebraska, and 5) documenting bugs and other technical issues that arise in production implementation of VIVO and the VIVO Harvester within the Jira tracking environment. Meanwhile, we are working closely with the VIVO Mini-Grant recipient at IU who is building a Joomla extension for VIVO data that will be integrated into the HUBzero portal environment.

- Developing posters for the 2nd annual VIVO Conference: These papers will focus on the data enrichment tasks between IU CTSIhub and VIVO@IU and our work on Harvester Integration with the IUIE.
- Implementing 5 Years Worth of Class Teaching Data: This effort aims to bring in up to five years worth of classroom teaching and course data for researcher profiles within VIVO@IU.

4.3.4 Future plans

Future plans at IU include:

- Working closely with the IU Vice-President for Research to enable VIVO for all IU campuses.
- Identifying experts within the office of the IU Vice-President for Research at each IU regional campus to work with the IU VIVO Implementation Team on organizational structure implementation and cross-mapping between the IUIE (Indiana University Information Environment) for each regional campus.
- Using VIVO Harvester 1.1.1 to work with PubMed, GoogleScholar, and other open citation sources to enhance citation data within VIVO@IU.
- Working closely with the IU Library Collection Development Division on contracts with either Elsevier or Thomson for one-time data dumps to enrich citation data for VIVO@IU.
- Implementing IU regional campuses within the production VIVO environment starting with IUPUI campus.

4.4 Ponce School of Medicine

4.4.1 Data Acquisition and Repurpose

Ingest PubMed data in our production instance using the 1.0 release of the harvester.

We have populated 41 people records - includes all basic research scientists, still lacking clinical researchers and scientists/faculty from public health program

We have loaded all departments in Medical School and Biomedical Sciences PhD Program.

We have only modest coverage of faculty publications and very few grants loaded. Publications were ingested from PubMed. Grants have only been manually added.

4.4.2 Data Maintenance

Continuing to manually updated data for some profiles.

Provide feedback to the national team on our local VIVO issues.

4.4.3 Application Update and Extension

Test and continuing to update our production VIVO to the latest releases.

Continuing to test the various releases of the harvester on the testing server.

4.4.4 Current Tasks

PSM will continue to:

- Update VIVO at least on a monthly basis with the latest data fetched from our data sources.
- Update VIVO as future releases become available.
- Provide support to any institutions that need it and provide any documentation that I have available at the moment or provide remote support as last resort if needed.
- Provide support to local users of VIVO. At PSM in year two we kept current with releases of VIVO.

4.4.5 Future Considerations

The PSM IS staff will continue to work on the VIVO to keep it current, but that will simply roll into their on-going workload. Use of VIVO will be important to the development of the PRCTRC consortium (now a U54 will be a CTSA next -renewal in 2 years). The consortium members will use Eagle-i for resources and will use VIVO for scientific networking. It is expected that at time of renewal, each institution will incorporate budget allocation to keep VIVO running and current at each location.

4.5 The Scripps Research Institute

4.5.1 Data Acquisition and Repurpose

In July and August 2010, Scripps Library staff entered as complete data as possible for all faculty members of the Department of Chemical Physiology, our "showcase department" for the VIVO National Conference in August 2010. In the months following, we continued to add data to the brief records created for all other Scripps faculty, and to create profiles for newly arriving faculty, and delete profiles for departing faculty. We succeeded in exchanging (both importing and exporting) selected categories of data with the Faculty Profile records maintained by the Scripps IT Services Department on the Scripps home page. This streamlines data entry and data maintenance for both VIVO and ITS.

4.5.2 Application Update and Extension

Scripps installed the new versions of VIVO as they were released (v.1.1 in September 2010, v.1.1.1 in November 2010, v. 1.2 in March 2011). Following each upgrade, Library staff reviewed existing faculty profiles for errors that resulted from the new releases, made corrections where possible, and reported bugs and issues that we could not resolve locally to the VIVO JIRA Issue and Project Tracking site for resolution by the national VIVO development team.

4.6 Washington University School of Medicine (WUSM)

4.6.1 Data Acquisition and Repurpose

The VIVO instance at WUSM (vivo.wustl.edu) has been populated with faculty (1,920) who are at the medical school at least 50%, their respective departments (20) and programs and divisions (12). Publications (33,620) and journals (2,881) harvested from PubMed are also included on the site.

We have continued to collect WU researcher CVs and photos and are in the process of obtaining permission to use the WU grant data. Our team has played an active role in identifying enhancements to the ontology, such as the need to link grants with researchers and publications, as well as developing and sharing authoritative source for educational institutions. In a testing environment, we have loaded grant data from NIH RePORTER and used e-mail as a login option. To have robust profiles with data that cannot be programmatically harvested from public sources, NIH biosketches or CVs have been collected from all faculty (tenure-track and research) and center members for five department/divisions, and the others are being acquired

4.6.2 Application Update and Extension

WUSM has upgraded VIVO from the 1.0 release to 1.2.1. This process from 1.1 to 1.2.1 took a significant amount of time as there were significant changes to the software and heavy testing needed to occur; this resulted in reporting bugs to the VIVO developers with fixes incorporated in the latest release. The new release necessitated altering aspects of the data ingest process due to changes in the software.

4.6.3 Current and Future Tasks

WUSM will

- Continue work on obtaining, updating and ingesting data from current sources (e.g. HR, PubMed, Divisions/Departments) as well as new sources (e.g. Grants and Contracts Office, Web of Science).
- Automate the ingest process to have at least weekly data renewal.
- Expand VIVO to include departments outside of the School of Medicine.
- Allow researchers to use a single-sign on (i.e. WUSTL Key) to log into VIVO and edit certain fields in their profiles.

