

TRAC Searchable Research Library



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TRAC Searchable Research Library

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This project cost the
Department of Defense approximately
\$271,000 expended by TRAC in
Fiscal Years 15-16.
Prepared on 20160518
TRAC Project Code # 090089.

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| REPORT DOCUMENTATION PAGE | | | <i>Form Approved OMB No. 0704-0188</i> |
|---|---|--|---|
| Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503. | | | |
| 1. AGENCY USE ONLY (Leave blank) | 2. REPORT DATE 18-05-2016 | 3. REPORT TYPE AND DATES COVERED Technical Report, May 2015 – May 2016 | |
| 4. TITLE AND SUBTITLE TRAC Searchable Research Library | | 5. PROJECT NUMBERS TRAC Project Code 090089 | |
| 6. AUTHOR(S) MAJ Haupt, Dr. Anderson | | | |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) US Army TRADOC Analysis Center - Monterey 700 Dyer Road Monterey CA, 93943-0692 | | 8. PERFORMING ORGANIZATION REPORT NUMBER TRAC-M-TM-16-020 | |
| 9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) Headquarters, TRAC ATTN: ATRC 255 Sedgwick Avenue Fort Leavenworth, KS 66027-2345 | | 10. SPONSORING/MONITORING AGENCY REPORT NUMBER TRAC-M-TM-16-020 | |
| 11. SUPPLEMENTARY NOTES Findings of this report are not to be construed as an official Department of the Army (DA) position unless so designated by other authorized documents. | | | |
| 12a. DISTRIBUTION / AVAILABILITY STATEMENT DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited. | | 12b. DISTRIBUTION CODE | |
| 13. ABSTRACT (maximum 200 words) In 2015 the TRADOC Analysis Center (TRAC) initiated the Digital Research Library project to develop a secure network accessible document repository for technical documents and similar document artifacts. We used a model-based approach using the Vector Relational Data Modeling (VRDM) computational paradigm. VRDM has the key attributes of being cloud available, using domain semantics for configured application development, and having a DoD network certified environment for implementing the executable information model applications. We developed a metadata framework for the digital library based on the standard DD 298 form and extended it to satisfy TRAC mission and technical products. The application was designed with user roles, search, upload/download, CAC login, version tracking, and an exemplar model behavior 'DocumentCites'. The configured semantically described behavior demonstrates the extensibility of the model application thus providing a means for rapidly implementing new methods for greater knowledge discovery. The resulting executable information model application was populated with over 60 documents for proof of concept demonstration and model refinement. | | | |
| 14. SUBJECT TERMS Knowledge Management, Document Repository, Digital Library, Vector Directional Data Model, Model Behavior, Executable Information Model | | 15. NUMBER OF PAGES 70 | |
| | | 16. PRICE CODE | |
| 17. SECURITY CLASSIFICATION OF REPORT Unclassified | 18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified | 19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified | 20. LIMITATION OF ABSTRACT UU |

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Acknowledgements

This project would not have been possible without the input, feedback and developmental help from the following organizations and personnel:

TRADOC Analysis Center (TRAC)

Mr. Paul Works
MAJ Michael Cerchio
Mr. Larry Larimer
LTC Charles Sulewski

Defense Technical Information Center (DTIC)

Mr. Andrew Pedrick
Mr. Ron Shackelford
Mr. William Jacobs
Ms. Anette Powell

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Chapter 1 – Introduction

1.1. Purpose

The purpose of this project was to develop a DoD network certified, network accessible TRAC Searchable Research Library that consolidates, stores, and distributes documents according to user and document attributes and through processes and procedures prescribed by TRAC leadership.

1.2. Background

The TRAC Searchable Research Library project was initiated by TRAC-HQ to address a current capability gap in the TRAC organization. Currently TRAC does not have a simple or consolidated location to archive and manage TRAC intellectual property. The corpus of study documents, to include final technical reports and memorandums, are independently and locally maintained on file servers at all five TRAC locations with no means of searching, sharing, or access by the greater TRAC community. Many of these technical reports and memorandums are located at TRAC-HQ. Unclassified digital documents (post-2001) are maintained on a TRAC-HQ controlled M-Drive and hard copy documents (pre-2001) are contained in a storage room (see Table 1). All non-Technical Reports and memorandums (i.e. study data, code, In Progress Reviews (IPR), etc.) are exclusively maintained on local hard drives at their respective TRAC locations. In many instances some of these products are lost in the local drives or not archived at all resulting in additional loss to TRAC's intellectual property.

TRAC's current policy and procedure for the long term archiving and distribution management of technical reports and memorandums is to submit them to TRAC-HQ for subsequent submission to the Defense Technical Information Center (DTIC) for digital publication. DTIC is the primary repository for TRAC historical documents and is network accessible to TRAC analysts. DTIC currently has digital copies of more than 1000 TRAC documents dating back to 1975 and it is continually growing. A draw back to relying on DTIC as a repository is that TRAC has little control over the repository. That is, TRAC analysts cannot access TRAC limited distribution documents without initiating a six-to-eight-week request process through the outside agency that if successful, results in a hard copy document being delivered to them. These archiving and access challenges prompted this effort to create a TRAC searchable research library that consolidates and organizes documents and makes them network available to TRAC members and specified users.

This project was sponsored by TRAC-HQ, the primary authority for scope and execution of this effort was presided over by LTC Christopher Smith (TRAC-MTRY Director). The primary stakeholder was Mr. Paul Works (TRAC-FLVN) who first analyzed the desired requirements of the TRAC Searchable Research Library which resulted in a proposed Performance Work Statement (PWS) that outlined objective and capability requirements for the proposed digital library. Mr. Works was instrumental in reviewing TRAC-MTRY's scope and progress and provided coordination support that allowed the TRAC-MTRY team to demonstrate and solicit feedback from TRAC analysts across all the centers. The project was jointly executed by Dr.

Thomas Anderson, (USACE ERDC CRREL) whose expertise in VRDM and network applications was instrumental in the model conception, development and implementation.

Ultimately this project lasted eleven months. The initial scoping phase began in May 2015 and lasted until approximately June 2015. Contracting and implementation started in June 2015 and lasted until approximately December 2015. Between January and March 2016 the project team went through the process of making the finalized product network available, solicited feedback from the TRAC centers during capability demonstrations and completed the documentation.

Table 1. Type and classification of technical documents in the possession of TRAC-HQ.

| Document Type and Classification | Number of Documents |
|--|---------------------|
| Digital Unclassified Technical Reports and Memorandums | 580 |
| Digital Classified Technical Reports and Memorandums | 37 |
| Hard Copy Unclassified Technical Reports and Memorandums | 646 |
| Hard Copy Classified Technical Reports and Memorandums | 229 |

1.3. Problem Statement

Develop a network accessible document repository for TRAC organized in a hierarchal conceptual model that will enable TRAC to gain full control, network access and transparency to its intellectual capital and support knowledge discovery and archiving.

Issue 1: Develop conceptual model and underlying meta-model that describes documents and network library function within a TRAC mission context.

EEA 1.1: What types of documents will the library support?

EEA 1.2: Who should have access to library, and from where?

EEA 1.3: What is the server and directory structure to support this capability?

EEA 1.4: What are the fundamental library behaviors to be implemented?

EEA 1.5: What existing meta-models already exist within the library science domain that support document repositories?

Issue 2: Implement library in a technology that supports TRAC security, search, transparency and network accessibility needs.

EEA 2.1: What technologies exist that are CAC enabled and SIPR and NIPR capable?

EEA 2.2: What technologies support network accessibility; have robust search capabilities; will support robust and versatile meta-models that demonstrate a high level of control for TRAC?

1.4. Constraints, Limitations and Assumptions

- Constraints¹.
 - Library must be network available and securable.
 - Technology solutions must support NIPR and SIPR.
- Limitation².
 - Will limit documents to TRAC-MTRY and TRAC-MRO research documents.
 - Will not use intermediate/unfinished reports and IPRs.
 - Limiting library to digital documents (2001-Present).
- Assumptions³.
 - Relevant research documents are primarily digital and archived in various TRAC locations.
 - Target documents are a representative sample that will support the development of versatile and transparent meta-models.

¹ Constraints limit the study team's options to conduct the study.

² Limitations are a study team's inability to investigate issues within the sponsor's bounds.

³ Assumptions are study-specific statements that are taken as true in the absence of facts.

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Chapter 2 – Methodology, Analysis and Implementation

In this chapter we describe our methodology and approach for the problem. Our methodology entailed two-phases that were broken into seven steps (see Figure 1). In the first phase (steps 1-4), we conducted background research to properly scope the project and determine what technology and capability the team would use to develop the library. We then developed After receiving guidance and permission to move forward the project team initiated contract support and implemented the initial library. This was followed with demonstrations of the library solution to the different TRAC centers which provided important feedback that will be drawn upon for future development.

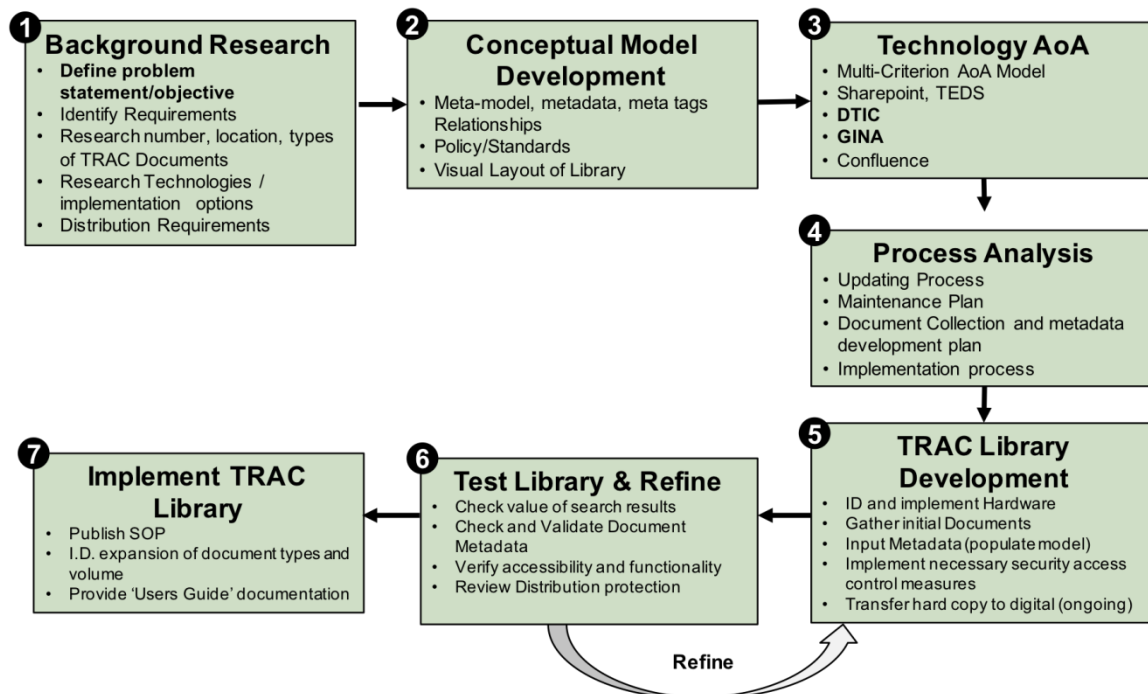


Figure 1. Methodology for TRAC Searchable Research Library Development.

2.1. Background Research

Define the problem: During this step the study team decided that the initial library would be a proof-of-concept TRAC digital library that would have a limited scale, be network available and have a searchable functionality. We identified that it must be capable of incorporating existing TRAC-MTRY technical documents and also capture relevant metadata for robust search and management of the library. The capability must provide network accessibility, control, transparency and meet TRAC security requirements. This library would facilitate knowledge discovery and return control of TRAC intellectual property to the TRAC organization.

Identify Desired Requirements: We created an initial list of library requirements designed to aid us with the technology and meta-model selection. Those desired requirements were:

- Provide comprehensive list of documents and projects from 1990-Present.

- Provide easily searchable interface to TRAC analysts to allow access to prior TRAC work.
- Supportable by SOP and framework that allows continual update and sustainment of document repository.
- Develop meta-model and metadata framework to describe library, library function, types/categories of TRAC projects and research for the library application.
- Provide robust search capability with web integrated results.
- Provide technology solution that is easy to use, extend, maintain, sustainable and minimizes cost to government.
- SIPR and NIPR sites required (implied DoD Network certification).
- TRAC documents must be secure and satisfy distribution requirements.
- TRAC has control of content, look, interface and framework.
- TRAC can make timely changes and upgrades.

Types and quantities of TRAC documents: TRAC produces numerous documents. The most significant document types are technical reports and memorandums that are produced at the end of an official study or project. Most technical reports and memorandums are centralized at TRAC-HQ in both digital and hard copy form (see Table 1). The other various document types are located on local hard drives at the distributed TRAC centers. For the initial proof-of-concept library, the project was limited to unclassified digital technical documents produced by TRAC-MTRY. We downloaded approximately 60 TRAC-MTRY technical reports and memorandums from the DTIC web site that contains more than 1000 TRAC documents.

Other document types that we identified as possible extensions to the library are in-progress reviews (IPR), study plans, data and finalized code. Here, extension refers to TRAC TTPs regarding storage, as the Library meta-model has the attribute of ‘DocumentType’ that accommodates any and all types of document artifacts.

Research technologies and implementation options: Network accessible library technologies are described in Section 2.3. Technology AoA.

Distribution Requirements: The specific protection requirements for documents and artifacts produced by TRAC are stated in DoDM 5200.01, Volume 2. The TRAC library meta-model solution must sufficiently describe the classification of documents according to DoDM 5200.01 and functionally be able to identify and manage accordingly documents that have limited distribution (for unclassified documents). Additionally, TRAC must establish TTPs for the library and user interaction, and implement them in the information model application.

2.2. Library Conceptual Model Development

The conceptual model was developed through SME elicitation and brainstorming process that explored and described the library functional requirements as it related to users, component objects and library behavior.

The conceptual model for the TRAC document library corpus was underpinned by a semantic meta-model comprised of the key terms (metadata) pertinent to general management of

documents. The initial metadata for this were derived from the OWL online ontologies [Owl 2004] for libraries and the DoD SF298 for documents and augmented by key terms with specific relevance to the ARMY TRADOC Analysis Center. These terms were discovered and validated through SME elicitation and brainstorming process exploring information associated with documents that is deemed pertinent to TRAC mission.

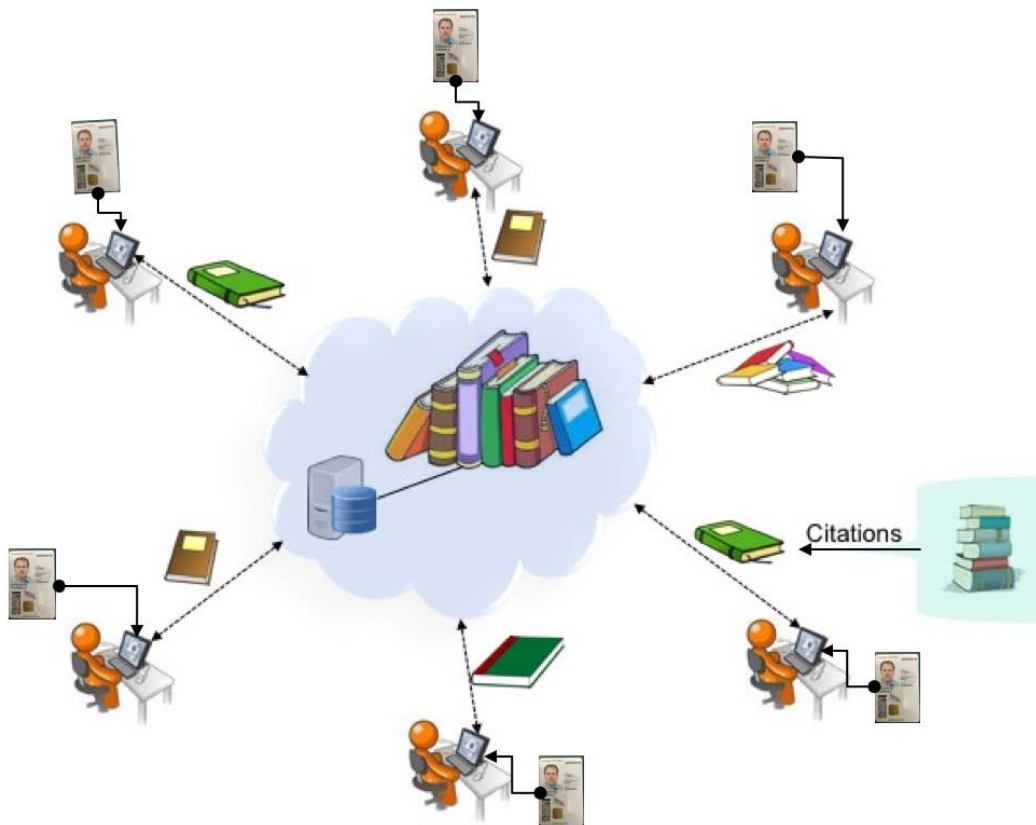


Figure 2. The conceptual model for the cloud resident, CAC accessed TRAC technical document library. The library is searchable, up/down loadable and accessed over the NIPR network by users with DoD CAC on the TRAC controlled access list.

