



**Joint All Domain Information System (JADIS)
The Sea Land Air Military Research initiative (SLAMR)
Naval Postgraduate School (NPS)
FY21 Joint Distribution Deployment Enterprise
Phase I White Paper**
Period of Performance: 1 October 2022 – 30 September 2025

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Fiscal Year	Estimated Investment

Total

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PROJECT DESCRIPTION

Background.

Mission planners and decision-makers need to access data and information contained in organizationally developed, aligned, and maintained data repositories to effectively and efficiently plan missions involving air, ground, sea, rail, and other resources. U.S. Transportation Command (USTRANSCOM) Joint Distribution and Deployment Enterprise (JDDE) stakeholders need to access such data repositories, which may not have been designed with current and future JDDE requirements in mind. Use of commercial transportation resources, in addition to U.S. Department of Defense (DoD) assets, exacerbates the workload and challenges placed on JDDE personnel to access, collate, and maintain current information critical to operational mission success.

Furthermore, the information needs to be tailored to individuals and their JDDE roles. Simply put, the Commander has different information needs than a mission planner and the system should provide information tailored to those needs.

Purpose.

The primary objective of this research is to investigate, develop, and deliver technologies that automate data extraction from DoD and commercial data sources to the maximum extent possible and create an information-centric knowledge management layer with curated information and visualizations tailored to the role-based needs of JDDE personnel.

USTRANSCOM JDDE CHALLENGES

The close synchronization required to effectively and efficiently orchestrate the movement of personnel and cargo across its global area of operations requires USTRANSCOM personnel to rapidly access data on the availability of the personnel and material to be moved plus Air Mobility Command, Surface Deployment and Distribution Center, Military Sealift Command, and commercial partners at a moment's notice.

USTRANSCOM's mission is unique in the fact that it does not direct all the organizations and agencies that accomplish the missions of mobilization, deployment, sustainment, employment, and redeployment. Rather, as an orchestrator, USTRANSCOM must collaborate rapidly, with many partners, to ensure the supply chain operates effectively and efficiently.

- USTRANSCOM RDT&E webpage

This research project addresses the need for a transformative capability that delivers decision-support needed for USTRANSCOM's global transportation network. Furthermore, the project directly supports the following focus area(s) identified in the JDDE Call for Government-Proposed Research, Development, Test, and Evaluation Projects, FY23-FY27:

- Knowledge Management: The operational and technical requirements of an effective near real-time global transportation network cannot be achieved through the application of legacy data-centric software design and development principles. Such a network calls for a degree of interoperability and a level of collaborative decision-support that is not available in any existing industry or government software environment of comparable scale.

USTRANSCOM is looking to create an information-centric knowledge management layer on top of a data-centric Corporate Data Environment meta database layer.

- Risk Assessment: There is a lack of available real-time risk assessment information for commanders and deploying units to rapidly determine acceptable levels of risk while en route to final destinations or to an intermediate staging location. Interested in technologies, to include AI/ML enabled modeling of contested environment/attrition effects, to address this gap.

PROJECT INFORMATION

Technical Merit.

The SLAMR has developed application-agnostic data collection, curation, and visualization architectures that use metadata-centric methods to provide tailored and automatically updated information to users. Furthermore, these architectures are accessible from public, .mil, and .gov internet domains and hosted in a Department of the Navy (DoN)-accredited Information Impact Level 4 (IL4) environment. The research and data engineering environment supports development and deployment of automated web crawling, data harvesters, and Machine Learning algorithms that will be used in the project.

The broader solution to disparate datasets lies in a database structure that encourages schema changes and preserves relationships between each piece of data, regardless of its source. The key to deep analysis of data is a structured relationship mapping for each piece of data and its neighbors. Graph databases can be used to store data in a central location, preserving the relationships between each piece of information and its neighbor. Graph databases allow for schema changes over time, which traditionally are costly and time consuming to implement. While a key component, the graph data architecture is just part of the much more robust solution.

Our solution proposes to streamline the data collection processes and formatting of incoming data programmatically creating relationships between different data points both from the incoming data stream and pre-existing data entities in the dataset. The connections between each data entity enable graph data to be intelligently and rapidly queried for answers to ad hoc and predetermined operational questions, such as if cargo will be at the air- or sea-port when the aircraft arrives. Query strings, for example, can be written to transverse across different subsets of the database, meaning the same database can be used by different JDDE members, each with their own missions and priorities.