4.7 Weill Cornell College of Medicine

4.7.1 Data Acquisition and Repurpose

Since June 2010, the Weill Cornell Medical College (WCMC) VIVO Implementation Team accomplished many objectives. One of the biggest accomplishments is the categorization of WCMC's vast systems of record, we were able to identify authoritative data sources and establish data feeds into VIVO. The integration between WCMC's systems of record and Harvester helped us provide a long desired feature of our faculty members which is the ability to automatically ingest updated data for their profiles.

4.7.2 Application Update and Extension

The WCMC team has also worked closely with the national VIVO team to install each version of VIVO, including v1.0, v1.1 and v1.2. With the installation of v1.2, we have updated the VIVO interface with WCMC's branding and have started ingesting publications from PubMed using the VIVO Harvester.

4.7.3 Current Tasks

WCMC is part of a CTSA and we confirmed the participation of our partners including the Hospital of Special Surgery, Hunter College and Memorial Sloan-Kettering Cancer Center. Each institution will provide data to WCMC's VIVO instance to help enrich faculty profiles. The current automated data ingest is not as mature and accurate as we would like, as a result the implementation team has crafted a manual data entry plan to help create more robust profiles. We have also formulated a plan for internal WCMC outreach, the goal is to explain to our users the benefits of VIVO and also socialize usage policies for the self-edit feature and the correction of profiles.

5 Outreach

5.1 Introduction

Outreach activities have scaled up over the past year. The VIVO team's presence at various conferences and meetings with contributed content has enabled the team to directly engage people outside of the project about VIVO and has encouraged follow-up conversations with institutional representatives. VIVO team members have been invited to deliver a number of presentations at national and international conferences – a great indicator of the significant interest in the project across a broad range of groups. The outreach team has

biweekly calls to discuss local issues related to support and adoption issues. These calls will be opened to attendees beyond the 7 funded institutions beginning July 2011. The outreach team has recently focused efforts to provide guidance, outreach ideas, background support, and presentation materials to facilitate outreach efforts at VIVO implementations beyond the original seven. These resources are openly available on the SourceForge wiki¹¹ and provide a sustainable way to support future adoption activities around the VIVO platform at institutions and organizations.

5.2 VIVO Speakers Bureau/Conference activities

The Speakers Bureau team is responsible for identifying appropriate conference venues for VIVO presentations, locating suitable VIVO team speakers and assisting team members with developing abstracts and meeting deadlines. The Speakers Bureau work was led by Val Davis and Michele Tennant from the University of Florida. Since July 2010, VIVO team members have delivered 82 presentations^{12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,} developed and displayed 33 posters^{94,95,96,97,98,99,100,101,102,103,104,105,106,107,108,109,110,111,112,113,114,115,116,117,118,119,120,121,122,123,124,125,126,} and organized 6 full discussion panels at various conferences and meetings^{127,128,129,130,131,}. Five peer-reviewed papers^{132,133,134,135,136} have resulted from conference submissions and 5 additional manuscripts^{137,138,139,140,141} have been published during this time which directly benefited from the VIVO funding opportunity. All project publications and presentations are recorded on the SourceForge wiki¹⁴², where presentation materials can be linked for viewers to download and view past presentations. Submissions to future conferences include: World Library and Information Congress: 77th IFLA General Conference and Assembly; the 2011 VIVO Conference; 2011 VIVO Conference; ScienceOnline London; Library and Information Technology Association (LITA) National Forum 2011; Internet2 Fall 2011 Member Meeting; the International Federation of Human Genetics Societies/American Society for Human Genetics joint meeting; AMIA 2011 Annual Symposium; and the Association of University of Technology Mangers.

In addition to these activities, the VIVO team has exhibited at 2 conferences^{143,144}. The exhibit booth offers project members an opportunity to answer questions that conference attendees may have in a relaxed and informal manner. The booth is also a big draw for attendees at conferences for people who may not have encountered the VIVO project through other national outreach activities.

The VIVO team has had an opportunity to develop a number of innovative workshops and tutorials over the course of the last year. These events serve as an opportunity to engage interested parties in a more significant fashion and allow the VIVO team to work side-by-side with attendees, creating professional relationships and engendering strong support for our open, community-based approach. At least 32 tutorials have been developed and taught¹⁴⁵, including Katy Börner's 12 Tutorials in 12 Days at NIH series as well as sessions at the 2010 VIVO Conference, the Second Annual International Science of Team Science Conference, and 24 individual sessions at the 2011 VIVO Implementation Fest. The Indiana University team, under Dr. Börner's direction, organized three very successful workshops on various topics

Academic Institutions	Organizations
University of Rochester	Weill Cornell CTSC
Florida State University	USDA x 2
University of Miami	CTSA Rare Diseases Work Group
University of Albany	Agriculture Network Information Center (AgNIC)
University of Michigan	CTSA Consortium Child Health Oversight Committee
University of Cincinnati	Northwestern Cell Imaging Portal
University of Nebraska x 2	Knowledge Exchange
Einstein University	USDA VIVO Board Update
University of California - Davis	CTSA Consortium Steering Committee
Georgia Institute of Technology	Netherlands Bioinformatics Institute, Barend Mons
Duke University	International Monetary Fund
Brown University	BioMedCentral
King Abdullah University	Informatics Key Function Committee
University of Melbourne	Direct2Experts organizing group
UMass Medical School	American Psychological Association
Georgetown University	NIH
Howard University	CTSA Strategic Goal 3 Committee
University of North Texas	Lilly.com
UMass Lowell	Symplectics, Daniel Hook
University of California-Davis	Microsoft Research
University of Wisconsin	CrossRef
	Thomson Reuters x 3
	Elsevier/Scopus

