



Anomaly Detection on US Army OTC Level 1 and Level 2 Data from Structured and Unstructured Data Sources

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Topics for Discussion

- US Army's Doctrine for Engaging Long Range Targets: Key Operational Test Elements.
- Process of Test Planning and Data Reduction.
- An Overview of the Multivariate Data Workbench (MVDW)
- Support Provided by MVDW; Viewing and Analysis of Disparate Data Types
 - Network Analysis
 - Accuracy of Fire
 - Operational Test (OT) Mission Thread Analysis
- Summary



Major OT Elements In US Army M109 Paladin Battery Engaging Remote Target



Six M109s In Battery



Threat Convoy Target (3 to 15KM)

5 to 30 KM Range



Forward Observer



Major Coms Links

Fire Direction Center

3 to 6 KM

- Engagements of remote targets by artillery is a complex process.
- Targets are “fleeting” sometimes lasting no longer that 15-30min in engagement window.
- The Doctrinal Process governing these Engagements must assure safety of friendly troops while being flexible enough to capture “targets of opportunity”

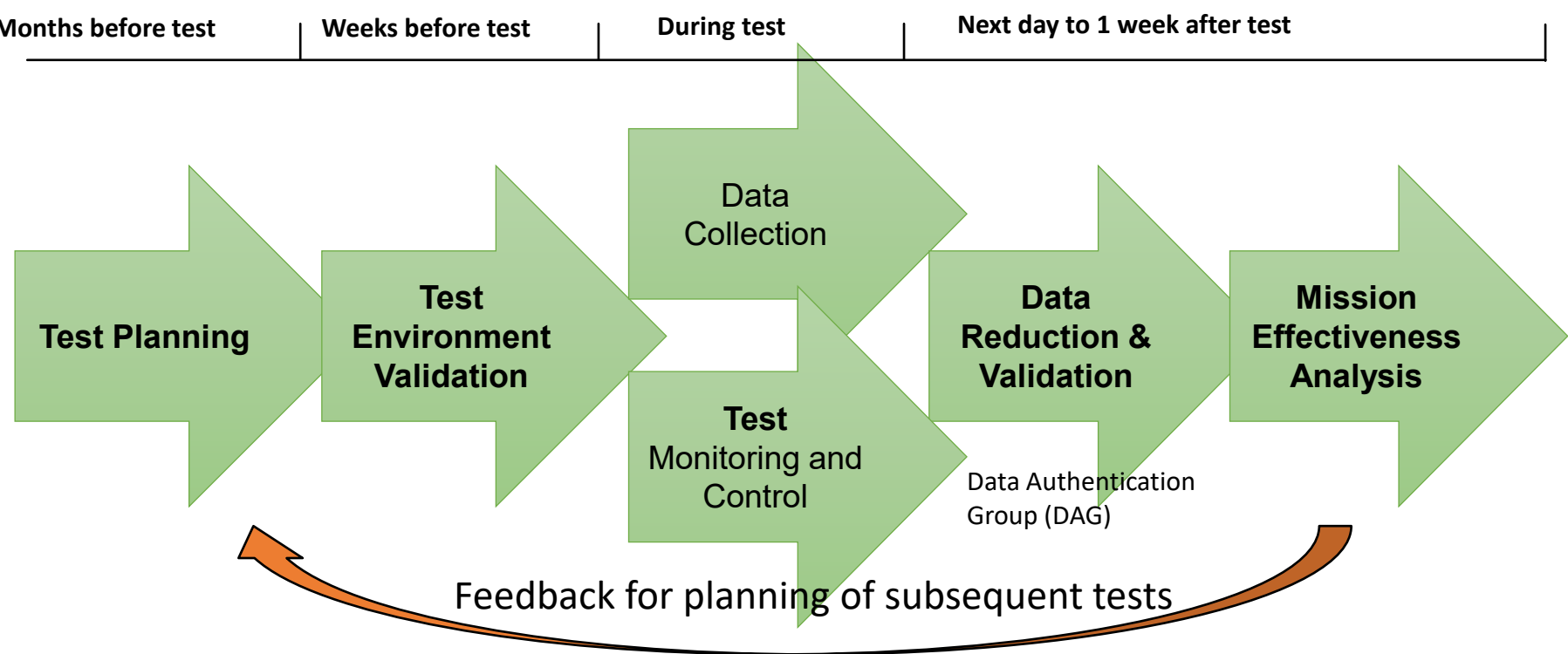


Steps in Testing Indirect Fire Doctrine for US Army

- Engagements of remote targets by artillery is a complex process.
- Targets are “fleeting” sometimes lasting no longer than 15-30 minutes in engagement window.
- The Doctrinal Process governing these Engagements must assure safety of friendly troops while being flexible enough to capture “targets of opportunity”.
- Message types indicate steps/information in the Call For Fire Process beginning with Forward Observer
 - Observer Identification and Warning Order (contains forward observer location and type of fire)
 - Target Location
 - Target Description method of engagement, fire type and method of control
- The Warning Order clears the Net for the fire mission and tells Fire Direction Center (FDC) type of mission needed. Warning Order also describes target type and size.
- The FDC then executes the Fire Mission with selected Battery.



Operational Test Command (OTC) Process that Requires Big Data Analytic Capabilities