The final conceptual model for this initial phase contains document and mission meta-information valuable to leadership and institutional situational awareness, as well as for informed decision making in the future, e.g. , ProjectNumber, Sponsor, ProjectCost, etc. See Appendix D for meta-model.

2.3. Technology AoA

2.3.1. Technologies Researched

Our research considered the technologies that TRAC and DoD has historical experience or knowledge. The primary technologies that this project team analyzed were:

- **Defense Technical Information Center (DTIC):** DTIC uses internally developed web interface and search engines to manage documents for all DoD. This document

repository is widely used by TRAC and already contains more than 1000 TRAC documents. Additionally, it has several features that are desirable for a TRAC library, such as an advanced search, 'My Research' page, and the ability to export meta-data in a .csv document. It is important to note that during initial discussions with DTIC, DTIC offered to create a TRAC Library Home Page free of charge as an experimental customer service initiative. The library would utilize existing TRAC documents but create a filter that would limit searches to TRAC documents. This product would still have all the foundational capabilities (i.e. advanced search, 'My Research' page, exportable meta-data, and CAC access control) already available in DTIC.

- **TEDS:** TEDS is a web interface developed at TRAC-HQ to manage TRAC projects. TEDS already has the capacity to conduct advanced searches on projects and attach project documents. Implementing knowledge framework would possibly require funding and a level of development and interaction outside of TRAC-MTRY's internal capability but TRAC-HQ could execute after approval from the Configuration Control Board (CCB).
- **Sharepoint:** Sharepoint is a widely used web technology for document management and storage used by the DoD. It is designed to allow interactive collaboration between individuals and repository management for a limited set of scenarios. Implementing a TRAC knowledge framework in Sharepoint would require additional funding and development interaction. Additionally, experimentation with TRAC Sharepoint has demonstrated that search queries do not readily return usable results. This ambiguous search capability was also observed by analysts from the distributed TRAC centers. Sharepoint is however, currently used by the NPS library to maintain limited distribution student theses.
- **Confluence:** Confluence is a wiki environment used at TRAC and NPS, is supported by contractor, NPS faculty and civilians. Implementing knowledge framework would possibly require funding and a level of development expertise not immediately available, but would still likely be feasible. Confluence is currently used to archive COMBATXXI documents and maintain open dialogue between COMBATXXI analysts.
- **Global Information Network Architecture (GINA):** GINA is a component based object model for making executable models or "web applications" (Dolk et al., 2012) and is constructed using Vector Relational Data Modeling (VRDM). The core GINA technology is comprised of standard Microsoft components; Internet Information Server, MS SQL and dot Net. Information flows in and out of either port 80 or port 443, and may be viewed and configured in web forms in any standard web browser. GINA has the attributes of a 'blackboard architecture' in that data realized as conceptual objects in a VRDM model are available as object components to other VRDM models, provided appropriate rights and authorities. This is a key attribute that leads to comprehensive knowledge management and actionable information. In VRDM, domain semantics describe the entities and the relationships as objects that comprise a web application, and then manages the application in the GINA model (application). Thus, GINA serves as a model brokering network environment. The VRDM applications are *configured* implementations of a conceptual model and are not *compiled*. As a result, VRDM models are inherently non-brittle allowing for low cost model extension or change. GINA has an integrated syntax-matching object layer that allows for non-standard or one-off data schemas to be easily assimilated into the semantic model. This enables *comprehensive*

SoS integration while maintaining *information context* in the semantic model. The relationship object in VRDM maintains model contextual awareness and affords transparency via the ability to web navigate through the model using standard browsing technologies (e.g., Chrome, Firefox, etc.).

The base network model broker capability of GINA was DoD network certified as a MAC I classified enclave in 2012 and adopted by ARMY G2 TRISA as Dragon Pulse Information Management System (DPIMS) (Anderson et. al., 2012, Langford, 2014, Anderson, 2016). The certification allows for unlimited information model application solutions to be built and brokered within the certified system without requiring extensive and lengthy DoD certifications for each capability. Recent proof-of-concept GINA model implementations include; a network managed COMBATXXI Behavior Library model, and various NPS theses for Systems Engineering Directed Energy Weapons AoA, cyber threat detection, Tunnel ISR SoS, and inferential learning in Cyber domain (Team Bravo, 2012, Kelly 2014, Baugess et al., 2014, Anderson et al., 2012, Seng, 2016), and a new inferential learning model (USAF, 2016).

2.3.2. Technology AoA

This project team developed a multi-criterion model to better evaluate and select the technology solution for the future TRAC Searchable Research Library (see Table 2).

Table 2. Technology Multi-Criterion AoA.⁴

| Technology | Contract Required (No=2, Yes=0) | Control (High=2, Medium=1, Low=0) | Integrated KM Behavior (High=4, Medium=2, Low=0) | In-House Expertise (High=2, Medium=1, Low=0) | Total |
|-------------------|--|--|---|---|--------------|
| DTIC | 2 | 0 | 0 | 2 | 4 |
| TEDS | 2 | 1 | 0 | 2 | 5 |
| Sharepoint | 0 | 2 | 0 | 1 | 3 |
| Confluence | 0 | 2 | 0 | 1 | 3 |
| GINA | 0 | 2 | 4 | 2 | 8 |

The technology AoA showed that GINA was the most desirable technology solution primarily due to providing the high valuation of integrated KM behavior or *actionable information*. Although, TEDs ranked second best, there was concern amongst the project team, sponsors, and

⁴ High numbers are more desirable; **Contract Required:** Contracting needed to complete project; **Control:** Project Team’s ability to influence design, content and modifications in a timely manner; **Integrated Knowledge Management Behavior:** Capability to create context/relationship web and capture knowledge from TRAC corpus; **In-House Expertise:** Level of expertise currently available for implementation.

stakeholders that expanding TEDs to include the library function could possibly diminish the speed and quality of TEDs existing capability and would place greater demands on its development team. Additionally, the CCB approval process could have significantly extended the length of this initial project. A more in-depth pros and cons of these technologies that influenced the AoA process are shown in Table 3.

Table 3. Technology Pros and Cons

| Technology | PROs | CONs |
|-------------------|---|--|
| DTIC | <ul style="list-style-type: none"> • Contains the most comprehensive library of TRAC documents. • Widely used by TRAC. • Has advanced features implemented and is supported by a highly skilled team. • (CONTRACTING). | <ul style="list-style-type: none"> • Not currently capable of Integrated Behavior. • May be slow to change basic structure or modify because TRAC cannot task DTIC contractors. • (EXPERTISE, CONTROL, INTEGRATED BEHAVIOR). |
| TEDS | <ul style="list-style-type: none"> • Designed for project management. • Widely used across TRAC. • TEDS contractors work for TRAC and can be tasked at no additional fee. • (EXPERTISE, CONTRACTING). | <ul style="list-style-type: none"> • Currently the search capabilities are limited, but they can be further developed. • All changes and modifications must go before the CCB. • (INTEGRATED BEHAVIOR). |
| Sharepoint | <ul style="list-style-type: none"> • Already exists in TRAC and has some documents available. • Simple technology, with training. • Widely used in TRAC. • (CONTROL, CONTRACT). | <ul style="list-style-type: none"> • TRAC Sharepoint is no longer supported by a development team. • Does not have integrated behaviors built in. • No significant in-house expertise. • (INTEGRATED BEHAVIOR). |
| Confluence | <ul style="list-style-type: none"> • Capable technology that is widely used by TRAC WSMR. • Relatively easy to learn and use. • Would have high level of control at TRAC level. • (CONTROL, CONTRACTING). | <ul style="list-style-type: none"> • Costs 12K for 500 persons and may need to expand current contract to support more users. • No significant in-house expertise. • (INTEGRATED BEHAVIOR). |
| GINA | <ul style="list-style-type: none"> • User friendly and highly adaptable technology. • Can interface with TEDS. • Can create context /relationship web. • (CONTROL, INTEGRATED BEHAVIOR, EXPERTISE). | <ul style="list-style-type: none"> • Would require training and some contracted implementation support up front, but not to update and modify later on. • (CONTRACTING). |

The end result of the technology AoA step was that the TRAC-MTRY Director approved the implementation of the TRAC Searchable Research Library in the GINA framework. He also authorized DTIC to implement the TRAC Research Library Homepage. Although the DTIC solution did not initially rank high during our AoA process, DTIC's proposal offered an expedient and zero cost solution that met this projects baseline threshold for success and provided a fallback solution should the GINA solution never fully be extended to all TRAC documents.

2.4. Process Analysis

This section discusses document collection plan, business practices and maintenance plan for the DTIC and GINA library solutions. The initial GINA solution was a limited scope proof of concept and capability demonstration. Detailed business practices and collection plans for any future expanded library capability must be developed or approved by a headquarter elements from all the TRAC centers.

2.4.1. DTIC Solution Collection Plan, Business Practices, and Maintenance Plan

Currently there are more than 1000 TRAC documents on DTIC and no collection plan is necessary. TRAC business practices keep DTIC up-to-date on TRAC technical reports and memorandums. TRAC centers submit completed technical reports to TRAC-HQ. TRAC-HQ uses the metadata on the contained DD-298 Form to populate DTIC submission requirements. The document and the metadata are then submitted to DTIC and are added to the DTIC repository in the course of several weeks. Maintenance is exclusively the domain of DTIC and there are no additional requirements of TRAC to maintain their documents in DTIC's repository.

2.4.2. GINA Library Solution Collection Plan, Business Practices, and Maintenance Plan

The GINA TRAC Digital Research Library proof of concept entailed the population of the web application with documents for use. While process flow is a key attribute of the VRDM model, business rules and practices were not analyzed or developed in detail, as the development of TTPs and SOPs by headquarter elements from the TRAC centers must precede model implementation. The prototype application is capable of accommodating any document type (where *documentType* is a meta data attribute whose data element may be added to as needed), however, the proof of concept was limited to TRAC-MTRY technical reports and memorandums. Approximately 60 technical report documents were collected from TRAC-MTRY internal servers and imported from DTIC. Documents imported from DTIC had the corresponding DD-298 Form metadata available in a separate .csv database that the study team exported from the DTIC repository.

The study team did identify that there would need to be at least two types of user roles in the library. The first role is that of *administrator*, one who could change the metadata model of the library, approve and add documents to the repository, and grant access to the repository to

approved users. The second role would be a library *user* who could search for, and download documents.

Additionally, the study team identified that the repository model must adhere to distribution statements and specifications that were specified in the original document. The directory infrastructure framework on the server to was designed to align with the model. This entailed creating document directories according to the distribution status; unlimited and limited distribution. This allows the component data (documents in specific directories) to be as shareable as the model application, e.g. easily and rapidly package the directory of unclassified documents and send to partner running the application model. The model manages access to each object, in this case documents, according to user types and authorities and is *just* an executable model (no data or users). The model may be shared with interested partnered organizations without the data (documents). To facilitate this, the actual library directories were designed to be easily managed according to distribution level and thus may be archived and shared en masse according to agreements, authority and permissions of a collaborating organization, separate from the model. This addresses organized and transparent data storage with or without the model application- making the ARMY independent of the model or VRDM technology, and always having the option to use data in other applications or for other purposes.

A maintenance plan was not developed, because TRAC is the official DoD sponsor of GINA, and, the software is maintained for RMF by Big Kahuna Technologies. Furthermore, GINA, being a model itself, is not vulnerable to corruption when system software is upgraded. Future efforts may need to reevaluate the maintenance plan for the *TDL model* at the TRAC level to ensure that the quality of metadata and the documents continues to meet TRAC's needs.

For future expansion of the repository to include a broader range of the TRAC document corpus, additional documents would need to be collected from the TRAC-HQ internal server (M-Drive), which includes limited distribution documents (unavailable on DTIC) and documents from all TRAC centers.

2.5. Library Solution Implementation

2.5.1. DTIC TRAC Digital Library

DTIC assigned a project team to the DTIC TRAC Digital Library page in August 2015 and completed the page in September 2015. This DTIC effort was done at zero cost to TRAC as it was a proof-of-concept customer service venture designed to meet future DTIC customer needs. The product was designed to leverage existing DTIC library functionalities, as well as filter the search results to one specific organization. Additionally, the TRAC homepage would include limited cosmetic features indicative to TRAC and provide an approved TRAC homepage instruction window with a TRAC POC.

The TRAC-MTRY project team and the DTIC project team negotiated the following capabilities that were implemented in the final product:

1. Search TRAC reports that have been submitted to DTIC.
2. Search TRAC projects that have been submitted to DTIC through URED.

3. Expand search to include all reports and projects at DTIC.
4. Search metadata (such as author, project code, abstract terms) and select fields.
5. Search metadata and full text.
6. Download PDFs.
7. Documents and metadata controlled according to distribution markings and classification.
8. Site is on NIPR.
9. Site is limited to DTIC registered users (DoD employees, DoD Contractors, Federal Government employees, Federal Government contractors).
10. Minor customization of search page look and feel (add a TRAC label to the banner).
11. Ability for users to request changes to document metadata.
12. Export metadata describing documents selected during a search.

The TRAC-MTRY project team requested four additional capabilities that the DTIC project team was unable to undertake due to development time, but stated that they could execute in the future if a follow-on funded project could be arranged. These capabilities were:

1. Alternate site on SIPR. (Note: Initially, DTIC would not have much on this site because much of the SECRET documents are hard copy and would require DTIC to photo copy).
2. Under advanced search would like to be able to check the 'project type' (i.e. AoA, Future Concept Analysis, Requirements Analysis, Experimentation, Scenario Development & Data Development, Models and Methods R&D, Support to COCOM JIM, Training Studies, Other Studies, Non-Studies).
3. Ability for searchers to request document access and owners to grant access (overriding access controls based on document markings).
4. Report site usage metrics to TRAC POC.

The completed product was delivered in the form of a URL listed as, <https://www.dtic.mil/DTICOnline/home.search?tabId=DoDResearchTab&library=trac>. For convenience it was also made available on the TRADOC Analysis Center Homepage, <https://ako.hq.tradoc.army.mil/sites/trac/SitePages/Home.aspx>, under the *Links* section and titled *DTIC TRAC Research Library*. The site is CAC enabled and network accessible from any location with internet connection.

2.5.2. GINA TRAC Digital Research Library

The TRAC-MTRY project team began implementation of the GINA library solution in June 2015 and completed it in March 2016. Implementation was done in three phases.

2.5.2.1. Phase I Conceptual Design and Initial Implementation

The first phase started with the development of a conceptual model for a document repository that encompassed a network capability with user roles, document types and document

relationships to citations. The conceptual model also included configurable repository location specification (server and directory). The conceptual model (Figure 3) was devised in less than two weeks, this is attributed to the basic functionality initially scoped for the repository, and existence of robust semantics for the library domain that did not need to be recreated. The conceptual model behavior object of *HasCitation* was devised and implemented to demonstrate the objectified relationships in VRDM. In this case the *Documents* object implements the Vector *HasCitations* as the relationship to a specified set of *Documents*. The semantic name of the behavior is a clear description to domain SMEs of the meaning and model behavior.