Table 1 Academic and other organizations participating in VIVO webinars. July 1, 2010 - June 30, 2011

related to the project, including: IU VIVO Ontology Workshop, VIVO & eagle-i @ IU Workshop, and the NIH Workshop on Value Added Services for VIVO. Six additional tutorial sessions have been scheduled for presentation as part of the 2011 VIVO Conference. Tutorials are listed and are in the process of being made available on the SourceForge community wiki¹³⁷. Finally, Jon Corson-Rikert from the VIVO project and Dr. Melissa Haendel from eagle-i attended two STAR METRICS workshops in Washington in January and April in a technical advisory capacity at the request of the STAR METRICS team and the National Institutes of Health.

5.3 Adoption and Collaboration

There has been a great amount of work in the area of Adoption and Collaboration by the adoption lead, Elly Cramer, and other team members. The adoption and collaboration team has provided 49 webinars to academic institutions and organizations across the country (see Table 1). Requests for information from the website contact form and other referrals are initially handled by the adoption team lead and routed to the proper person as needed (administrative, development, ontology, etc). We have a team of project members representing different aspects of VIVO that can be recruited to present at the webinars.

5.4 VIVO Publishers and Aggregators

Our activities in this area focus upon developing relationships with publishers and aggregators for the purpose of data ingest and availability in VIVO. We have endeavored to work with these groups in a straightforward fashion with specific principles as our guide, 1) We request basic, non-copyrightable data elements; 2) We request that data must be available in perpetuity and 3) We emphasize that instances must be able to store and use the data in a manner consistent with linked open data. We have a number of exciting developments that will make it possible for institutions to take advantage of an institutional subscription to a data provider or that will allow an institution to purchase bulk data in batch form from the data provider.

We continue to actively pursue other data source options for institutions and organizations with a VIVO instance. We have been encouraged by the willingness of content providers to work with us to achieve agreements that allow data to be stored in a manner consistent with linked open data (allowing for unlimited use and reuse of the data as it becomes part of the linked open data cloud) and also the willingness of data providers to allow institutions to have access to data elements in perpetuity – both reflect a new understanding and recognition of the growing role that the semantic web plays in research and scholarship. Additional content providers are welcome to participate, and we maintain an open spirit of collaboration.

5.4.1 Web of Science

Cornell University, Washington University and the University of Florida will participate in a pilot to begin on July 1 and run through September 30, 2011. The results of this pilot will serve as a guide to future institutions to use Web of Science data to populate the VIVO profiles of their researchers. Pilot institutions are entitled to use the Web of Science web services API to access data. The web service will provide the following data for source records from the Web of Science: author, title, source, author keywords, UT (WoS identifier), ISSN, ISBN, DOI, and IDS (WoS identifier for document delivery). Web of Science records may be included in the VIVO system and available as open-linked records. Each of the three institutions can use the web service to populate their implementation of VIVO using WoS data authored by their faculty, students or affiliated researchers. Each record from the Web of Science must contain a link back to the WoS record by relying on the UT data element. The participating pilot institutions will also have access to the Article Match Retrieval (AMR) service to access current times cited counts for each article. The times cited count can: be displayed in the VIVO system with the article information and must link back to the Web of Science citing articles results. The times cited content cannot be made available as open-linked data, but can be displayed on the specific article page within an institution's VIVO instance.

5.4.2 BioMed Central

Preliminary work has been done related to the use of an open source protocol called SWORD to facilitate transfer of automatic article feeds to its member institutions of articles BMC publishes that have member institutional affiliation. This work is ongoing.

5.4.3 Scopus

Scopus subscribing institutions may extract and index Affiliation Data (as defined below) from the SciVerse Scopus online service respecting published journal articles, abstracts, conference proceedings, technical reports, presentations/lectures, and other research and intellectual output as published for the Subscriber by its affiliated authors, to load in, make publicly accessible from at no charge, and store in perpetuity in, the Subscriber's secure database system that Subscriber uses to collect, preserve and disseminate information about the intellectual output of the Subscriber's institute(s) ("Institutional Repository"), provided that the display of any Affiliation Data shall at all times include (if available) the associated Digital Object Identifier ("DOI"), and incorporate links in Affiliation Data to the relevant landing page in SciVerse Scopus from which such Affiliation Data was extracted. "Affiliation Data" shall be limited to the following bibliographic metadata: author name, author profile number, author country of residence, author affiliation, document title, document publication year, source title, volume, issue, pages, source and document type, publisher, ISSN, DOI, subject category (ASJC). CAS registration numbers, author contact information, author profiles, non-English language tags, chemical names and controlled vocabulary are excluded.

5.4.4 Mendeley

Team members have recently begun conversations with Mendeley to leverage their rich bibliographic metadata to populate author profiles using the Mendeley API. Mendeley currently boasts over 31 million papers in their database. The discussions with Mendeley are ongoing and would provide another avenue for a local VIVO instance to acquire bibliographic data for VIVO profiles.