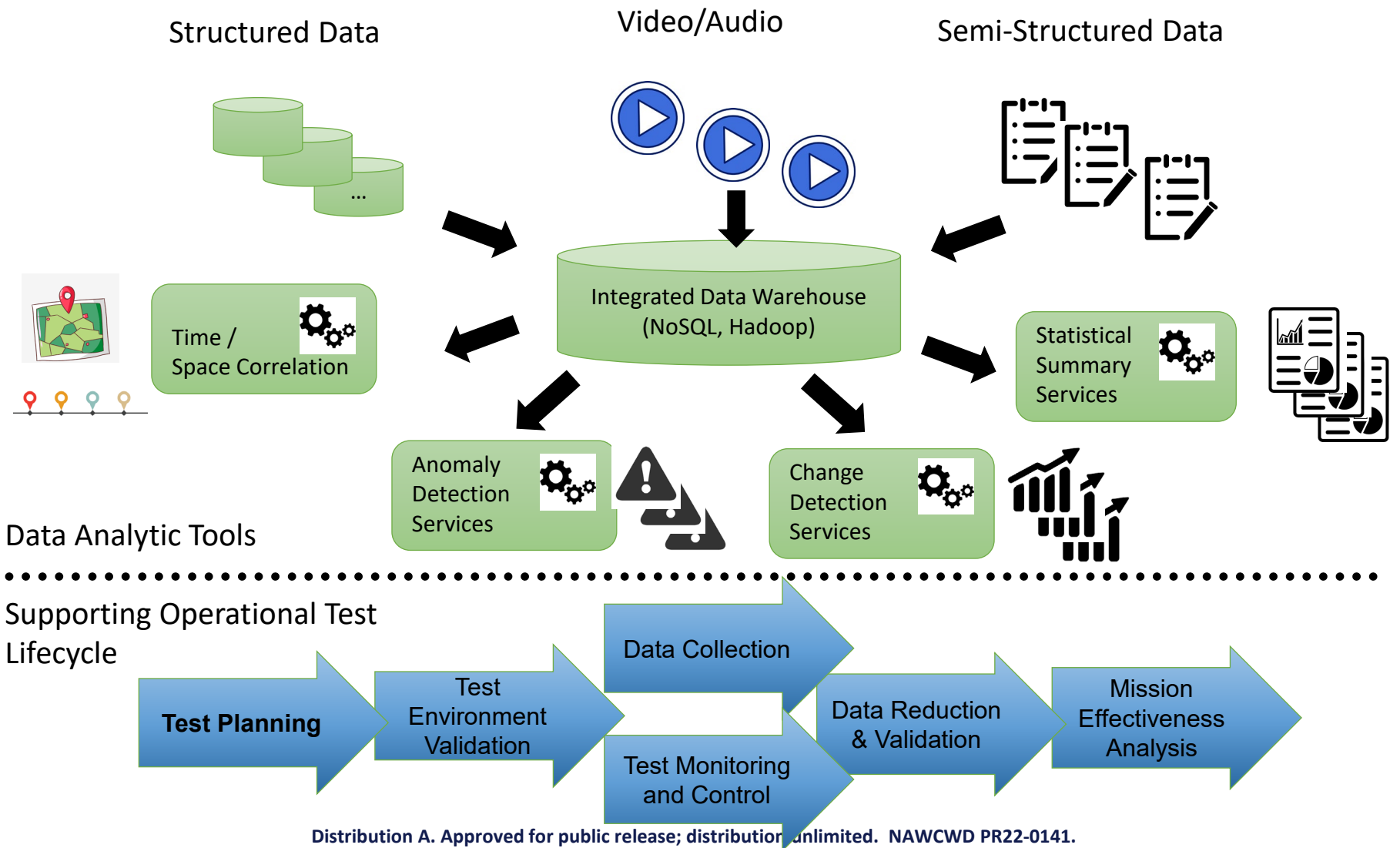


Common Needs Across these Processes:

- Ability to correlate across multiple data streams/data types
- Ability to view data correlated across multiple dimensions—time, geospatial, organizational (hierarchy and information exchange)
- Ability to recognize patterns within and across data streams
 - Identify problems/incidents
 - Identify key events



OV-1/SV-1





Multivariate Data Workbench Primary Support

The Workbench and the underlying analysis capabilities are intended to address the following questions:

1) Was all the data collected?

Currently the Fire Support Test Directorate utilizes visual displays for identifying missing data. With the use of MVDW, missing data will be highlighted automatically.