The prototype framework model was implemented in GINA with the metadata structure discussed in Appendix D. The initial configuration in VRDM of the conceptual model was done in less than 3 weeks. The document repository was populated with approximately 60 TRAC-MTRY technical reports and memorandums with corresponding metadata that was exported from DTIC and merged with the GINA library model. The works cited information was copied from each document and inserted manually into the GINA library framework.

The prototype capability at this phase was only accessible on the TRAC-MTRY internal network (and Naval Postgraduate School) and was not CAC enabled. Further, there were no user roles and the initial search capability was based on an initial SME estimate of search criteria.

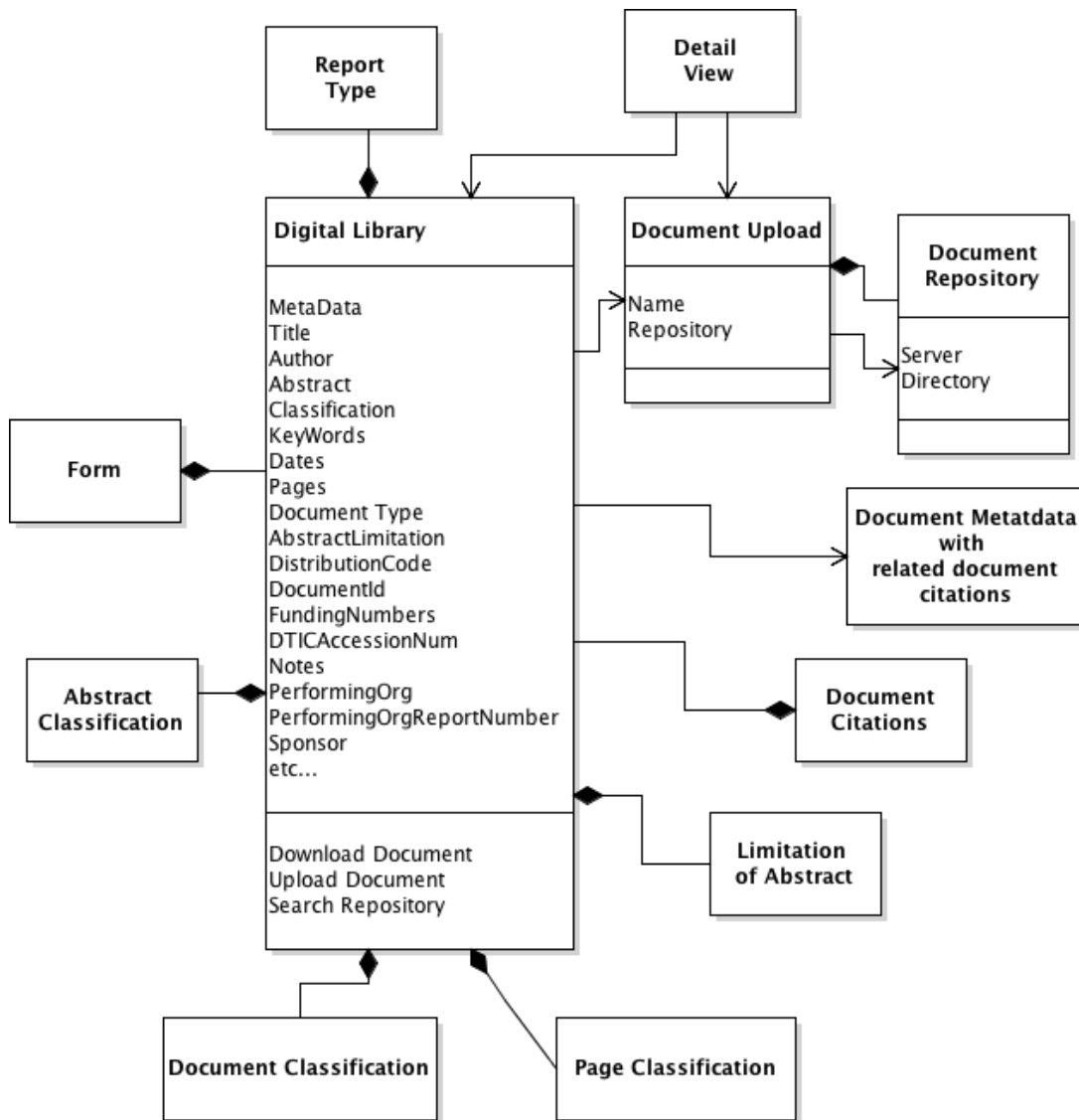


Figure 3. Conceptual model of the TRAC Digital Library showing the fundamental concepts and relationships for the web based application.

2.5.2.2. Phase II Added Functionality

The second phase addressed increased functionality, security and network accessibility that entailed contract support from technology partners, BKT. The contract was executed through an existing DTIC ID/IQ task order, allowing for the work to be rapidly approved and executed.⁵ The contract was executed October through December 2015. The contract added DoD required security features, CAC access, model hardening, user roles and advanced search form and features. Once these upgrades were complete, the model was transferred to a stand-alone server supplied by TRAC-FLVN. Additionally, the contract implemented a document adding functionality that allowed users and administrators the ability to specify the machine and the

⁵ DTIC has a unique interest in GINA and the resulting application of that technology for a document repository, because of its ability to be easily tailored to a customer's specific needs.

directory locations to upload new documents. Another significant functionality was the added metadata export feature that allowed library search results to be exported into .csv, pdf, and xml formats.

2.5.2.3. Phase III Implementation

The final phase entailed making the GINA solution network accessible to TRAC analysts in the .mil domain. This required a certificate of net-worthiness from DISA, a series of security scans and tests by NPS ITACS and approval of the local Designated Authority. This process lasted approximately a month and resulted in the server being connected to the NPS DMZ, the ITACS network zone that exists in the NPS .edu domain and is accessible to outside internet sources to include standard .mil domain users. The server address is <https://trac-dl.nps.navy.mil>. This is the same network location that TRAC-MTRY coordinated for the COMBATXXI Confluence wiki page, that is utilized as a COMBATXXI forum for TRAC-WSMR. Access to the GINA digital library solution is also linked on the TRADOC analysis Center homepage, <https://ako.hq.tradoc.army.mil/sites/trac/SitePages/Home.aspx>, under the *Links* section and titled *TRAC Digital Research Library Beta Version*.

Reference Chapter 3 for a more in-depth description and walkthrough of the features and capabilities of the GINA digital library solution.

2.6. Testing and Refinement

There were two series of testing and refinement that occurred during the lifecycle of this project. The first involved having TRAC-MTRY analysts review the initial library framework that was located on the TRAC-MTRY internal network. The results from that testing was that analysts wanted an advanced search feature and also commented that the library should be expanded to other types of documents, such as IPRs. The project team responded by ensuring that the advanced search function was included in the contract, but the addition of other types of documents was set aside for a later date and further approval.

The second series of tests involved briefings and live demonstrations to the other TRAC centers. During February and March 2015 the project team demonstrated the TRAC Digital Research Library to TRAC-WSMR and TRAC-LEE through DCS/Telecon and conducted an onsite live demonstration to TRAC-HQ and TRAC-FLVN in two separate sessions. During these sessions approximately 20 analysts provided feedback and recommendations for future capability. The main takeaways were that business rules needed to be developed by TRAC headquarters elements that would govern access, types of documents that would be added, create standardized metadata vocabulary/formats to maintain quality, and administrative responsibilities to maintain upkeep. Additionally, analysts wanted a PDF text reader with analysis capabilities, a *My Research* page to collect user selected documents⁶, and an easier user interface.

⁶ The *My Research* page is a feature already inherent on the DTIC site that allows analysts to select documents from multiple searches and collect them on a personalized page for future use. It also allows the analyst to export all the metadata from that page for easy bibliography creation.

Chapter 3 – Results

3.1. DTIC TRAC Research Library

The DTIC TRAC Research Library was completed in September 2015 and is network available to all TRAC analysts. Users can access it at <https://www.dtic.mil/DTICOnline/home.search?tabId=DoDRResearchTab&library=trac>. For convenience it is also made available on the TRADOC Analysis Center Homepage, <https://ako.hq.tradoc.army.mil/sites/trac/SitePages/Home.aspx>, under the *Links* section and titled *DTIC TRAC Research Library*. The site is CAC enabled and network accessible from any location with internet connection.

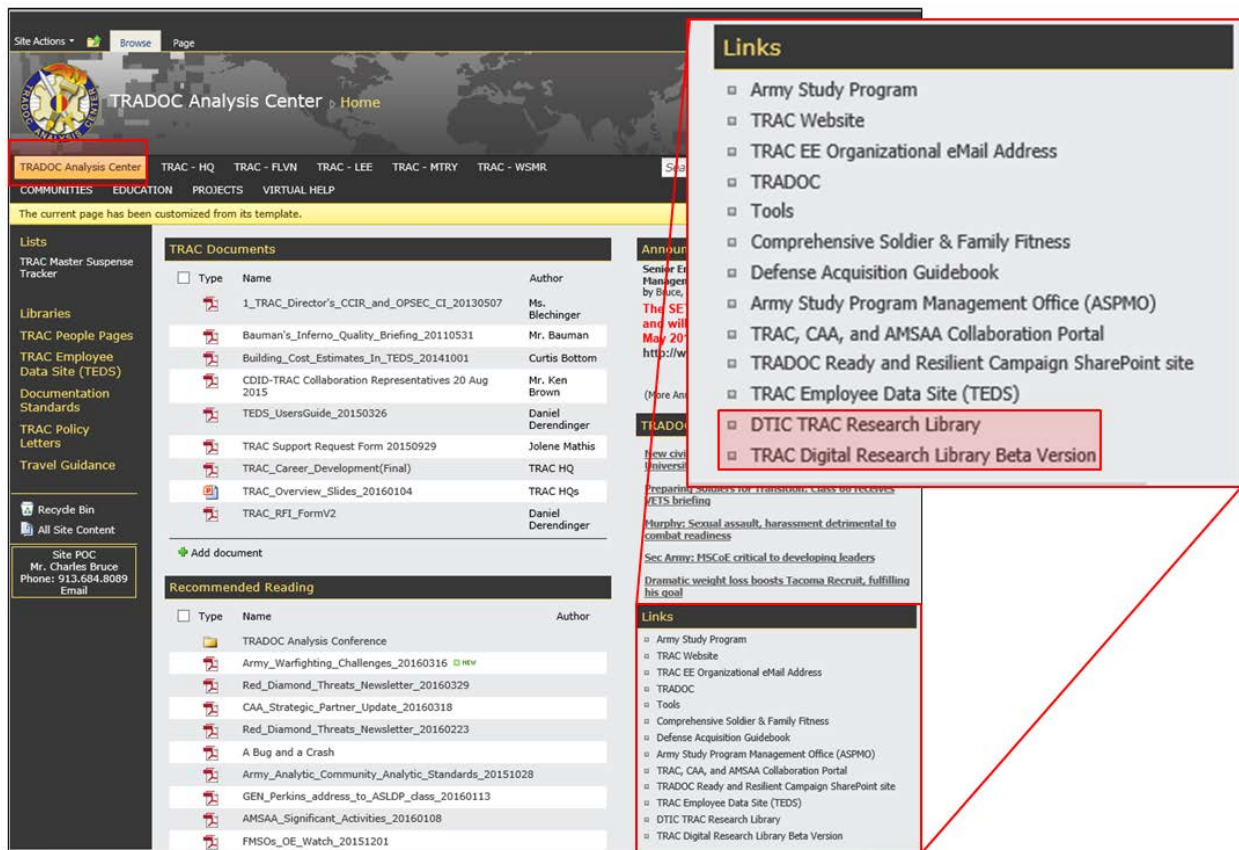


Figure 4. TRADOC Analysis Center with library links.

Below is a brief walkthrough on how to navigate the various features on the website.

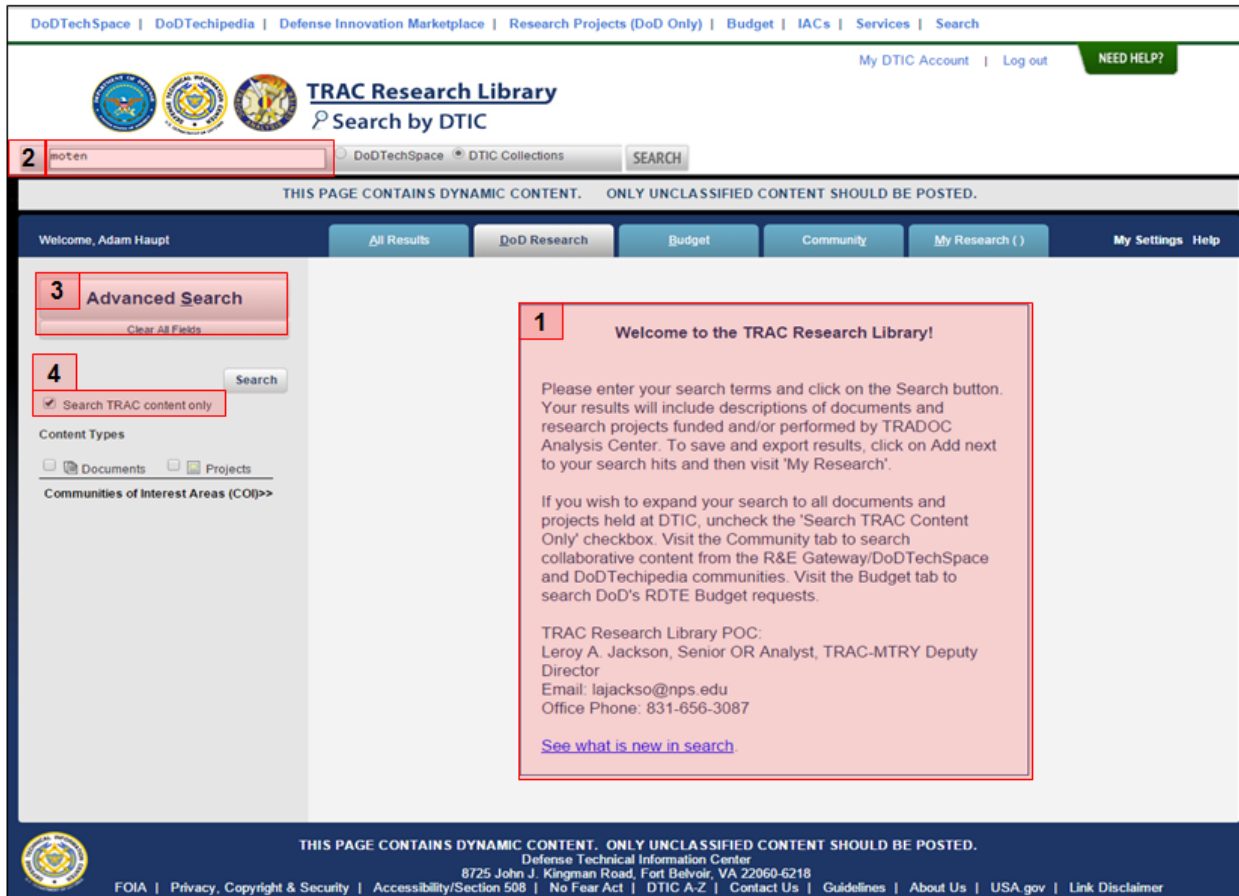


Figure 5. DTIC TRAC Research Library homepage: 1. Welcome message and POC; 2. Simple search of title, author, keywords, and description; 3. Advanced search feature that allows precision search of metadata; 4. Toggles TRAC filter on and off. Allows search of all DTIC documents if toggled off.

THIS PAGE CONTAINS DYNAMIC CONTENT. ONLY UNCLASSIFIED CONTENT SHOULD BE POSTED.