5.4.5 CrossRef

We have had discussions with representatives from CrossRef about data acquisition options for VIVO. Data from CrossRef are open and can be consumed and repurposed. CrossRef offers a library affiliate program which allows users to query through 1) a web interface (login and use XML query for batch) 2) an openURL end-user interface (single search) or they can deliver data through a bulk load (which they call CMS services). CrossRef can offer many of the same bibliographic metadata fields that are available through other data aggregators (such as Scopus or Web of Science), however they do not provide affiliation information. This work is ongoing.

5.5 Other Outreach

The VIVO project has been highlighted at least 23 times in a variety of local, national, and international media coverage^{146,147,148,149,150,151,152,153,154,155,156,157,158,159,160,161,162,163,164,165,166,167,168}. The VIVO project has been the subject of hundreds of blog posts, Friend Feed posts, Tweets, and other social networking communication vehicles. The VIVO project continues to maintain an aggressive social media marketing strategy to highlight various efforts of the project through a variety of information streams. VIVO has a page on Facebook¹⁶⁹, a group on LinkedIn¹⁷⁰, and maintains an active presence of Twitter¹⁷¹ to help engage the public, promote the project, and direct people to the project website¹⁷² and SourceForge community site⁷.

5.6 Outreach Activities at VIVO Institutions

VIVO team members are engaged in outreach efforts at varying levels at the partner institutions. Most institutions support outreach efforts through a library-based model of support and dissemination. This model optimizes the library's role as a trusted entity on campus with a strong tradition of service and support to their user communities via liaison relationships of librarians to their local academic community.

5.6.1 Cornell University

Cornell University outreach efforts have focused on (1) building university-level support to incorporate VIVO into the fabric of the Cornell information technology infrastructure, (2) staying current with changing formats and access restrictions of authoritative data sources (e.g. Office of Human Resources, Office of Sponsored Programs, Registrar, and faculty reporting information), and (3) understanding the research and profile needs of faculty and researchers through the eyes of the library.

We have monthly meetings with Dr. Barbara Knuth in the Provost's Office, who provide funds of the Provost to review priorities and progress in our Provost-funded VIVO implementation project. Dean Krafft and Jon

Corson-Rikert met with the new CIO for Cornell University to make him aware of VIVO and will continue to bring ongoing developments to his attention as part of the larger effort to mainstream VIVO in Cornell's academic and research missions.

Several librarians in different knowledge domains participate actively as VIVO curators and are helpful in connecting with academic departments and graduate programs. Library connections also provide opportunities for round table discussions, council meetings, orientation booths, and interactions with specialized centers (e.g., Sustainability, Entrepreneurship).

We provide regular training sessions for college and department level administrators to learn how to edit in VIVO to take advantage of their familiarity with their organizational area and provide a clearer picture of the university structure.

Cornell University and University of Florida staff provide consultation support to the National Agriculture Library to assist with their USDA implementation of VIVO and meet regularly with the USDA/VIVO advisory board as part of this collaboration.

5.6.2 Indiana University

Indiana University's VIVO implementation team primarily has focused on building interest locally. Individual meetings with leaders have yielded great support from the research administration area, while presentations at brown bags and individual training sessions with departmental staff have spread the word about VIVO and stoked interest at a grass roots level. One of the most notable efforts focused upon work with the with the Indiana CTSI Administration to enhance CTSI researcher profile data. This data was then harvested and imported to the production VIVO@IU¹⁷³ site for approximately 169 IUPUI faculty and 60 IU Bloomington faculty.

The Indiana team has taken opportunities to promote VIVO on a national scale, most notably by coordinating the VIVO Boot Camp that was a pre-conference addition to the 2011 Code4Lib Conference, held on the campus of Indiana University in Bloomington, IN. This brought together colleagues from Cornell University, Indiana University and Cornell-Weill Medical Center to offer a comprehensive session on VIVO adoption for the Code4Lib community.

5.6.3 Ponce School of Medicine

The team at Ponce School of Medicine provides feedback to the national team on our local VIVO issues and offers support to other institutions to install VIVO on a Windows environment and provide guidance to get support from the national team or act as an intermediary.

We have assisted the following organizations with implementation:

- Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) - Costa Rica
- Universidad Central del Caribe (Joel Nieves attended implementation fest with partial sponsorship from Ponce)
- University of Puerto Rico

We have presented VIVO to several other schools that are part of a consortium/network to which PSM belongs:

- March 16, 2011: Puerto Rico Clinical and Translational Research Consortium (PRCTRC-U54RR026139), short presentation made about VIVO to University of Puerto Rico and Universidad Central del Caribe, both institutions are implementing VIVO (UPR contact Jose Conde & Humberto Ortiz; UCC contact Robert Hunter & Joel Nieves).
- April 11-12, 2011: Research Centers in Minority Institutions (RCMI) Program Directors meeting. Discussed VIVO without a formal presentation - follow up with Tuskegee University/Cesar Fermin, Charles Drew University/Keith Norris, Jackson State University/James Perkins, Florida A&M/Karam Soliman - follow up has not yet led to implementation decision by these institutions.