2) Is the data collected of sufficient quality, i.e., are there anomalies?

Currently the Fire Support Test Directorate utilizes visual displays for identifying data anomalies. With the use of MVDW Artificial Intelligence (AI) software, anomalies will be highlighted automatically.

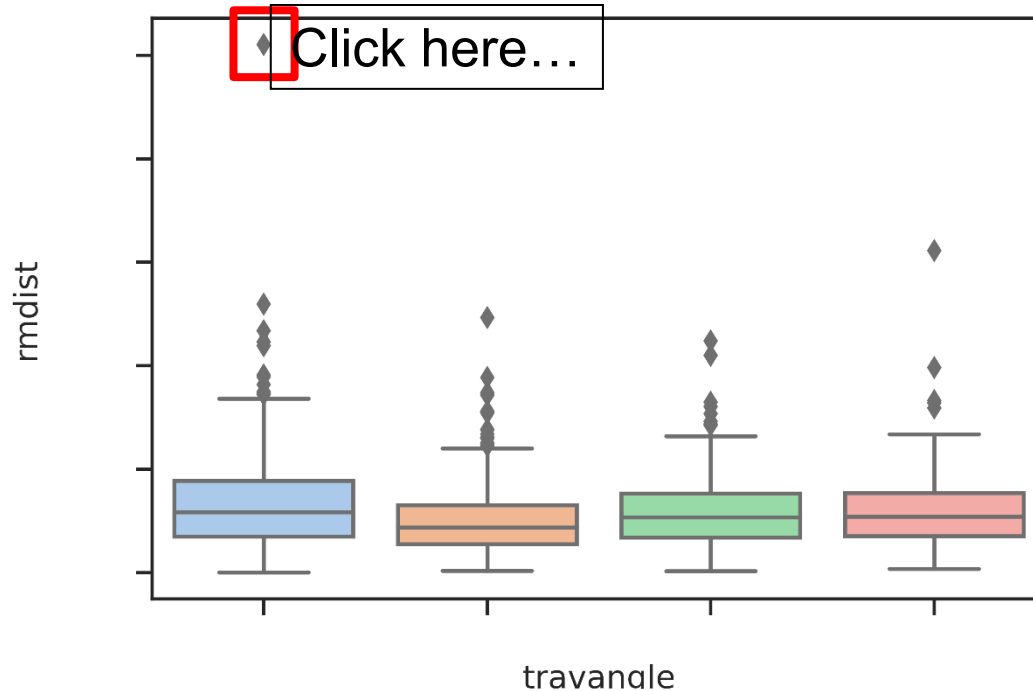
3) Is the data sufficient to analyze tests objectives?

Currently the Fire Support Test Directorate must utilize Operations Research Systems Analysis (ORSA) to relate test objectives to data. Utilizing MVDW software, a first level effort will be automatically made to relate specific data to test objectives.