Welcome, Adam Haupt

All Results DoD Research Budget Community My Research (7) My Settings Help

Advanced Search

Clear All Fields

Search

Search TRAC content only

Content Types

Documents Projects

Communities of Interest Areas (COI)>>

Author

moten, iii, cardy (2)

adint, eric (1)

buttrey, sam (1)

felts, steve (1)

kamel, magdi (1)

masotti, edward m. (1)

moten, cardy (1)

Organization

army tradoc analysis center monterey ca (3)

Save Hits Per Page: 10 Sort By: Relevance Showing 1 - 3 out of approx. 3 results

1 **Understanding Optimal Decision-making in War-gaming II**
Moten, III, Cardy
ARMY TRADOC ANALYSIS CENTER MONTEREY CA
[View Full Text](#) 2015-02-01
ADA614320
A - 01 - APPROVED FOR PUBLIC RELEASE Request Change

2 **Analysis of the Global Assessment Tool (GAT) Response Data in Support of Comprehensive Soldier and Family Fitness (CSF2)**
Masotti, Edward M. Buttrey, Sam Kamel, Magdi Felts, Steve Moten, Cardy Adint, Eric
ARMY TRADOC ANALYSIS CENTER MONTEREY CA
[Scan Document](#) 2014-11-30
ADB405977
F - 05 - FURTHER DISSEMINATION ONLY AS DIRECTED Request Change

3 **Understanding Optimal Decision-Making in Wargaming III**
Moten, III, Cardy
ARMY TRADOC ANALYSIS CENTER MONTEREY CA
[View Full Text](#) 2015-10-01
ADA622273
A - 01 - APPROVED FOR PUBLIC RELEASE Request Change

Save Hits Per Page: 10 Sort By: Relevance Showing 1 - 3 out of approx. 3 results

Figure 6. DTIC TRAC search results. 1. Search results from the query “Moten”; 2. Click this button to request a change to the metadata of the document; 3. Allows user to add document to *My Research* to consolidate search discoveries; 4. Lists affiliated authors and organizations to the document.

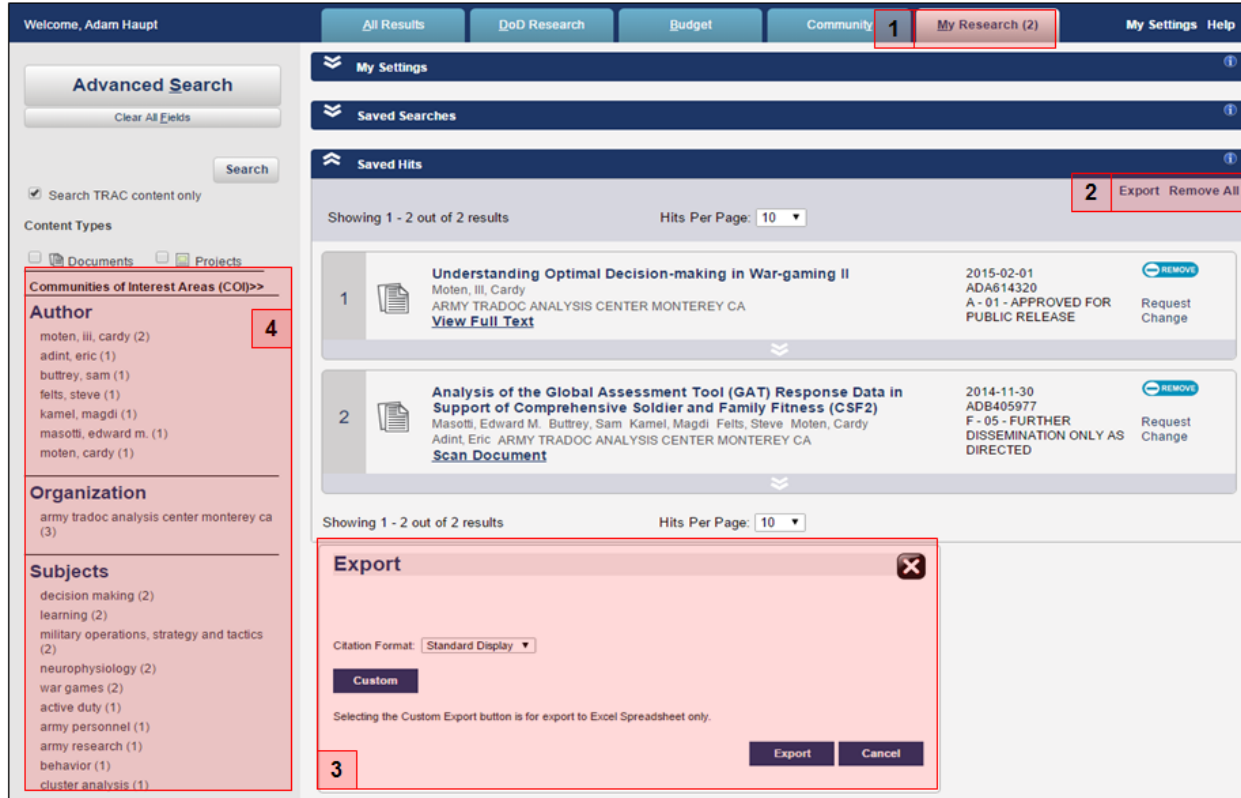


Figure 7. DTIC TRAC My Research Page. 1. View of the My Research page, which lists all documents that user collects from search results; 2. This button allows user to export metadata to various formats; 3. Export window that executes export function; 4. Lists of associated authors, organizations and document subjects contained in My Research.

3.2. TRAC Digital Research Library Executable Model

The TRAC Digital Library network application is an implementation of a conceptual model in VRDM that designed to provide secure network access and information management through any standard web browser that has network access. The implementation is done by configuration of the VRDM objects and objectified relationships, using semantics (natural language) with no compiling. This unique approach allowed non-computer programmers to construct the capability. Further, the VRDM model is web navigable, and has a very high degree of transparency that leads to inherent understanding of the component objects and model behavior.

The login process and password criterion for the library is designed in accordance with DoD password standards compliance. This implementation however, is configured through Windows Internet Information Server (IIS) for CAC login only. Upon logging in for the first time, the user's assigned login name and a temporary password are used, then the user's CAC card is associated to the user name in the GINA application model. All subsequent logins are via CAC only. The login page is shown in Figure 8.

To log in to the library, on the home page (<http://trac-dl.navy.nps.mil>), the user selects the 'LOGIN' hyperlink that is in red text in the upper right of the browser.

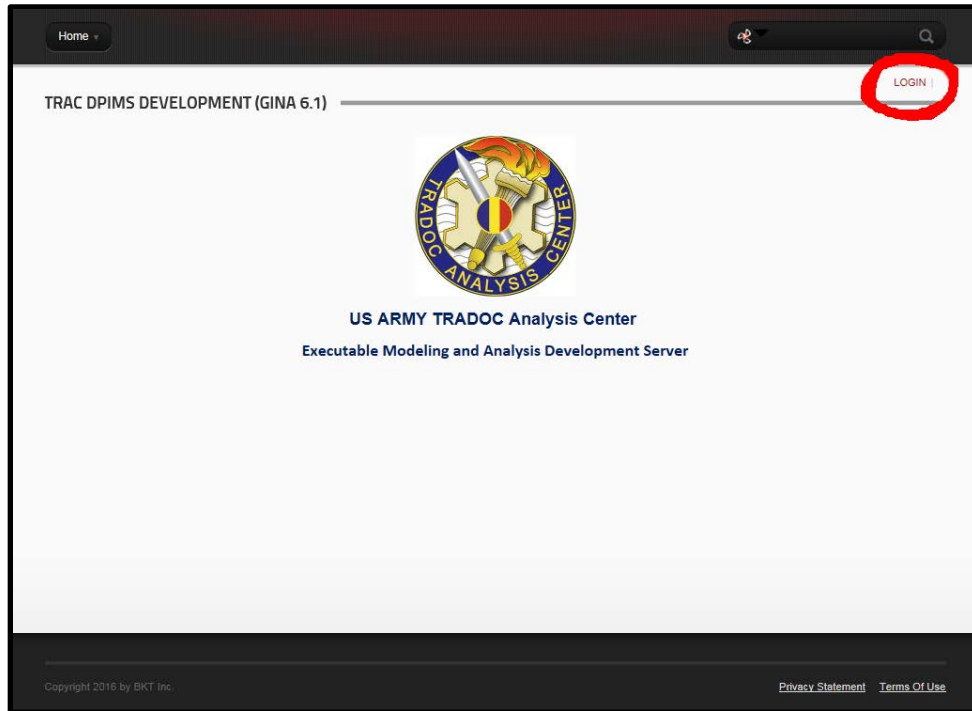


Figure 8. The login page for the TRAC Digital Library.

The user when logged in, first selects the GINA button in the top left of the window, see Figure 9. Note, in accordance with network security specifications, the prior login history is shown on this page to provide user situational awareness on past interactions with the system.

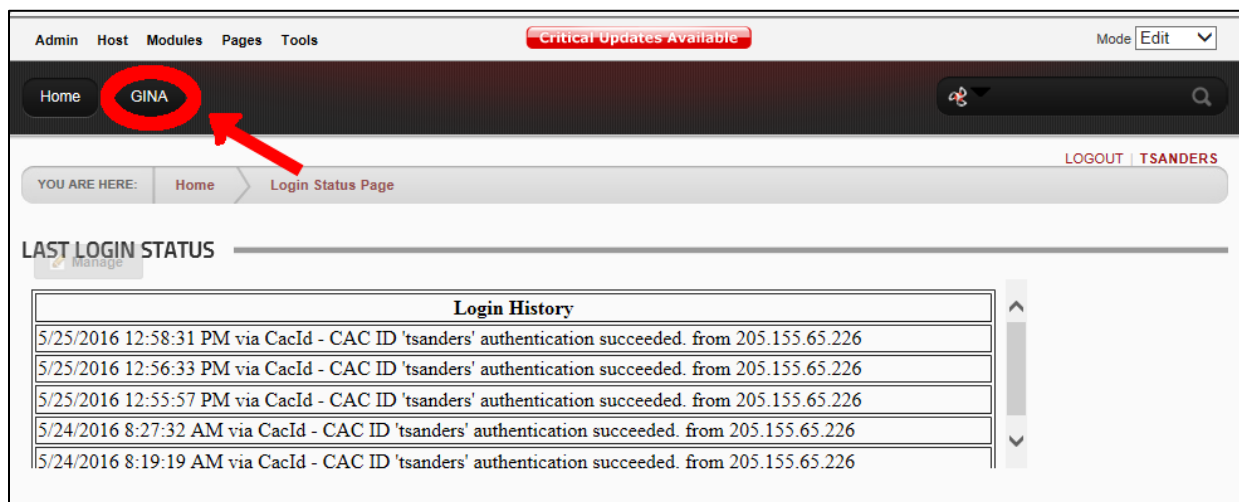


Figure 9. GINA access point. Upon logging into the TDL, the user selects the "GINA" button on the top left to navigate to available web applications, specifically, the TDL. The button here is circled in red.



Figure 10. Application Select Page. The user selects the application link for the TDL on the 'Select Application' page.

The GINA button navigates to a page where the user sees only the GINA model applications that they are assigned and have the authority to see, e.g. TRAC Digital Library (Figure 10). The user selects the TDL application link and then is presented with the Application Modules Form (see Figure 10). This form for TDL allows the user to select link button for an advanced Search (A) or select from the linked forms to add a new document or to search the document repository (B). The Utilities module is for the TDL administrator(s) and contains forms for managing the library

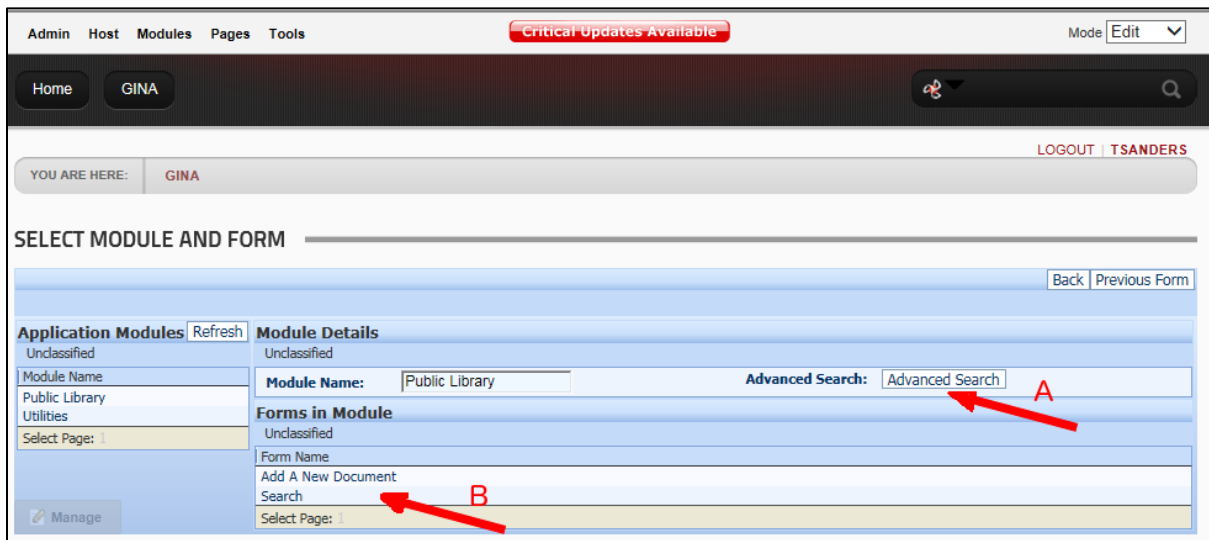


Figure 11. GINA module and form select page. The module form for TDL allows the user to select link button for an advanced Search (A) or select from the linked forms to add a new document or to search the document repository (B). The Utilities module is for the TDL administrator(s) and contains forms for managing the library.

(See Appendix D). The 'Add a New Document' link leads to a page that begins the process to input the meta data pertaining to a new submission, as well as links for inputting the documents citations. The process flow with approval and management roles has not been implemented, as it has not yet been defined by TRAC. The 'Search' link leads to a simple, yet broadly specified search window that allows the broadest of searches to yield reasonable results. This search has

been configured to find a term that is *contained* (partial match) in any of the following meta fields for document; *title, abstract, project number, performing organization, report number, authors, or subject terms*. The search results are listed by; *report date, title and author(s)*. The simplicity of this search yields offers rapid user interaction and results. Figure 12 illustrates results from a search. From the search results list, the desired document would then be selected, and the user would navigate to the abbreviated document metadata page (Figure 13) for a view of the abstract, key words and option to download document. The navigation buttons at the top of this page allow for download of latest document version or to navigate to the complete detail view of document metadata.