5.6.4 The Scripps Research Institute

Scripps has postponed launching its major Outreach effort to on-campus users pending the following conditions, on-site: the PubMed article Harvester is functional, the inter-institutional search feature is functional, and the ability for users to update their own profiles is easy and intuitive

The Library Director made an informal presentation on VIVO to the Library Director at California Institute of Technology, Pasadena, California in November 2010. At the invitation of a UF Librarian, Scripps Librarians contributed to abstracts and text for two presentations at the NCNMLG/MLGSCA Conference in February 2011: a paper, "Sustaining Networks of Researchers: Experiences with the VIVO Collaboration at University of Florida and The Scripps Research Institute," and a poster, "Sustaining our Future through Innovation - VIVO: Library-Based Support for Researcher Networking." Throughout Year 2, Library staff continued to provide feedback to, and learn from conference calls with the national Outreach team.

5.6.5 University of Florida

The University of Florida (UF) VIVO Outreach team has presented to at least 44 Departments and Organizations at UF since July 2010. The team has presented VIVO posters at four campus research days since July 2010 and the UF VIVO Outreach Training team has conducted 7 training sessions for library employees informing them about VIVO. VIVO has been presented to important UF organizations, including: Library Town Hall Meeting (November 2010), Deans' Council (March 2011), Faculty Senate (April 2011), and College of Dentistry Curriculum Committee (April 2011).

UF migrated content from Confluence to the SourceForge wiki, and improved categorization of content.

UF assisted in national ontology development and identified and implemented local ontology extensions for UF International Center data, internal/external organizations, and courtesy faculty. Results of these efforts were posted to SourceForge, serving as examples for others.

The UF VIVO Outreach team has presented 10 posters off campus at conferences and meetings since July 2010 and they have given approximately 16 presentations at national meetings/events. The UF Outreach team has made significant contributions to other project efforts led the planning and migration of materials from Confluence to SF wiki (ongoing). The UF Outreach team led the planning and coordination of the 2011 VIVO Hackathon in May and the UF Outreach team has received IRB approval to conduct usability testing on the VIVO interface (ongoing). The UF VIVO Outreach has had articles published in Library News and The Post, has been advertised on the myUFL splash page¹⁷⁴, and through posters, postcards, handouts, table tents and other means.

5.6.6 Washington University

Washington University outreach activities have consisted of a variety of efforts, including presentations, one-on-one conversations, and local press. Over 40 presentations have been given to various stakeholders at Washington University, including: IT directors from WU and our partner institutions, various divisions and departments, high-level stakeholders such as the Associate Dean for Research, the Associate Vice Chancellor for Research, the Assistant Vice Chancellor and Executive Director of Corporate and Foundation Relations, the Dean of the School of Medicine, and the Research Affairs Committee (a group comprised of department and division chairs at the School of Medicine). VIVO has been introduced in new graduate student orientation activities, in stand-alone lectures during the Office of Faculty Affairs lecture series in March and also as part of a general lecture on data in the Introduction to Genomic Medicine seminar series. Various one-on-one conversations and email exchanges with faculty members have taken place during this time and the WU VIVO has been featured in the Institute of Clinical and Translational Sciences (ICTS) newsletter¹⁷⁵ and also in the WU Record¹⁷⁶. We have also reached out about VIVO to ICTS institutional partners including: BJC HealthCare, Saint Louis University, and St. Louis College of Pharmacy. Future efforts include working on adoption-related efforts with stakeholders on Washington University's Danforth campus and reaching out to other partner institutions and organizations that regularly collaborate with Washington University investigators. Local outreach activities will continue at Washington University School of Medicine.

In addition, the WUSM Implementation team aggregated all the educational institutions with a 4-year degree or higher, manually curated them for accuracy, and shared them on SourceForge for others to use. We felt this was necessary as there were multiple representations of the same institution (e.g., Texas A&M vs. Texas A & M) that prevented an accurate assessment of within and across institutions.

5.6.7 Weill Cornell Medical College

During the time period between July 1, 2010 and June 30, 2011, Weill Cornell's VIVO outreach efforts have focused on our CTSC partners as well as other Weill Cornell affiliates. We have also presented at two national meetings whose focus is on information technology and libraries.

We have met with the following organizations and presented an overview of VIVO to each:

- Hospital for Special Surgery (HSS; November, 2010). We are working with HSS now to help them import data into the Weill Cornell instance of VIVO.
- Hunter College of the City University of New York (November, 2010). Hunter College has decided to install their own instance of VIVO, so we had follow-up discussions with them to provide an overview of this process and to give them some examples of how custom reports that were important to their senior leadership could be created via SPARQL queries.
- Memorial Sloan-Kettering Cancer Center (MSKCC). We continue outreach efforts with MSKCC and are working toward an import of their data into the Weill Cornell instance of VIVO beginning Q1 of 2012.
- The Methodist Hospital (Houston)

National-level VIVO Outreach has been accomplished by Paul Albert of the Weill Cornell Library in his presentations at the Computers in Libraries conference in March 2011 and at Code4Lib in February, 2011.

6 Sustainability

The sustainability of VIVO – as a community, as a development and as a support effort – has many elements. We have developed partnerships with vendors regarding support, promotion and access to data. Additional research partnerships afford opportunities for future grant funding and institutional support. Community members are joining our implementation, development and outreach calls.

Our events provide an opportunity to spread the word of VIVO activities, as well as capitalize on the vitality and creativity of the VIVO community.

6.1 VIVO Open Source Community

The centerpiece of the VIVO community is the VIVO open source community site⁷. Code, wiki, support, and more are available there. The site was launched this year and has seen explosive growth with over 280 pages of content. The project continues to move into the open, generating additional collaborators.