The roadmap for this project will include data consumption using an analyst portal, a document database, and a linked graph database which can be deeply queried for questions that are expensive or cannot be answered with disparate datasets. Later phases will investigate training a Machine Learning (ML) analyst to search for data from DoD and commercial data sources to be entered into the dataset, as well as a ML-based capability to identify and recommend relationships between new and previously entered data in a human-on-the-loop framework.

Technology Maturity.

The candidate solution builds upon existing component prototypes at Technology Readiness Levels (TRLs) 4 and 5, which will be matured to TRL 7 by the project's completion.

Anticipated Benefits.

“Dirty data costs the [U.S.] economy up to \$3.1 trillion a year and organizations have been trying to deal with it by...by hand.”¹ Those surveyed reported spending 19% of their time collecting data and approximately 60% of their time “cleaning” data.² Preliminary pilots had returns on investment (ROIs) of 300% and higher. The project’s quantitative ROI will be refined when Research Team members are able to gather information from USTRANSCOM Subject Matter Experts (SMEs).

Additional benefits include: (1) a prototype R&D network environment accredited by the DoN for IL4 operations at NPS for use in formal experimentation that will remain available at project conclusion³; (2) an operational testbed and repository for Machine Learning and Artificial Intelligence algorithms; and (3) a gateway to non-U.S. DoD transportation and R&D ecosystem members.

Performance Metrics.

Tailored performance metrics will be developed after speaking with USTRANSCOM SMEs. Preliminary ones, assuming USTRANSCOM personnel predominantly use email, telephone, and web-based methods to collect, manage, and disseminate information, are estimated to reduce:

- data collection costs by 50%, and
- the time to disseminate information by 50%.

Use in/by non-DoD Organizations.

In addition to the relatively significant body of research on complex workflow automation, data engineering and architectures, and Artificial Intelligence and ML algorithms, an industry partner has developed an advanced automated data harvester used in the pharmaceutical sector and by Fortune 500 companies. Available capabilities, however, do not cross public and .mil internet domains, generally recreate existing databases at tremendous expense, and generally do not exploit gains from graph data schema and metadata-centric ML algorithms.

System Integration.

The design approach and capabilities are largely application-agnostic, which permits them to be deployed using tools/technologies available to USTRANSCOM. It is assumed data from Corporate Data Environments can be extracted and added via Application Programming Interfaces in common commercial data formats. While some capabilities require a general software capability, such as a graph database application not tied to a specific application, advanced automated data harvesting capabilities, for example, may require commercial solutions.

¹ Shacklett, M. (2018, May 17). Tech Republic: 4 tips for making data cleanup easier and more efficient. Retrieved from <https://www.techrepublic.com/article/4-tips-for-making-data-cleanup-easier-and-more-efficient/>.

² Press, G. (2016, March 23). Forbes: Cleaning Big Data: Most Time-Consuming, Least Enjoyable Data Science Task, Survey Says. Retrieved from <https://www.forbes.com/sites/gilpress/2016/03/23/data-preparation-most-time-consuming-least-enjoyable-data-science-task-survey-says/#2ecda5cc6f63>.

³ “Level 4 accommodates [Controlled Unclassified Information (CUI)] and/or other mission critical data to include that used in direct support of military or contingency operations. CUI is information the Federal Government creates or possesses that a law, regulation, or Government-wide policy requires, or specifically permits, an agency to handle by means of safeguarding or dissemination controls. CUI requires protection from unauthorized disclosure,” according to the DoD Cloud Computing Security Requirements Guide (p. 26).

After detailed information is gathered from USTRANSCOM SMEs, a specific integration roadmap will be developed. The roadmap will be used to methodically and systematically transition and integrate project capabilities.

Research Team.

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DELIVERABLES AND SCHEDULE

Task No.	Description	Completion Date
1	Establish R&D environment	28 Feb 2023
2	Streamlined data input tool, API, and document and graph databases	31 May 2023
3	Data harvesting from JDDE and other known viable datasets	31 Jul 2023
4	Data input tool user acceptance testing	30 Sep 2023
5	Robotic Process Automation capability demonstration	30 Nov 2023
6	ML algorithm development and training	30 Nov 2024
7	Finalize and harden API layer for prototype deployment	31 Mar 2025
8	Role-based User Experience and visualizations	31 May 2025
9	System integration and demonstration	30 Sep 2025

Multiple conference papers, journal papers, and/or theses will document the work enabling widespread application of lessons learned.

Appendix

Joint All Domain Information System Operational View-1