Accuracy of Fire Regarding Target: Boxplot View

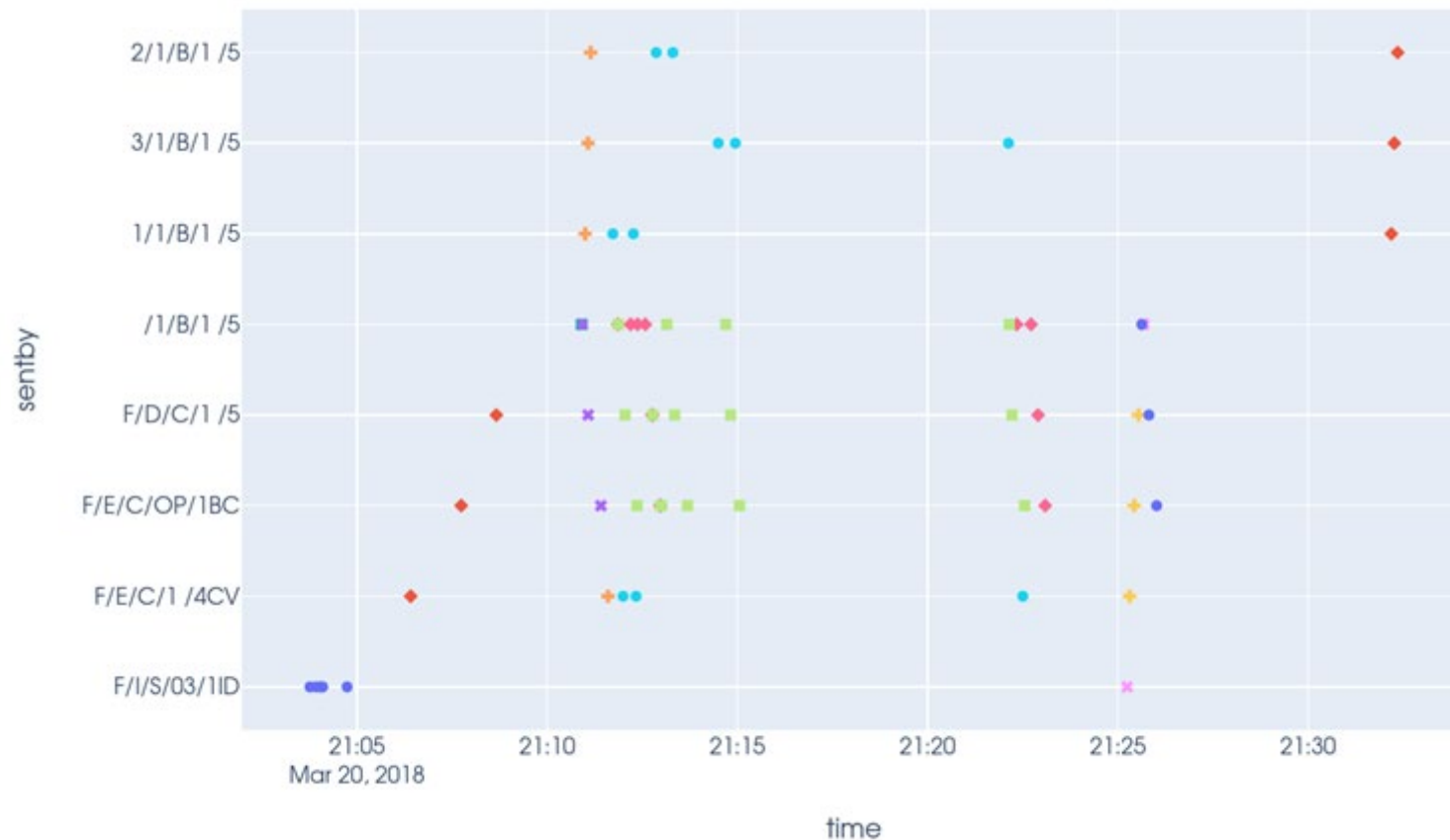
Radial Miss Distance by Angle of Traverse



There is a very large outlier in the experiment with a low angle of fire and a small angle of traverse.