6.2 VIVO Events

The VIVO project has established four events that should be sustainable using a mixture of institutional, sponsor and registrant support. 1) The VIVO conference is designed to be an annual large-scale gathering of all those interested in all aspects of VIVO. 2) The VIVO Hackathon is an opportunity to bring together the best and brightest semantic web developers from around the world to brainstorm and create new opportunities for VIVO and the semantic web related to scholarly discourse and discovery; 3) the VIVO workshop provides an opportunity for senior level brainstorming regarding the needs of VIVO constituents and approaches to meeting those needs; and 4) the VIVO Implementation Fest provides training and hands on support to jump start VIVO implementations.

6.2.1 VIVO Conference 2010

The first annual VIVO conference¹⁷⁷ was held at the New York Hall of Science, August 12-13, 2010. The conference drew 207 registrants. Keynote speakers were Noshir Contractor of Northwestern University and James Hendler of the Tethered World Institute at Rensselaer Polytechnic Institute. Pre-conference workshops were held on visualization, ontology and implementation. Reviews from the conference were very positive and the conference received significant corporate and institutional sponsorship, obviating the need for the use of

grant support. Attendees came from seven countries. Discipline representation was eclectic with strong participation from library science, university administration, biomedical science, social network analysis, informatics and agriculture. A second conference will be held August 24-26, 2011 at the Gaylord Hotel in Washington DC. Registration, sponsorship and paper submissions are all significantly up from last year.

6.2.2 VIVO Hackathon

The 2011 VIVO Hackathon was held May 4th - 7th, 2011 at the Health Science Center Library, University of Florida, in Gainesville, Florida. There were 15 attendees, ten from institutions outside of the VIVO team, and five prominent ideas that emerged:

- SameAs: Using the publication corpus of two schools (work was demonstrated using the publication RDF from Harvard and UF) identify common publications through PubMedID. Create sameAs assertions and register these assertions at sameas.org. Use the assertions to inform schools of authors known at one school, but unknown at another. Assert the sameas of these common authors and register these assertions at sameas.org. Using this approach, Harvard can learn of authors of its joint papers with Florida who are located at Florida. Inversely, Florida can learn of Harvard authors and their profile URIs that are found in the Florida publication corpus. This approach has significant merit for creating the web of data deeply interlinking research networking systems.
- Sabaku: A game platform for connecting people, presentations and events. Sabaku apps running on smart phones would be used at conferences to create social networking "games" in which people compete to locate and create semantic data.
- Exposing visualization data in VIVO as a Data Cube¹⁷⁸, an RDF format for statistical purposes. The URI of the data cube resulting from a VIVO visualization can then be used as input to statistical analysis software accepting data cube vocabulary.
- Creating standardized concept representations for expanding semantic search. Using the ConceptWiki and DBpedia, map keywords expressed by faculty using open terminology into structured concept maps resulting in the ability to expand concept terms for use in search.
- Drupal Views: Views can query SPARQL endpoints such as VIVO. Drupal Views can then be used to present VIVO information within Drupal web sites.
- RDFa: Add RDFa to the HTML of VIVO display pages, providing semantic content in the HTML, which is useful for search engines.

6.2.3 NIH Workshop on Value Added Services for VIVO

The second annual VIVO workshop was held on the campus of Indiana University March 25-26, 2011¹⁷⁹. Twenty three thought leaders from research networking, federal agencies, the semantic web community and the sciences discussed potential applications that would rely on the information infrastructure being created by VIVO. What do practitioners need and want? What is practical to deliver now and in the future? What work is needed to get from where we are today to where we need to be to support research and scholarship in the future?

6.2.4 Implementation Fest

The Implementation Fest was held June 23-24, 2011 on the Washington University School of Medicine campus. The Fest was developed as a way for the VIVO project to help facilitate committed and ongoing implementations outside of the NIH-funded project in a small-group environment. Two tracks were offered at the Fest (technical and policy/adoption) to address the diverse challenges that may be associated with implementation and adoption of VIVO. Nearly all of the groups that attended have VIVO installed and have already ingested data into their VIVO instances. Institutions represented were: USDA, U of Nebraska, CU-Boulder, Duke, SUNY Stony Brook, U of North Texas, Hunter College, American Psychological Association, Symplectic, Inter-American Institute for Cooperation on Agriculture (IICA), Universidad Central del Caribe, and Georgia Tech.

6.3 Transition to Operations at each institution

6.3.1 Cornell University

Cornell has been operating VIVO in production since 2003 and will continue to do so from the Mann Agricultural Library with institutional support.

6.3.2 University of Florida

The UF Libraries, in collaboration with the Clinical and Translational Science Institute, will be sustaining VIVO in the future. On September 1st, 2011 VIVO transitions from implementation to operations. UF has approached operations work by separating into four areas: Management/Governance, Data Stewardship, System Administration, and Outreach. The library will manage all areas: Management/governance will include a Library Management Team supported by a Technical Advisory Board; UF will hire a Data Curator who will manage all aspects of VIVO data; system administration is being fully transferred over from the grant project team to the Library Systems department; and outreach will be integrated into existing support services within the Library.

6.3.3 The Scripps Research Institute

TRSI expects to maintain its VIVO instances following the end of the grant, particularly if the inter-institutional search feature is functional and if the automatic ingest of publications data from PubMed is functional.

The robust search features of VIVO, enabled by the triples, make VIVO the superior choice for identifying individual scientists on the Scripps faculty who are performing specific types of research. As such, we anticipate VIVO will serve as an important research tool for faculty, postdocs, and graduate students, as well as outside searchers, who are seeking to identify potential collaborators at Scripps.