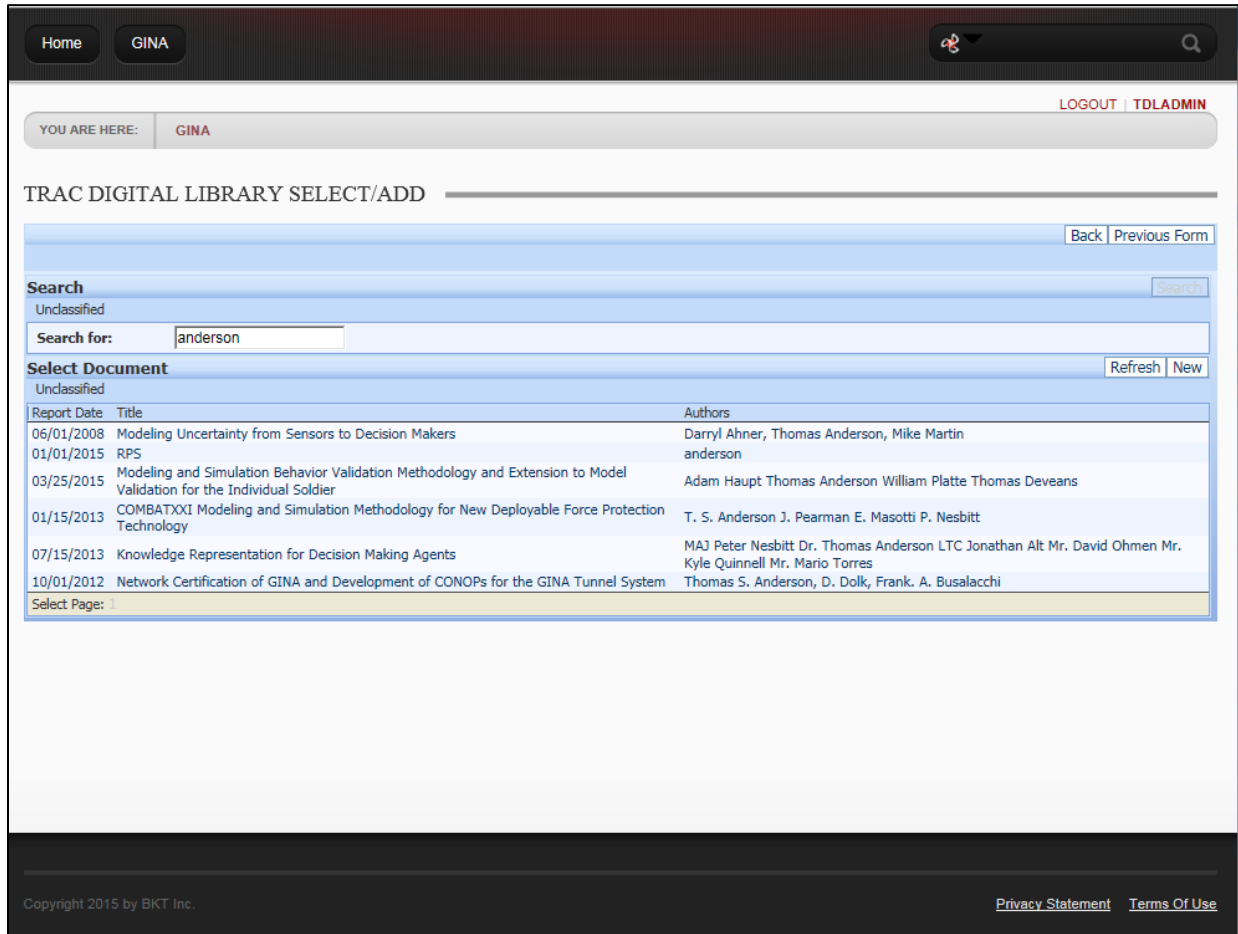


Figure 12. The 'Search' window showing results for search on author.

TRAC Digital Library
Unclassified

Download Latest | Document Details

Title: Network Certification of GINA and Development of CONOPs for the GINA Tunnel System

Abstract: We examine the GINA System of Systems technology and its application and viability to be the underlying architecture for implementing and managing the CBP Tunnel Defeat mission system and process. The validation and network integrity of the architecture approach is addressed through taking a

Subtitle:

Responsible Person: Thomas Anderson

Telephone Number: 831-656-2977

Performing Org: TRAC-MTRY

Distribution:

Key Terms: Tunnel, tunnel defeat, systems architecture, system of systems, SoS, networked decision support system, C4ISR, command and control, C2

Authors: Thomas S. Anderson, D. Dolk, Frank. A. Busalacchi

Report Date: 10/1/2012 12:00:00 AM

Report Type: Technical Report

Update Details: Update Details

Document Versions
Unclassified

| Document Name | Version |
|----------------------|---------|
| TRAC_M_TR_13_003.pdf | 1 |

Select Page: 1

Figure 13. Document metadata page. The abbreviated view for a document shows key information and has the collected versions linked at the bottom. The navigation buttons at the top of the page allow for download of latest version or to navigate to the detail view of document meta data.

The detail view page for documents (Figure 14) has the complete metadata information that was derived from DoD standard form 298 (SF298) and expanded upon by the TRAC SME team to include fields that contain mission relevant data. The information fields throughout the model are write protected, and may not be altered by the USER.

The detail page has a button link on the lower right that leads to the document's citations. The *document cites* is an example of a *related behavior*, where the VRDM concept object of document is related to the concept of documentCites. Further behaviors may be easily added e.g. (refuted by, cited by, downloaded by, times downloaded, etc.). It is a matter of understanding what information is deemed of value to TRAC organization from a research analyst perspective as well as a management perspective.

LOGOUT | TDLADMIN

YOU ARE HERE: GINA

DOCUMENT DETAILS [Back](#) | [Previous Form](#)

[Download Latest Version](#)

Document Details
Unclassified

| | |
|---|---|
| <p>Title: Network Certification of GINA and Development of CONOPs for the GINA Tunnel System</p> <p>Subtitle:</p> <p>Abstract: We examine the GINA System of Systems technology and its application and viability to be the underlying architecture for implementing and managing the CBP Tunnel Defeat mission system and process. The validation and network integrity of the architecture approach is addressed through taking a</p> <p>Limitation of Abstract: SAR</p> <p>Subject Domain:</p> <p>Abstract Classification: Unclassified</p> <p>Document Classification: Sensitive</p> <p>This Page Classification: Unclassified</p> <p>Dates Covered From: 3/1/2009 12:00:00 AM</p> <p>Dates Covered To: 9/30/2012 12:00:00 AM</p> <p>Telephone Number: 831-656-2977</p> <p>Number of pages: 564</p> <p>DTIC Accession Number:</p> <p>Authors: Thomas S. Anderson, D. Dolk, Frank. A. Busalacchi</p> | <p>Notes:</p> <p>Distribution Statement: Distribution authorized to U.S. Government Agencies only for administrative or operational use. All other requests for this document shall be referred to U.S. Army TRADOC Analysis Center Monterey, TRAC-MTRY. This determination was made on 28 SEP 2012.</p> <p>Performing Org: US Army TRADOC Analysis Center Monterey</p> <p>Perf Org Report Number: TRAC-M-TR-13-003</p> <p>Project Number: 736</p> <p>Report Date: 10/1/2012 12:00:00 AM</p> <p>Report Type: Technical Report</p> <p>Sponsor Acronym: DHS CBP LSS</p> <p>Sponsor: Sponsor Department of Homeland Security Customs and Border Protection Laboratory of Scientific Services</p> <p>Sponsor Address:</p> <p>Sponsor Report Number: TRAC-M-TR-13-003</p> <p>Update: <input type="checkbox"/></p> <p>Last: 1</p> <p>Document Citations: Document Citations</p> |
|---|---|

Figure 14. Expanded document metadata page. The page for document details also has a link button at the bottom right to see the documents citations.

The 'Advanced Search' offers finer resolution and customized search specification (Figure 15A). The top right of the 'Advanced Search' page has buttons linked to execute search and export search results. There are 5 drop down Elements for choosing what attribute to search on (see Figure 15B) The search logic may be specified for each element by choosing from the drop down menu (see Figure 15C). The result attributes may also be selected for viewing and ordered. The results are listed at the bottom of the page and are hyperlinked to the abbreviated metadata page for document downloading, just like with results from the simple search. The page also provides a summary count for the search hits.

QUERY EXECUTION Manage Back Previous Form

Search Filters A { Report Excel Xml Execute Search

Unclassified

| Element | Operator | Value |
|------------------------|---------------------------|---------------------------|
| Authors B | Contains C { | Anderson D { |
| PerformingOrg | (none) | |
| ReportDate | (none) | |
| ReportType | (none) | |
| SponsorAcronym | (none) | |

Display Elements

Unclassified

| Element | Display | Sort Order | Ascending/Descending |
|------------|-------------------------------------|------------|----------------------|
| Authors | <input checked="" type="checkbox"/> | 2 | Ascending |
| ReportDate | <input checked="" type="checkbox"/> | 1 | Descending |
| Title | <input checked="" type="checkbox"/> | (none) | (none) |

Search Results

Unclassified

| Authors | Report Date | Title |
|--|--------------------------|--|
| thomas anderson | 2/24/2016 12:00:00 AM | b22 |
| Adam Haupt Thomas Anderson William Platte Thomas Deveans | 3/25/2015 12:00:00 AM | Modeling and Simulation Behavior Validation Methodology and Extension to Model Validation for the Individual Soldier |
| anderson F | 1/1/2015 12:00:00 AM | RPS |
| MAJ Peter Nesbitt Dr. Thomas Anderson LTC Jonathan Alt Mr. David Ohmen Mr. Kyle Quinnell Mr. Mario Torres | 7/15/2013 12:00:00 AM | Knowledge Representation for Decision Making Agents |
| T. S. Anderson J. Pearman E. Masotti P. Nesbitt | 1/15/2013 12:00:00 AM | COMBATXXI Modeling and Simulation Methodology for New Deployable Force Protection Technology |
| Thomas S. Anderson, D. Dolk, Frank. A. Busalacchi | 10/1/2012 12:00:00 AM | Network Certification of GINA and Development of CONOPs for the GINA Tunnel System |
| Darryl Ahner, Thomas Anderson, Mike Martin | 6/1/2008 12:00:00 AM | Modeling Uncertainty from Sensors to Decision Makers |

Figure 15A. Advanced Search page of the TDL. A. Function buttons to execute search and export search result; B. drop down for choosing what attribute to search on (see Fig 15B); C. Drop down to choose the logic on which to search (see Figure 15C); D. Parameter for the search; E. Configurable metadata to display from search; F. Search results, which are linked to abbreviated meta page for document download.

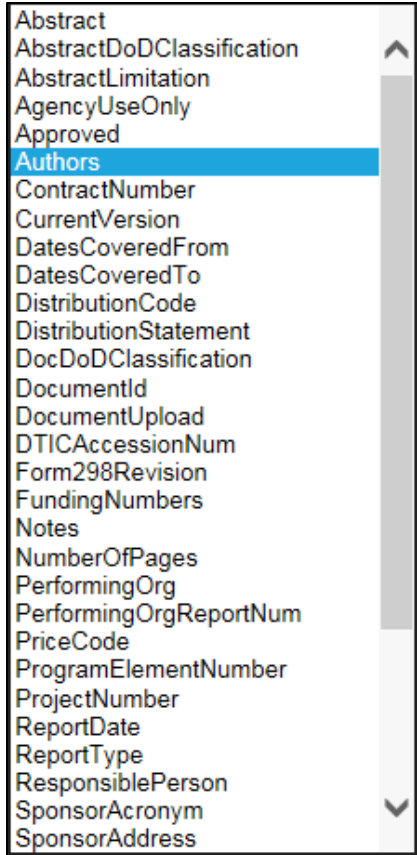


Figure 15B. Metadata available to advanced search (see Figure 15A item B).

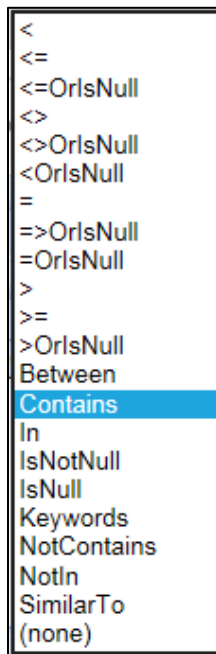


Figure 15C. Logical operators used to configure search vectors (see Figure 15A item C).

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Chapter 4 – Conclusion and Recommendations

4.1. Conclusion

This project produced two viable solutions to improve and enhance TRAC's capability to archive and search its corpus of documents. The DTIC solution is a ready technology solution, which is already populated by more than 1000 documents and offers improvements to search capabilities. The VRDM solution offers the most control and potential for expansion to meet TRAC's future needs. The next step for TRAC to take full advantage of its intellectual capital is to expand this GINA solution to all desired documents in a methodical and organized way. Recommendations on how to expand this capability are addressed below in section 4.2.

4.2. Recommendations

4.2.1. Scope

The project team recommends the following future expansions to the TRAC Digital Research Library:

- Expand library to include documents from all TRAC centers.
- Expand types of study documents to Technical Reports and Memorandums, published study plans, IPRs, budget execution plans, and study datasets and models.
- Include white papers, information pages (summaries of TRAC Sharepoint pages with links), current policy papers and SOPs.
- Create SIPR library for classified documents.

Note: Documents must be finalized documents, representative of TRAC intellectual property, and ready for official publication to the TRAC document corpus.

4.2.2. Business Rules and Administrative Control

The following are recommendations for future business rules and administrative controls to maintain quality and longevity of the expanded TRAC Digital Research Library:

- Establish a CCB to manage content and SOP changes.
- Establish TRAC center document authorities that ensure documents and metadata meet publishing requirements.
- Create specific Administrative user roles for TRAC center document authorities that allow them to exclusively add/remove documents to the library, modify metadata, and make content changes.
- Create user roles for different groups of TRAC analysts (e.g. senior analysts, directors, junior analysts) as a means to control documents based on distribution limitations.
- Identify classes of documents that require additional release control.
- Create initial master list of keywords to maintain uniformity and to improve search results.

- Identify additional metadata fields that are TRAC specific and could be used by TRAC leadership to analyze work programs, sponsors, budget, analyst skills, etc. Could be used to create study teams and locate sponsors.

4.2.3 Technology Enhancements

The following are recommendations for future technology improvements in the GINA environment:

- Add a “My Research” page (similar to DTIC) to collect discoveries and consolidate metadata/document export.
- Add a .pdf reader capability to the advanced search feature (toggle on/off) to improve search function and create topic models.
- Improve display usability to make navigation through library functions simpler. Make search window always visible.
- Make advanced search feature easier to combine multiple criteria with “and/or” operators.

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Appendix B – Glossary

| | |
|-------|--|
| BKT | Big Kahuna Technologies |
| CAC | Common Access Card |
| CCB | Configuration Control Board |
| DISA | Defense Information Systems Agency |
| DoD | Department of Defense |
| DTIC | Defense Technical Information Center |
| FLVN | Fort Leavenworth |
| GINA | Global Information Network Architecture |
| IPR | In Progress Review |
| ITACS | Information Technology Assistance Center |
| MTRY | Monterey |
| NIPR | Non-Secure Internet Protocol Router |
| NPS | Naval Postgraduate School |
| PWS | Performance Work Statement |
| SIPR | Secure Internet Protocol Router |
| SOP | Standard Operating Procedure |
| TRAC | TRADOC Analysis Center |
| WSMR | White Sands Missile Range |

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Appendix C – ERDC CRREL Marketing Research and Scoping

Implementation Scoping Report for TRAC Digital Library (TDL)

Author: Thomas Anderson

Report Date: 17 June 2015

Organization: USACE ERDC CRREL (CEERD-RR-D)

Report Title: Scoping of TDL Model and Implementation

1. Introduction

The report describes the implementation options, efforts, and the preliminary meta model framework required for implementing a Digital Library for TRAC. The report is organized in the following 14 sections.

1. Introduction
2. TDL Objective
3. Background
4. Performance Requirements
5. Market Research
6. Preliminary Meta framework
7. Behaviors: Knowledge Capture
8. VRDM Implementation Considerations
9. Timeline
10. Risks and Mitigation
11. Conclusion
12. **Appendix A Standard Form 298 (Rev. 8/98)**⁷
13. **Appendix B Standard Form 298 (Rev. 2-89)**⁸
14. **Appendix C OWL Citation Annotation**⁹

2. TDL Objective

The TRAC TDL project has as a threshold objective, to develop a TRAC Library that will consolidate, organize and make network accessible relevant TRAC research documents to the TRAC organization.

⁷ <http://www.dtic.mil/whs/directives/forms/eforms/sf0298.pdf>

⁸ <http://www.acq.osd.mil/osbp/sbir/solicitations/sbir20002/refe002.pdf>

⁹ <http://purl.org/net/cito/>

The TRAC TDL project has a research object that seeks to provide an information management framework that allows TRAC to organize discoveries/projects/conclusions, etc. into a conceptual hierarchy with ties to the documentation / papers / data that relate articles to knowledge and makes the information available on a rules based criteria over the network.

3. Background

The USARMY TRADOC Analysis Center (TRAC) is comprised of four regionally separate laboratories, Fort Leavenworth, Kansas, Fort Lee Virginia, White Sands Missile Range, and at the Naval Postgraduate School in Monterey. TRAC's mission is to produce relevant and credible operations analysis to inform decisions. The studies from research and analysis produce a considerable corpus of publications, documents and presentations. TRAC is building a semantic executable network model that describes the TRAC Digital Library behaviors. TRAC seeks a cost effective solution to creating a Digital Library that has network availability is viable on both NIPR and SIPR and may have behaviors associated with the document repository and TRAC mission domain to make the document corpus transform to knowledge.