Timing of the Mission Thread; Interactive Plotting of Doctrinal Events



- Messages sent over time, broken out by message type within a mission
- ORSA can see who said what, when, and use their knowledge to check collection integrity



Summary

- C4T is developing Big Data Analysis tools (Multivariate Data Workbench) to support doctrinal Operational Testing of the Army's Fire Support Test Directorate, Fort Sill OK
- MVDW provides the ability to display, correlate and identify outliers in disparate types of data.
- Data Reduction Time for OT is expected to be reduced from a week to 6 hours

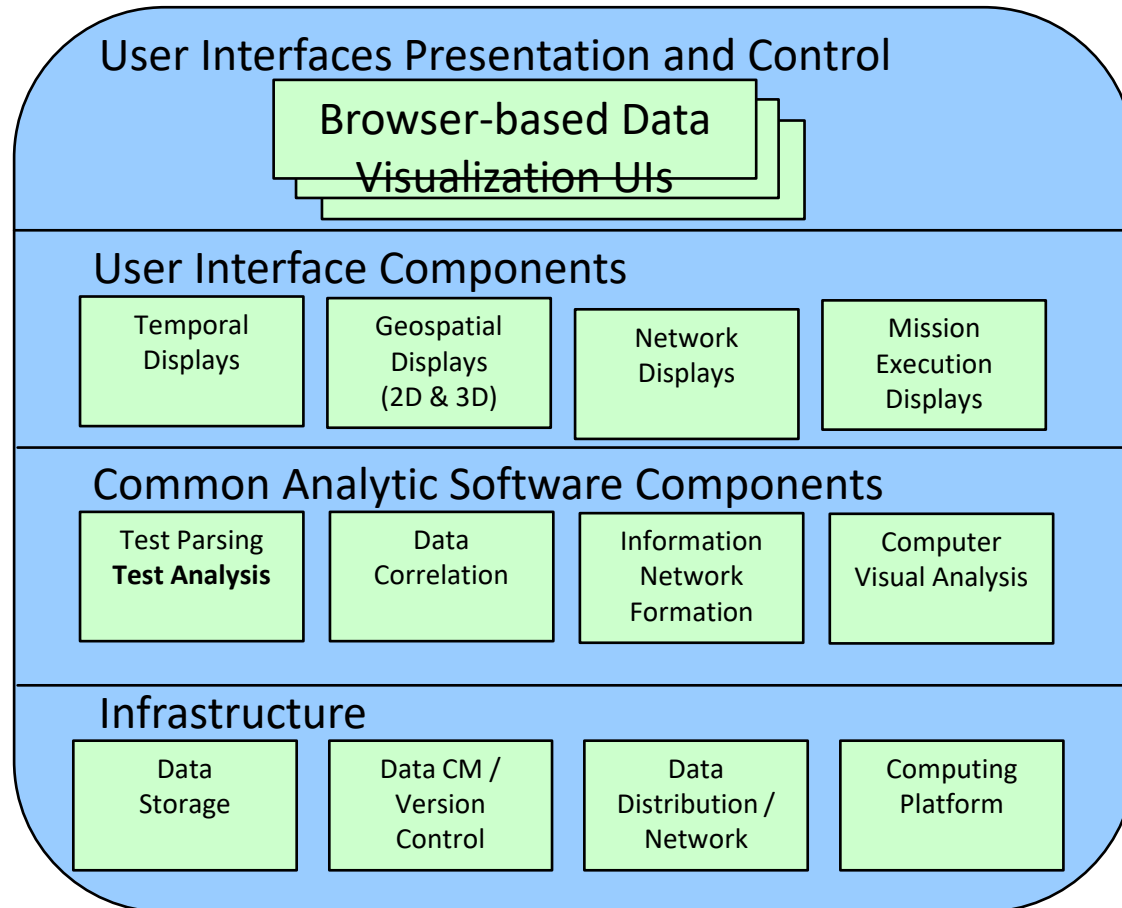


Backup Slides



Overarching Concept

A data workbench, based on core capabilities and technologies that provides meaningful displays to the OTC user





Network Analysis

- Network analysis allows the ORSA to easily find problematic nodes and do root cause analysis
- Upon discovering the identity of unidentified nodes, the ExCIS reducers can update the ExCIS plan configuration to assign correct role information
- As the test progresses, roles are constantly entering and leaving the network, requiring fast investigations into network problems