We are considering expanding the Scripps VIVO database to include profiles of postdocs and graduate students. Further, the Scripps Translational Science Institute (funded by a CTSA grant) has expressed interest in having profiles of their researchers entered into the Scripps VIVO instance in the future. If the inter-institutional search feature is functional, we will encourage other local biotech organizations, such as The Salk Institute and the Sanford-Burnham Medical Research Institute, to implement their own VIVO instances, further strengthening opportunities for collaborations between our various faculties. Scripps Library and ITS staffs, who have now developed some expertise in implementing VIVO, could serve as a local resource that other local implementing sites could call upon for advice.

Work on the Scripps VIVO instances will continue to be performed by Library and ITS staff members, now as part of their regular assigned duties, without need for additional external funding.

6.3.4 Ponce School of Medicine

The Ponce VIVO implementation will be maintained using institutional funds. Ponce has a strong interest in developing VIVO across its natural partners and has supported VIVO work at multiple partner institutions.

6.3.5 Washington University School of Medicine

The support of VIVO was extensively written into the WUSM CTSA renewal. If funded, the WUSM VIVO team will contribute to VIVO Consortium activities with development of features that are of use in the academic research environment, specifically in the areas of profile editing and curation, and we will also pursue co-funded projects with other VIVO Consortium members. In the next funding period, we will continue to work with VIVO consortium members as well as other adopters of VIVO and contributors to VIVO code to extend its functionality and facilitate integration with other systems such as our local resources (core facilities) application and department-, center-, and institute-specific web sites.

6.3.6 Weill Cornell College of Medicine

Immediately after August 2011, VIVO will supplement the current WCMC profile systems. We will determine if VIVO will replace them and become the sole enterprise wide profiling system for all WCMC faculty. We hope to accomplish this with marketing efforts centered around the promotion of VIVO's marquee features such as the auto ingestion of profile data and publications and the semantic search capabilities within the national VIVO network.

VIVO is a long term commitment for WCMC. When the grant and carryover funding are exhausted, the project will be sponsored by the CTSC with operational support from WCMC's Information Technology Services (ITS) group.

6.4 Governance

VIVO governance consists of a team lead group with weekly calls, a principal investigator group that meets as needed, and a technical advisory board which meets regularly via conference call to provide input into technical directions, assure alignment with other efforts world-wide and apprise the VIVO team of opportunities for further development of both the software and the community. A scientific advisory board is being formed to provide additional input on the needs of researchers and scholars.

These efforts will be transitioned in the coming year to open community processes. Using the conference as a gathering point and annual check point, the governance groups will eventually set a course for further VIVO development.

6.5 Additional VIVO Activities

VIVO team members have been active in seeking new partnerships and support.

Over fifty institutions have VIVO pilot projects or VIVO implementation projects underway, including the USDA, the American Psychological Association, and the National Institutes of Health. The VIVO software has been downloaded over 8,000 times. VIVO support continues to grow in the international agricultural science community, the biomedical sciences in collaboration with CTSA's beyond the five in the original VIVO consortium, and in the semantic web community.

7 Evaluation

Evaluation has become a robust process, and at least three primary domains have been determined to be significant in the assessment and understanding of this multi-institutional project: 1) the nature and needs of collaborating across multi-institutions; 2) needs for implementing VIVO across institutions; and, 3) the development and assessment of the application itself. Only the third item had a focus within the grant.

7.1 The nature and needs of collaboration across multi-institutions

The first domain deals with the nature of both the personnel and technical needs when forming a working relationship across many sites. The VIVO team has three broad groups – development, implementation, and outreach – each with different functions and communication styles. While face-to-face time has proved invaluable for all, the manner in which that time is used and valued varies across the groups. Significant improvement in development has occurred over the past year when the developers have spent face-to-face time working with one another. Over the past year, this took place through two developers at Indiana working at Cornell for one week, one developer from IU moving to the Cornell team, and a Developer's Summit where five developers from Cornell and two from IU went to UF for three days to work.

7.2 Needs for implementing VIVO across institutions

The second domain pertains to assessing the implementation needs of each site in installing and populating VIVO. As articulated in Sections 4 and 6, all original VIVO institutions as well as 'outside' institutions have implemented VIVO to at least version 1.2 and have aggregated considerable data. For more complex institutions (e.g. IU and WUSM) it has typically taken to acquire access and get permission to make the data publicly available. From site visits and other input to the evaluator, gaining access to, manipulating, verifying, and displaying data could 'make or break' VIVO at any institution. The critical data components for academic institutions include items that make up a person's curriculum vitae. All institutions have either manually or programmatically ingested people, educational background, and photos; publications and grant data have proven to be difficult to ingest.

7.3 The development and assessment of the application itself

This was the primary domain originally anticipated in the evaluation of 'VIVO'. The VIVO User Interface team has performed three types of usability testing during the course of the grant: heuristic analyses; informal, usability interviews; formal, task-based usability testing; and, research evaluation.

The heuristic analyses involved having people with usability design or HCI backgrounds review the application (or large functional areas within the application) and provide feedback on design inconsistencies and possible user interaction issues. For the interviews, we interviewed potential end users and reviewed parts of the application with them, eliciting feedback on what they perceived were the strengths and weakness of VIVO. The task-based tests involved giving participants a series of specific tasks to perform using the application. Both the interviews and the task-based tests were recorded on video using the Morae software package.