4. Performance Requirements

The critical performance requirements of the TDL are:

Thresholds:

1. Searchable
2. Network Available
3. Incorporate TRAC MTRY and MRO technical documents
4. Accommodate TRAC centric meta model framework
5. NIPR implementation
6. Meta-model framework
7. Standard meta-tags
8. Sustainable technology
9. TRAC Control
10. Timely changes

Objectives

11. Knowledge Discovery
12. Incorporate semantic behaviors (e.g. isReferencedBy, Cites, RelatesToModel)
13. CAC access
14. SIPR capable

5. Market Research

The principal market research technique was a TRAC query of known possible technology solutions and internet search for appropriate technologies or products to achieve the TDL objective. The search revealed five potential solution paths.

1. Defense Technical Information Center (DTIC)¹⁰: DTIC uses internally developed

¹⁰ <http://www.dtic.mil/dtic/>

web interface and search engines to manage documents for all DoD. Implementing knowledge framework would require \$ and a level of development interaction beyond funding means of project

2. TEDS: TEDS is a web interface developed at TRAC HQ to manage TRAC projects. TEDS already has the capacity to conduct advanced searches on projects and attach project documents.
3. Sharepoint: Is a widely used web technology for DoD. Is designed to allow interactive cooperation between individuals and is well suited for document repositories. Implementing knowledge framework would require \$ and a level of development interaction beyond funding means of project.
4. Confluence¹¹: Confluence is used at TRAC and NPS, is supported by WSMR, NPS faculty and civilians.
5. Global Information Network Architecture (GINA)¹²: Is an information network architecture that is highly adaptable and simple to implement, use and modify a knowledge management framework with repository. DoD network certified and implements semantically described information models using domain relevant semantics in a loosely coupled model solution.

** See PowerPoint presentation “TRAC Library, TRAC Project 000096, June 2015” for comparison of the approaches. To summarize, the Vector Relational Data Modeling (using GINA) approach offers the capability to achieve both thresholds and objectives.

6. Preliminary Meta framework

The meta framework for the TDL is be based off of the DTIC SF 298, Rev.8/98 (see Appendix A) and the OWL Citation Typing Ontology. This is due to the well-defined meta elements for DoD publications from the 298 form and the added elements from OWL that allow for version tracking. The Vector Relational Data Model (VRDM) model will also accommodate prior versions of the DTIC SF 298 e.g. Rev 2-89 (Appendix B) that is used in earlier technical reports and theses. If further 298 revisions are encountered, it is trivial to add in the capability to the VRDM model to accommodate new meta structures without effecting the semantic model that is developed.

The preliminary meta model is suggested as follows:

1. REPORTDATE (DD-MM-YYYY)
2. REPORTTYPE
3. DATES COVERED
[DateFrom]

¹¹ <https://www.atlassian.com/software/confluence>

¹² Dolk, Daniel, Thomas Anderson, Frank Busalacchi, and David Tinsley. “GINA: System Interoperability for Enabling Smart Mobile System Services in Network Decision Support Systems.” 2012 45th Hawaii International Conference on System Science: 1472–1481.

<http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6149063&isnumber=6148595>

[DateTo]

4. TITLE AND SUBTITLE
- 5a. CONTRACT NUMBER
- 5b. GRANT NUMBER
- 5c. PROGRAM ELEMENT NUMBER
- 5d. PROJECT NUMBER
- 5e. TASK NUMBER
- 5f. WORK UNIT NUMBER
6. AUTHOR(S)
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
10. SPONSOR/MONITOR'S ACRONYM(S)
11. SPONSOR/MONITOR'S REPORT
12. DISTRIBUTION/AVAILABILITY STATEMENT
13. SUPPLEMENTARY NOTES
14. ABSTRACT
15. SUBJECT TERMS
16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE
17. LIMITATION OF ABSTRACT
18. NUMBER OF PAGES
- 19a. NAME OF RESPONSIBLE PERSON
- 19b. TELEPHONE No. (9 digit)
20. VERSION
21. CONTRIBUTOR

The following is a description of the suggested TDL meta tag terms:

1. REPORT DATE. Full publication date, including day, month, if available. Must cite at least the year and be Year 2000 compliant, e.g. 30-06-1998; xx-06-1998; xx-xx-1998.
2. REPORT TYPE. State the type of report, such as final, technical, interim, memorandum, master's thesis, progress, quarterly, research, special, group study, etc.
3. DATES COVERED. Indicate the time during which the work was performed and the report was written, e.g., Jun 1997 - Jun 1998; 1-10 Jun 1996; May - Nov 1998; Nov 1998.
4. TITLE. Enter title and subtitle with volume number and part number, if applicable. On classified documents, enter the title classification in parentheses.
- 5a. CONTRACT NUMBER. Enter all contract numbers as they appear in the report, e.g. F33615-86-C-5169.
- 5b. GRANT NUMBER. Enter all grant numbers as they appear in the report, e.g. AFOSR-82-1234.
- 5c. PROGRAM ELEMENT NUMBER. Enter all program element numbers as they appear in the report, e.g. 61101A.
- 5d. PROJECT NUMBER. Enter all project numbers as they appear in the report, e.g. 1F665702D1257; ILIR.
- 5e. TASK NUMBER. Enter all task numbers as they appear in the report, e.g. 05; RF0330201; T4112.

- 5f. WORK UNIT NUMBER. Enter all work unit numbers as they appear in the report, e.g. 001; AFAPL30480105.
6. AUTHOR(S). Enter name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. The form of entry is the last name, first name, middle initial, and additional qualifiers separated by commas, e.g. Smith, Richard, J, Jr.
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES). Self-explanatory.
8. PERFORMING ORGANIZATION REPORT NUMBER.
Enter all unique alphanumeric report numbers assigned by the performing organization, e.g. BRL-1234; AFWL-TR-85-4017-Vol-21-PT-2.
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES). Enter the name and address of the organization(s) financially responsible for and monitoring the work.
10. SPONSOR/MONITOR'S ACRONYM(S). Enter, if available, e.g. BRL, ARDEC, NADC.
11. SPONSOR/MONITOR'S REPORT NUMBER(S). Enter report number as assigned by the sponsoring/ monitoring agency, if available, e.g. BRL-TR-829; -215.
12. DISTRIBUTION/AVAILABILITY STATEMENT. Use agency-mandated availability statements to indicate the public availability or distribution limitations of the report. If additional limitations/ restrictions or special markings are indicated, follow agency authorization procedures, e.g. RD/FRD, PROPIN, ITAR, etc. Include copyright information.
13. SUPPLEMENTARY NOTES. Enter information not included elsewhere such as: prepared in cooperation with; translation of; report supersedes; old edition number, etc.
14. ABSTRACT. A brief (approximately 200 words) factual summary of the most significant information.
15. SUBJECT TERMS. Key words or phrases identifying major concepts in the report.
16. SECURITY CLASSIFICATION. Enter security classification in accordance with security classification regulations, e.g. U, C, S, etc. If this form contains classified information, stamp classification level on the top and bottom of this page.
17. LIMITATION OF ABSTRACT. This block must be completed to assign a distribution limitation to the abstract. Enter UU (Unclassified Unlimited) or SAR (Same as Report). An entry in this block is necessary if the abstract is to be limited.
18. NUMBER_OF_PAGES.
- 19a. NAME OF RESPONSIBLE PERSON
- 19b. TELEPHONE_NO (9 digit)
20. Version
21. Contributor. The entity responsible for making contributions to the resource. Examples of a Contributor include a person, an organization, or a service.

7. Behaviors: Knowledge Capture

Developing and adopting a suite of semantic behaviors will provide extensive capability for knowledge elicitation from the TRAC Digital Library. The behaviors for the document citation domain are taken from OWL's Citation Ontology. The semantic definitions of the behaviors are listed in Appendix C. Initially, and to demonstrate the

incorporation of citation behaviors into the TRAC VRDM digital library model, the behaviors of *Cites* and *isCited* by will be developed as VRDM objects. This behavior attribute will allow for rapid navigation through a subjects domain of related work.

Future behavior. The addition of new behaviors as directed by TRAC will be added at discretion of TRAC technical director and director. The ability to specify process is within the realm of the VRDM capability, thus CONOPs and TTPs for managing, not only documents, but knowledge must be considered.

8. VRDM Implementation Considerations

The implementation of the meta framework, the development of the CONOPs and TTPs and the core semantic construct in the VRDM are tasks that TRAC MTRY and experts can execute. The capability that is being developed however, is a secure network accessed capability with CAC access and Sharepoint tie in. To accomplish implementing a TRAC TDL VRDM model, the following considerations must be addressed by contracted experts

1. VRDM Network Security Analysis
This is a security analysis for the Risk Management Framework. This is a requirement to continue SIPR compliance.
2. VRDM Training and modeling
Initial training and modeling of VRDM will be performed by TRAC and ERDC. Advanced VRDM concepts and modeling should be taught in order for TRAC to execute behavior and network processes.
3. VRDM Sharepoint authentication
The TDL meta model will have access through Sharepoint in order to offer seamless access to TDL.
4. VRDM Version management/archiving
The version management and archiving process will be refined according to the TRAC TDL meta model specifications
5. VRDM Document upload/access
The document repository configuration and access interaction with the TRAC CONOPs and TTPs will be accomplished.
6. VRDM Content Management Services Adaptor (Sharepoint)
This adapts the GINA framework to the Sharepoint framework to accomplish the data and system interoperation.
7. Oversight/Final Report

A separate cost analysis and scope of work for this has been drawn up with a total cost of 64K.

9. Timeline

Based on a July 1 start, the timeline for the expected work is as follows:

Finalize meta model and initial behaviors in spreadsheets, terms and CONOPs July 15

| | |
|--|---------|
| Initial Training | July 20 |
| Prototype Information model Implementation | July 31 |
| Incorporation meta model into VRDM | |
| Development of VRDM web Forms | |
| Prototype Information model Testing | Aug 3 |
| Initial document testing | |
| Prototype Information model Testing | Aug 18 |
| Spiral document testing | |
| Security Analysis (with USG and CTR) | Aug 31 |
| CAC Access and access model | Aug 31 |
| Prototype Information model Testing | Sept 1 |
| Spiral document testing | |
| SharePoint Access | Sep 15 |
| Final Out brief | Sep 30 |

Note that the contracted aspects are not tightly coupled to the initial and threshold outcome levels and that the project is anticipated to run into FY16.

10. Risks and Risk Mitigation

The risks associated with a short project execution timeline are primarily associated with the contracting execution timeline capabilities. NPS has in recent year been unable to execute timely contracts to meet mission requirements. This risk may be mitigated though working with DTIC. DTIC plays a central role in the TRAC Digital Library solution, as they are the ultimate destination of technical reports, and DTIC has recently developed a contracting relationship with the GINA technology CTRs. DTIC has contracting capability and bandwidth to accommodate the TRAC TDL tasks that have been earmarked for CTR expertise, and thus MIPR is required for the funds from TRAC to DTIC for this option.

11. Conclusion

Irrespective of the approach taken, the meta model framework that is derived from the SF298 and the OWL Citation Annotation properties provides a robust basis to build the TDL around. The threshold for the project, archiving technical documents will be easily achieved using existing process and technologies, as well as new technologies. The

objectives for knowledge elicitation and behavior for the TDL where the outcome is entirely controlled by TRAC is only easily achieved using VRDM in the GINA framework.

The path forward for an enhanced knowledge capability associated with the fundamental archiving of technical documents requires a meta model and a framework to manage the information. The only known network resident model broker that is DoD network certified is the Global Information Network Architecture, a framework that uses the unique Vector Relational Data Modeling for configuring semantically described executable information models. Choosing this approach to implementing the TDL combines the ability to manage information with network security, access control, behavior (CONOPs) control, and model modification with the information model yielding a resulting System of Systems. The adoption of the GINA technology by other DoD agencies, including DTIC is a huge factor in mitigating risk associated with contracting, in that contract vehicles already exist that can accommodate TRACs requirements.

12. Appendix A Standard Form 298 (Rev. 8/98)

Prescribed by ANSI Std. Z39.18

This appendix lists the document elements contained in the SF 298 (Rev. 8/98). This form is filled out for submission of technical documents and papers to DTIC.

1. REPORTDATE (DD-MM-YYYY)
2. REPORTTYPE
3. DATES COVERED
[DateFrom]
[DateTo]
4. TITLE AND SUBTITLE
- 5a. CONTRACT NUMBER
- 5b. GRANT NUMBER
- 5c. PROGRAM ELEMENT NUMBER
- 5d. PROJECT NUMBER
- 5e. TASK NUMBER
- 5f. WORK UNIT NUMBER
6. AUTHOR(S)
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
10. SPONSOR/MONITOR'S ACRONYM(S)
11. SPONSOR/MONITOR'S REPORT
12. DISTRIBUTION/AVAILABILITY STATEMENT
13. SUPPLEMENTARY NOTES
14. ABSTRACT
15. SUBJECT TERMS
16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE
17. LIMITATION OF ABSTRACT
18. NUMBER OF PAGES
- 19a. NAME OF RESPONSIBLE PERSON
- 19b. TELEPHONE NO (9 digit)

Description of TERMS:

1. REPORT DATE. Full publication date, including day, month, if available. Must cite at least the year and be Year 2000 compliant, e.g. 30-06-1998; xx-06-1998; xx-xx-1998.
2. REPORT TYPE. State the type of report, such as final, technical, interim, memorandum, master's thesis, progress, quarterly, research, special, group study, etc.
3. DATES COVERED. Indicate the time during which the work was performed and the report was written, e.g., Jun 1997 - Jun 1998; 1-10 Jun 1996; May – Nov 1998; Nov 1998.
4. TITLE. Enter title and subtitle with volume number and part number, if applicable. On classified documents, enter the title classification in parentheses.
- 5a. CONTRACT NUMBER. Enter all contract numbers as they appear in the report, e.g. F33615-86-C-5169.

- 5b. GRANT NUMBER. Enter all grant numbers as they appear in the report, e.g. AFOSR-82-1234.
- 5c. PROGRAM ELEMENT NUMBER. Enter all program element numbers as they appear in the report, e.g. 61101A.
- 5d. PROJECT NUMBER. Enter all project numbers as they appear in the report, e.g. 1F665702D1257; ILIR.
- 5e. TASK NUMBER. Enter all task numbers as they appear in the report, e.g. 05; RF0330201; T4112.
- 5f. WORK UNIT NUMBER. Enter all work unit numbers as they appear in the report, e.g. 001; AFAPL30480105.
6. AUTHOR(S). Enter name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. The form of entry is the last name, first name, middle initial, and additional qualifiers separated by commas, e.g. Smith, Richard, J, Jr.
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES). Self-explanatory.
8. PERFORMING ORGANIZATION REPORT NUMBER.
Enter all unique alphanumeric report numbers assigned by the performing organization, e.g. BRL-1234; AFWL-TR-85-4017-Vol-21-PT-2.
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES). Enter the name and address of the organization(s) financially responsible for and monitoring the work.
10. SPONSOR/MONITOR'S ACRONYM(S). Enter, if available, e.g. BRL, ARDEC, NADC.
11. SPONSOR/MONITOR'S REPORT NUMBER(S). Enter report number as assigned by the sponsoring/ monitoring agency, if available, e.g. BRL-TR-829; -215.
12. DISTRIBUTION/AVAILABILITY STATEMENT. Use agency-mandated availability statements to indicate the public availability or distribution limitations of the report. If additional limitations/ restrictions or special markings are indicated, follow agency authorization procedures, e.g. RD/FRD, PROPIN, ITAR, etc. Include copyright information.
13. SUPPLEMENTARY NOTES. Enter information not included elsewhere such as: prepared in cooperation with; translation of; report supersedes; old edition number, etc.
14. ABSTRACT. A brief (approximately 200 words) factual summary of the most significant information.
15. SUBJECT TERMS. Key words or phrases identifying major concepts in the report.
16. SECURITY CLASSIFICATION. Enter security classification in accordance with security classification regulations, e.g. U, C, S, etc. If this form contains classified information, stamp classification level on the top and bottom of this page.
17. LIMITATION OF ABSTRACT. This block must be completed to assign a distribution limitation to the abstract. Enter UU (Unclassified Unlimited) or SAR (Same as Report). An entry in this block is necessary if the abstract is to be limited.