All three types of testing revealed flaws in the design and user experience of the VIVO application. These flaws ranged from the very simple, such as inconsistent capitalization on submit buttons, to more complex issues involving navigation and form completion. Whenever these patterns were identified, we created issues using the Jira bug and issue tracking software for them. We then analyzed each Jira issue and made the appropriate user interface design change within the application.

The research evaluations have occurred to understand how and why VIVO would be used. These evaluations are still underway, but preliminary results indicate that there are many more uses for VIVO than identified in the grant. Some of these include biosketch generation and assessing researcher impact.

The evaluation effort has monitored growth in the use of VIVO on-line resources during the year. The change in accessing the VIVO sites – VIVOweb.org and VIVO instances at the seven institutions – has increased 130% since the same time last year with over 625,000 visits and 1.2 million page views. While the number of new visitors has remained about the same, people are spending slightly longer times on the site and looking at more pages on average. Over the past year there have been views to at least one of the VIVO sites from people in 209 countries and territories other than the United States, where about 81% of the internet users log onto a VIVO site. While the greatest number of visitors outside the US comes from China, there has been an almost 300% increase in visitors from many countries including Russia and Costa Rica as compared to last year. Additionally, there were approximately 1,400 downloads of VIVO installation documents.

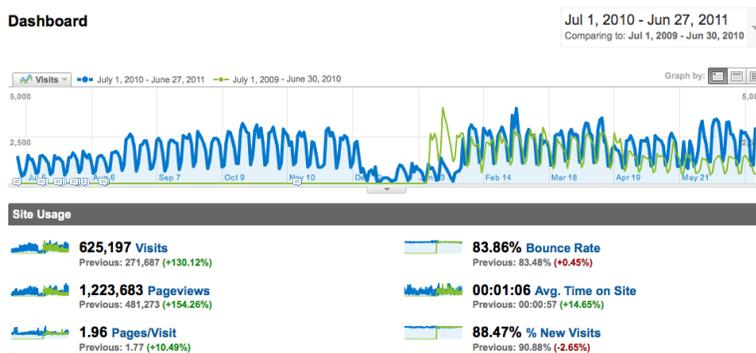


Figure 5 Google Analytics for VIVO project sites

8 Summary

The VIVO project has made significant progress over its second year. Implementations at the original seven schools have been or are now planned to transition to sustainable institutional operations. Development has produced a major release and two maintenance releases to the core software along with four releases to the Harvester software. The ontology has matured and we have demonstrated interoperability with significant related ontologies. Outreach has been strong, generating interest and mind share across many disciplines with significant strength in library science, agriculture and biomedical science. Future efforts will further extend interest in to new discipline areas, as well as new geographical areas.

VIVO has established a growing open source community, physically instantiated on-line at vivo.sourceforge.net, but more importantly, consisting of dozens of partners, implementers and contributors meeting and discussing and working on VIVO. This community forms the basis for the sustainability of development, the creation of support materials and opportunities, and further sharing of ideas. Significant effort remains to establish open community governance and insure an open future for VIVO.

Challenges remain in simplifying data ingest, providing additional sources of ingest and simplifying the internals of the VIVO system for open source development. The community has been clear in its needs for better instructional materials, lowering barriers to entry created by the fundamentally new approaches VIVO takes to representing data and providing data via the semantic web. Additional simplification of ingest, the creation of data ingest wizards, as well as materials describing simple processes for ingest are all needed. Many schools desire a turn-key solution – one that requires very little effort to set-up and implement. We will continue to partner with others we strive to lower the effort needed to implement VIVO. Further development will simplify VIVO internal code structure, allowing greater open source participation. Provenance and access control need to be further improved.

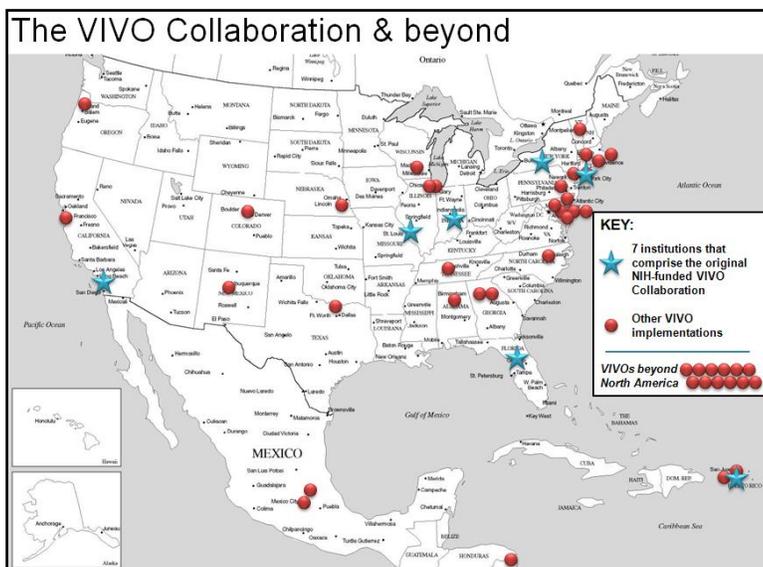


Figure 6 VIVO sites across North America and beyond

Despite these challenges, VIVO faces a bright future. Schools continue to adopt. Implementations continue to grow. Participation in development, implementation, support, interest in the conference, attendees on calls are all up significantly. Interoperability with other linked open data systems has been demonstrated. In the years ahead, VIVO will participate in the emergence of a web of data, linking VIVO information to information in other systems, creating opportunities for research and scholarship discovery and collaboration around the world.

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