13. Appendix B Standard Form 298 (Rev. 2-89)

This appendix describes the terms for entry in the Standard Form 298 (Rev. 2-89). Prescribed by ANSI Std. Z39-18.

The VRDM model will easily accommodate the varying forms of the 298 meta tags.

1. AGENCY USE ONLY
2. REPORT DATE
3. TYPE OF REPORT AND DATES COVERED
4. TITLE AND SUBTITLE
5. FUNDING NUMBERs
6. AUTHOR(S)
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
10. SPONSOR/MONITOR'S ReportNumber
11. SUPPLEMENTARY NOTES
- 12a. DISTRIBUTION/AVAILABILITY STATEMENT
- 12b. Distribution Code
13. ABSTRACT
14. SUBJECT TERMS
15. NumberOfPages
16. PriceCode
17. SECURITY CLASSIFICATION OF REPORT
18. SECURITY CLASSIFICATION THIS PAGE
19. SECURITY CLASSIFICATION THIS PAGE ABSTRACT
20. LIMITATIONS OF ABSTRACT

Description of TERMS:

1. AGENCY USE ONLY: Leave blank
2. REPORT DATE. Full publication date, including day, month, if available. Must cite at least the year (e.g. 1Jan88).
3. TYPE OF REPORT AND DATES COVERED. State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10Jan87 - 30Jun88).
4. TITLE AND SUBTITLE. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, and volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.
5. FUNDING NUMBERS. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:
 - C - Contract
 - G - Grant
 - P - Program Element
 - PR - TA - WU -
Project
Task

Work Unit Accession No.

6. AUTHOR(S). Enter name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. The form of entry is the last name, first name, middle initial, and additional qualifiers separated by commas, e.g. Smith, Richard, J, Jr. If editor or compiler, this should follow the name(s)
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES). Self-explanatory.
8. PERFORMING ORGANIZATION REPORT NUMBER.
Enter all unique alphanumeric report numbers assigned by the performing organization, e.g. BRL-1234; AFWL-TR-85-4017-Vol-21-PT-2.
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES). Enter the name and address of the organization(s) financially responsible for and monitoring the work.
10. SPONSOR/MONITOR'S REPORT NUMBER. Self explanatory.
11. SUPPLEMENTARY NOTES
- 12a. DISTRIBUTION/AVAILABILITY STATEMENT. Use agency-mandated availability statements to indicate the public availability or distribution limitations of the report. If additional limitations/ restrictions or special markings are indicated, follow agency authorization procedures, e.g. RD/FRD, PROPIN, ITAR, etc. Include copyright information.
- 12b. DISTRIBUTION CODE. Denotes public availability or limitations.
13. ABSTRACT. A brief (approximately 200 words) factual summary of the most significant information.
14. SUBJECT TERMS. Key words or phrases identifying major concepts in the report.
15. NUMBER OF PAGES. Enter the total number of pages.
16. PRICE CODE. Enter appropriate price code (NTIS only).
- 17-19. SECURITY CLASSIFICATIONs. Self-explanatory. Enter U.S. Security Classification in accordance with U.S. Security Regulations (i.e., UNCLASSIFIED). If form contains classified information, stamp classification on the top and bottom of the page.
20. LIMITATION OF ABSTRACT. This block must be completed to assign a distribution limitation to the abstract. Enter UU (Unclassified Unlimited) or SAR (Same as Report). An entry in this block is necessary if the abstract is to be limited.

14. Appendix C. OWL Citation Typing Ontology.

From Owl: CiTO, the Citation Typing Ontology, is an ontology written in OWL 2 DL to enable characterization of the nature or type of citations, both factually and rhetorically, and to permit these descriptions to be published on the Web.

The citations characterized may be either direct and explicit (as in the reference list of a journal article), indirect (e.g. a citation to a more recent paper by the same research group on the same topic), or implicit (e.g. as in artistic quotations or parodies, or in cases of plagiarism).

OWL Annotation properties : Annotation Property

1. **contributor**

Label: Contributor

Definition: An entity responsible for making contributions to the resource.

Comment: Examples of a Contributor include a person, an organization, or a service.

2. **creator**

Label: Creator

Definition: An entity primarily responsible for making the resource.

Comment: Examples of a Creator include a person, an organization, or a service.

3. **date**

Label: Date

Definition: A point or period of time associated with an event in the lifecycle of the resource.

Comment: Date may be used to express temporal information at any level of granularity. Recommended best practice is to use an encoding scheme, such as the W3CDTF profile of ISO 8601 [W3CDTF].

4. **description**

Label: Description

Definition: An account of the resource.

Comment: Description may include but is not limited to: an abstract, a table of contents, a graphical representation, or a free-text account of the resource.

5. **rights**

Label: Rights

Definition: Information about rights held in and over the resource.

Comment: Typically, rights information includes a statement about various property rights associated with the resource, including intellectual property rights.

6. **title**

Label: Title

Definition: A name given to the resource.

7. **comment**

A description of the subject resource.

8. **label**

A human-readable name for the subject.

9. **priorVersion**

comment "The annotation property that indicates the predecessor ontology of a given ontology." ;

rdfs:domain owl:Ontology ;

10. **versionInfo**

rdfs:comment "The annotation property that provides version information for an ontology or another OWL construct." ;

Object Properties (behaviors)

1. agreesWith

Example: We share Galileo's opinion: the Earth moves [X.]

comment The citing entity agrees with statements, ideas or conclusions presented in the cited entity.

2. Cites:

comment :The citing entity cites the cited entity, either directly and explicitly (as in the reference list of a journal article), indirectly (e.g. by citing a more recent paper by the same group on the same topic), or implicitly (e.g. as in artistic quotations or parodies, or in cases of plagiarism).

3. citesAsAuthority

Example: Newton asserted that we are like dwarfs standing on the shoulders of giants [X]

comment :The citing entity cites the cited entity as one that provides an authoritative description or definition of the subject under discussion.

4. citesAsDataSource

Example: Italy has more than ten thousand kilometers of shoreline: see [X].

comment The citing entity cites the cited entity as source of data.

5. citesAsEvidence

Example: We found an unquestionable demonstration of our hypothesis in [X].

The citing entity cites the cited entity as source of factual evidence for statements it contains.

6. citesAsMetadataDocument

Example: Basic bibliographic, entity and project metadata relating to this article, recorded in a structured machine-readable form, is available as an additional file [X] accompanying this paper.

7. citesAsPotentialSolution

Example: This risk could be avoided using the approach shown in [X].

The citing entity cites the cited entity as providing or containing a possible solution to the issues being discussed.

8. citesAsRecommendedReading

Example: To our knowledge, [X] is the best source of exercises about UML, making it a valuable proposal for beginners.

The citing entity cites the cited entity as an item of recommended reading. This property can be used, for example, to describe references in a lecture reading list,

where here the cited references are relevant to the general topic of the lecture, but might not be individually cited within the text of the lecture. Similarly, it could be used to describe items in a 'Suggested further reading' list at the end of a book chapter.

9. citesAsRelated

Example: An analysis similar to what we proposed here is presented in [X]
The citing entity cites the cited entity as one that is related.

10. citesAsSourceDocument

Example: Several sections of this work are based on our literature review of the topic published as journal article [X].

comment :The citing entity cites the cited entity as being the entity from which the citing entity is derived, or about which the citing entity contains metadata.

11. citesForInformation

Example: The grammar of Pascal was introduced in [X]

comment The citing entity cites the cited entity as a source of information on the subject under discussion.

12. Compiles

Example: This book gathers interviews with academic researchers of several disciplines [X]

Note: This property has been imported from the CiTO4Data ontology, usage of which has been deprecated.

comment The citing entity is used to create or compile the cited entity.

13. Confirms

Example: Our findings are similar to those published in [X].

comment The citing entity confirms facts, ideas or statements presented in the cited entity.

14. containsAssertionFrom

Example: We think that to stand on the top of giants [X] is a valuable principle to follow for our own research.

comment The citing entity contains a statement of fact or a logical assertion (or a collection of such facts and/or assertions) originally present in the cited entity. This object property is designed to be used to relate a separate abstract, summary or nanopublication to the cited entity upon which it is based.

15. Corrects

Example: The result published in [X] is partially wrong, the correct result is 42

comment The citing entity corrects statements, ideas or conclusions presented in the cited entity.

16. Credits

Example: Galileo was the first to observe Jupiter's satellites [X]

comment The citing entity acknowledges contributions made by the cited entity.

17. Critiques

Example: The ideas presented in [X] are badly substantiated.

comment The citing entity critiques statements, ideas or conclusions presented in the cited entity.

18. Derides

Example: The ideas published in [X] are incredibly stupid.

comment The citing entity express derision for the cited entity, or for ideas or conclusions contained within it.

comment The citing entity agrees with statements, ideas or conclusions presented in the cited entity.

19. Describes

Example: Galileo's book [X] is a dialog among three scientists about Copernicus's heliocentric theory.

comment The citing entity describes the cited entity.

inverseOf: isDescribedBy

20. disagreesWith

Example: We do not share Galileo's opinion [X]: the Earth does not move.

comment The citing entity disagrees with statements, ideas or conclusions presented in the cited entity.

21. Discusses

Example: We now examine if Galileo is right when he writes [X] that the Earth moves

comment The citing entity discusses statements, ideas or conclusions presented in the cited entity.

22. givesBackgroundTo

comment The cited entity provides background information for the citing entity.

inverseOf obtainsBackgroundFrom

23. givesSupportTo

comment The cited entity provides intellectual or factual support for the citing entity.

24. hasCitationCharacterization

comment A property that links a cito:CitationAct to its characterization made by using a CiTO citation characterization property such as cito:extends.

25. hasCitedEntity

26. isAgreedWithBy

comment The cited entity contains statements, ideas or conclusions with which the citing entity agrees.

27. isCitedAsAuthorityBy

The cited entity is cited as providing an authoritative description or definition of the subject under discussion in the citing entity.

28. isCitedAsDataSourceBy

comment The cited entity is cited as a data source by the citing entity.

29. isCitedAsEvidenceBy

The cited entity is cited for providing factual evidence to the citing entity.

30. isCitedAsMetadataDocumentBy

The cited entity is cited as being the container of metadata relating to the citing entity.

31. isCitedAsPontentialSolutionBy

The cited entity is cited as providing or containing a possible solution to the issues being discussed in the citing entity.

32. isCitedAsRecommendedReading

The cited entity is cited by the citing entity as an item of recommended reading. This property can be used, for example, to describe references in a lecture reading list, where the cited references are relevant to the general topic of the lecture, but might not be individually cited within the text of the lecture. Similarly, it could be used to describe items in a ‘Suggested further reading’; list at the end of a book chapter.

inverseOf :citesAsRecommendedReading

33. isCitedAsRelatedBy

The cited entity is cited as being related to the citing entity

34. isCitedAsSourceDocumentBy

The cited entity is cited as being the entity from which the citing entity is derived, or about which the citing entity contains metadata

35. isCitedBy

The cited entity (the subject of the RDF triple) is cited by the citing entity (the object of the triple)

36. isCitedForInformationBy

The cited entity is cited as a source of information on the subject under discussion in the citing entity

inverseOf citesForInformation

37. isCompiledBy

Note: This property has been imported from the CiTO4Data ontology, usage of which has been deprecated

The cited entity is the result of a compile or creation event using the citing entity
inverseOf: compiles

38. isConfirmedBy

The cited entity presents facts, ideas or statements that are confirmed by the citing entity

39. isCorrectedBy

The cited entity presents statements, ideas or conclusions that are corrected by the citing entity.

40. isCreditedBy

The cited entity makes contributions that are acknowledged by the citing entity.
inverseOf credits

41. isCritiquedBy

The cited entity presents statements, ideas or conclusions that are critiqued by the citing
inverseOf critiques

42. isDeridedBy

The cited entity contains ideas or conclusions for which the citing entity express derision
inverseOf :derides

43. isDescribedBy

The cited entity is described by the citing entity

44. isDisagreedWithBy

The cited entity presents statements, ideas or conclusions that are disagreed with by the citing entity.
inverseOf disagreesWith

45. isDiscussedBy

The cited entity presents statements, ideas or conclusions that are discussed by the citing entity
inverseOf discusses

46. isDisputedBy

The cited entity presents statements, ideas or conclusions that are disputed by the citing entity
inverseOf :disputes

47. isDocumentedBy

Information about the cited entity is documented by the citing entity.
inverseOf = documents

48. isExtendedBy

The cited entity presents facts, ideas or understandings that are extended by the citing entity
inverseOf extends

49. isParodiedBy

The characteristic style or content of the cited entity is imitated by the citing entity for comic effect, usually without explicit citation.
inverseOf parodies

50. isPlagiarizedBy

The cited entity is plagiarized by the author of the citing entity, who includes within the citing entity textual or other elements from the cited entity without formal acknowledgement of their source. The cited entity is thus not explicitly cited from within the citing entity, according to the norms of scholarly practice, but is cited implicitly

51. isQualifiedBy

The cited entity presents statements, ideas or conclusions that are qualified or have conditions placed upon them by the citing entity.
inverseOf qualifies

52. isRefutedBy

The cited entity presents statements, ideas or conclusions that are refuted by the citing entity.
inverseOf refutes

53. isRetractedBy

The cited entity is formally retracted by the citing entity.
inverseOf retracts

54. isReviewedBy

The cited entity presents statements, ideas or conclusions that are reviewed by the citing entity
inverseOf reviews

55. isRidiculedBy

The cited entity or aspects of its contents are ridiculed by the citing entity
inverseOf ridicules

56. isSpeculatedOnBy

The cited entity is cited because the citing article contains speculations on its content or ideas.
inverseOf speculatesOn

57. isSupportedBy

The cited entity receives intellectual or factual support from the citing entity
inverseOf supports

58. isUpdatedBy

The cited entity presents statements, ideas, hypotheses or understanding that are updated by the cited entity.
inverseOf updates

59. likes

A property that permits you to express appreciation of or interest in something that is the object of the RDF triple, or to express that it is worth thinking about even if you do not agree with its content, enabling social media 'likes' statements to be encoded in RDF. Use of this property does NOT imply the existence of a formal citation of the entity that is 'liked'

60. agreesWith

Example: We share Galileo's opinion: the Earth moves [X]
The citing entity agrees with statements, ideas or conclusions presented in the cited entity

61. obtainsBackgroundFrom

Example: There is a need for more observational studies and studies using narrative causation to describe the potential contribution of information in problem-solving and decision-making [X]; our work addresses these needs
The citing entity obtains background information from the cited entity.

62. obtainsSupportFrom

Example: Our ideas were also shared by Doe et al. [X]
The citing entity obtains intellectual or factual support from the cited entity

63. parodies

Example: We act as giants on the shoulders of dwarfs [X]
The citing entity imitates the characteristic style or content of the cited entity for comic effect, usually without explicit citation

64. plagiarizes

A property indicating that the author of the citing entity plagiarizes the cited entity, by including textual or other elements from the cited entity without formal acknowledgement of their source. The citing entity thus contains no explicit citation of the cited entity, according to the norms of scholarly practice, but cites it implicitly

Example: The conclusion of our dissertation can be summarised by the following motto, we created specifically for this purpose: we are like dwarfs standing on the shoulders of giants

65. providesAssertionFor

The cited entity contains and is the original source of a statement of fact or a logical assertion (or a collection of such facts and/or assertions) that is to be found in the citing entity. This inverse object property is designed to be used to relate a cited entity to a separate abstract, summary or nanopublication based upon it
inverseOf containsAssertionFrom

66. providesConclusionsFor

The cited entity presents conclusions that are used in work described in the citing entity

67. providesDataFor

The cited entity presents data that are used in work described in the citing entity
inverseOf usesDataFrom

68. agreesWith

Example: We share Galileo's opinion: the Earth moves [X]
The citing entity agrees with statements, ideas or conclusions presented in the cited entity

69. providesExcerptFor

The cited entity contains information, usually of a textual nature, that is excerpted by (used as an excerpt within) the citing entity

70. providesMethodFor

The cited entity details a method that is used in work described by the citing entity
inverseOf usesMethodIn

71. providesQuotationFor

The cited entity contains information, usually of a textual nature, that is quoted by (used as a quotation within) the citing entity.
inverseOf includesQuotationFrom

72. qualifies

Example: Galileo's masterpiece 'Dialogo sopra i due massimi sistemi del mondo' [X] is formally a dialog and substantially a scientific pamphlet.
The citing entity qualifies or places conditions or restrictions upon statements, ideas or conclusions presented in the cited entity.

73. refutes

Example: We do not think that all their arguments in favour of their own and against the other strategies are equally convincing [X].
Citing entity refutes statements, ideas or conclusions presented in the cited entity

74. repliesTo

Example: We will not investigate the issues of the approach proposed in [X] here,

but rather we introduce yet another alternative.
The citing entity replies to statements, ideas or criticisms presented in the cited entity
inverseOf hasReplyFrom

75. retracts

Example: We wrote that the Earth moves in [X]; we now retire such statement
The citing entity constitutes a formal retraction of the cited entity
resource cites

76. reviews

Example: This paper discusses Toulmin’s methodology in modelling argumentation [X], focussing on highlighting advantages and drawbacks of the application of such a methodology in the Social Web
The citing entity reviews statements, ideas or conclusions presented in the cited entity

77. ridicules

Example: Galileo said that the Earth “moves” [X]; really? And where is it going?
The citing entity ridicules the cited entity or aspects of its contents

78. sharesAuthorInstitutionWith

Each entity has at least one author that shares a common institutional affiliation with an author of the other entity.

79. sharesAuthorsWith

Each entity has at least one author in common with the other entity

80. sharesFundingAgencyWith

The two entities result from activities that have been funded by the same funding agency

81. speculatesOn

Example: We believe that if Galileo believed that Earth goes around the Sun [X], he also should believe that Moon goes around Earth
The citing entity speculates on something within or related to the cited entity, without firm evidence.

82. supports

Example: We support Galileo’s statement [X], that Earth moves.
The citing entity provides intellectual or factual support for statements, ideas or conclusions presented in the cited entity.

83. updates

Example: Earth moves, said Galileo [X]; in addition, we can say now it moves very fast

The citing entity updates statements, ideas, hypotheses or understanding presented in the cited entity

84. usesConclusionsFrom

85. Example: Building upon Galileo's findings [X], we discovered that all the planets move

86. The citing entity describes work that uses conclusions presented in the cited entity

87. usesDataFrom

88. Example: Using the information collected from our recent study [X], we can estimate that there are tens of millions of HTML forms with potentially useful deep-web content

89. The citing entity describes work that uses data presented in the cited entity.

90. usesMethodIn

91. Example: We follow [X] in using design patterns for testing

92. comment The citing entity describes work that uses a method detailed in the cited entity

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Appendix D – TDL GINA Metadata Design

This appendix contains the metadata pertaining to the semantic model underlying the TRAC Digital Library. Note that the semantic model has definitions that are highly understandably SMEs, e.g. document metadata *author* is author of the document.

Additionally, this appendix provides a view of the pages that were constructed to manage the TDL and to provide the *document citations* behavior.

Table D.1 Key metadata tags in the TDL.

| | |
|---------------------------|---|
| Directory | The directory to which document is saved |
| Abstract | Entire document abstract |
| AbstractDoDClassification | Abstract classification |
| AbstractLimitation | Abstract limitation from sf298 |
| AgencyUseOnly | Agency use only |
| Approved | Approved for TDL (T/F) |
| Authors | Authors |
| ContractNumber | Associated contract number for the associated project |
| CurrentVersion | Current version number |
| DatesCoveredFrom | Project start date |
| DatesCoveredTo | Project finish date |
| DistributionCode | Distribution code |
| DistributionStatement | Distribution statement |
| DocDoDClassification | DoD classification for document |
| DocumentUpload | deprecated |
| DTICAccessionNumber | DTIC Accession Number |
| Form298Revision | 298 revision that was source of metadata |
| FundingNumbers | Dollars on associated project |
| GrantNumber | Associated grant number |
| DocumentId | The Document Unique ID |
| DocumentName | The Document Name |
| DocumentPath | The path to the stored document |
| DocVersion | Document version |
| Notes | Notes |
| NumberOfPages | Number of pages in document |
| PerformingOrg | Performing organization |
| PerformingOrgReportNumber | Performing organization report number |
| ReportDate | Report date |
| ReportType | Report Type |
| Repository | Name of the repository |
| ResponsiblePerson | Name of person responsible for report |
| SubjectCategory | Subject domain |
| SubjectTerms | Key subject terms |
| Subtitle | Subtitle for document |
| TelephoneNumber | Telephone Number for POC |
| ThisPageDoDClassification | The classification of the meta data page |
| Title | Title |

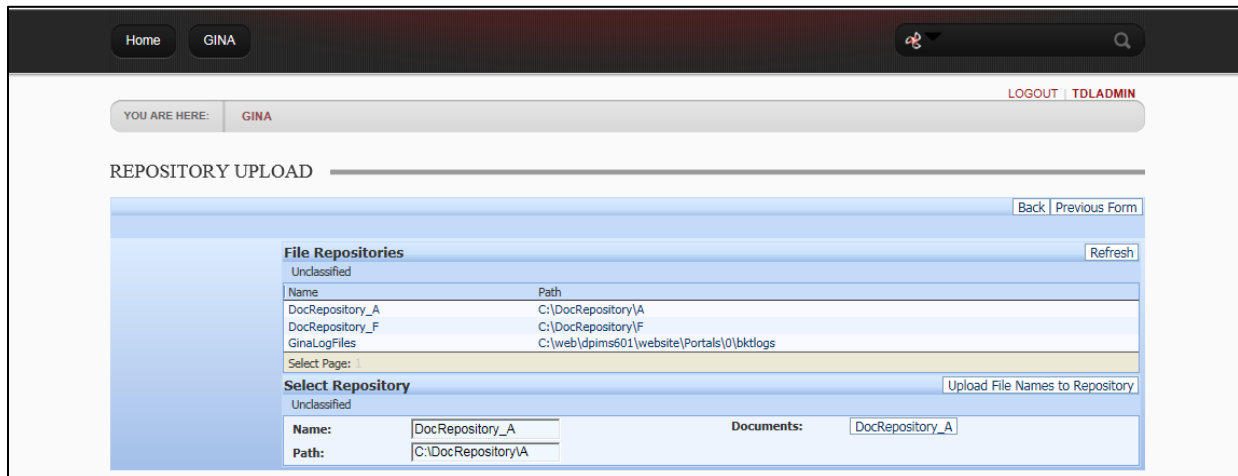


Figure D1. Administrator Repository Upload Page. Page to specify and configure the location of the repository. This allows both server location and directory specification and transparency. Management and backup of the library is rendered obvious.

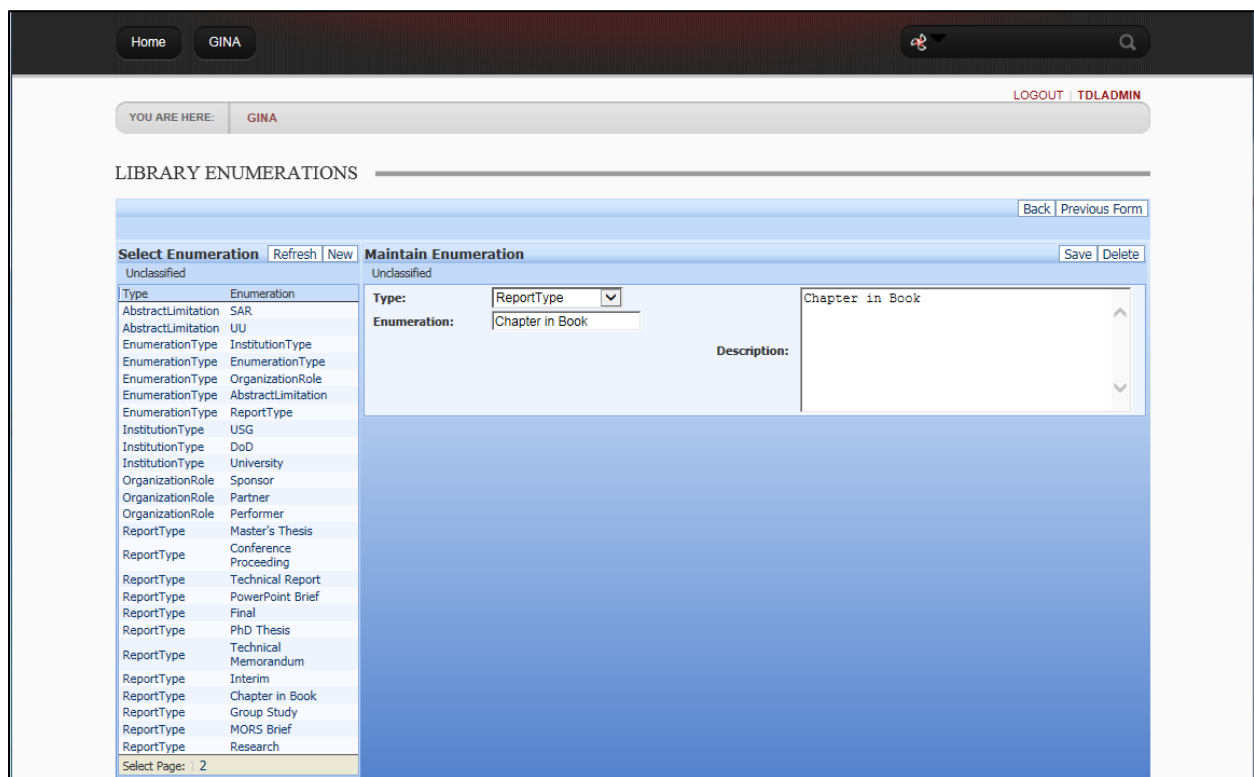


Figure D2. Administrator Library Enumerations Page. Enumerations are a way of configuring in new drop lists for the library interface. The list concepts are added here by 'listtype' and 'list' and are immediately available for library UI.

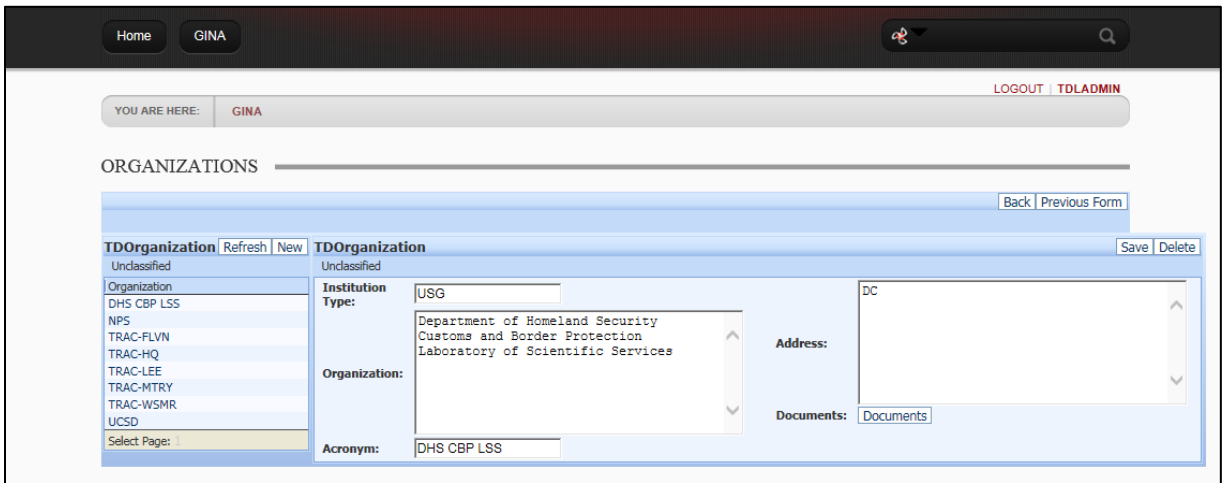


Figure D3. Administrator Organization Page. Organizations (partner and sponsor) are kept in their own concept form and available for use and association with documents.

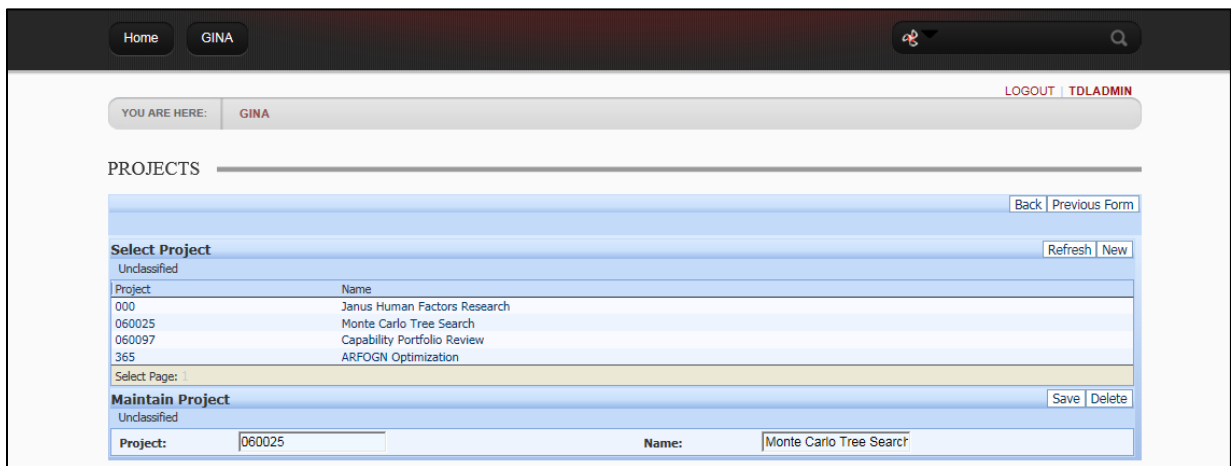


Figure D4. Administrator Projects Page. The project names and numbers are captured as a concept, allowing for the model to robustly embrace project management KM.

LOGOUT | TDLADMIN

YOU ARE HERE: [GINA](#)

CITES

Back | Previous Form

Select Cite Refresh | New

Unclassified

| Title | Authors | Document ID |
|---|--|------------------|
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Varner, M. A. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Agresti, A. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Mulaik, S. A. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Dept. of the Army | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | D'Orazio, M. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Costello, A. B., & Osborne, J. W. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Ploch, L. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Hayton, J. C., Allen, D. G., & Scarpello, V. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | DeCoster, J. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Harman, H. H. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Revelle, W. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Kulzy, W. W. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Hosmer, D. W., & Lemeshow, S. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Johnson, R. A., & Wichern, D. W. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Obama, B. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Upshur, W. P., Roginski, J. W., & Kilcullen, D. J. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | The White House | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Dept. of the Army | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Luce, R. D., & Tukey, J. W. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Kilcullen, D. J. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Kline, P. | TRAC-M-TR-12-037 |
| Africa Knowledge, Data Source, and Analytic Effort (KDAE) Exploration | Dziedzic, M., Sotirin, B., & Agoglia, J. (Eds.) | TRAC-M-TR-12-037 |
| An ARFORGEN Cycle Optimization Model | Department of the Army | TRAC-M-TM-13-030 |
| Analysis Federate | Tapestry Solutions, Inc. | 000 |
| Analysis Federate | Knight, Steven D. | 000 |

Select Page: 2 3 4 5 6 7 8 9 10 ...

Maintain Cite Save | Delete

Unclassified

| | | | |
|----------|-----------------------------|--------------|---|
| Authors: | DeCoster, J. | Publication: | 1998, Retrieved July 25, 2012, from http://www.stat-help.com/notes.html |
| Title: | Overview of Factor Analysis | Document: | Africa Knowledge, Data Source, and Analytic Effort |

Figure D5. Citation Page. Each document may have the citation data entered in the TDL model so that it is readily viewable upon document research. The metadata associated with cited documents are; authors, title, Publication, and citing document.