

INSTITUTE FOR DEFENSE ANALYSES

Data Principles for Operational and Live-Fire Testing

Rebecca Medlin, Project Leader

John Haman Matthew Avery

August 2023

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IDA Document NS - 1038201

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About This Publication

This work was conducted by the Institute for Defense Analyses (IDA) under contract HQ0034-19-D-0001, Task C9082, "CRP Statistics Work Group." The views, opinions, and findings should not be construed as representing the official position of either the Department of Defense or the sponsoring organization.

Acknowledgments

The IDA Technical Review Committee was chaired by Dr. V. Bram Lillard and consisted of Dr. Keyla Pagan-Rivera, Mr. Addison Adams, Dr. Brian D. Vickers, Mr. Christopher T. Dimapasok, and Dr. Curtis G. Miller from the Operational Evaluation Division.

For more information: Dr. Rebecca Medlin, Project Leader rmedlin@ida.org• (703) 845-6731

Dr. V. Bram Lillard, Director, Operational Evaluation Division vlillard@ida.org • (703) 845-2230

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Executive Summary

The Department of Defense is taking steps to improve its management of data. In 2021, Deputy Secretary of Defense Kathleen Hicks issued the memorandum "Creating Data Advantage," which coincided with a shift in the department toward viewing data as a strategic asset. Since the publication of the memorandum, the test community has questioned how the five data decrees may be applied to its work. In this presentation we discuss the effort by Institute for Defense Analyses to apply the data decrees to test and evaluation. Data is a critical component of operational evaluations, because any independent and unbiased assessment of system effectiveness and suitability must be based on quality and trustworthy data. While this is already standard operating procedure, the processes DOD employs to obtain, store, clean, and distribute data could, in our view, benefit from modernization.

In this presentation, we review the typical process through which test data contribute to operational evaluations of system performance, which we call the test data workflow, and provide some examples of substandard data practices. For example, it's not uncommon to receive a scanned PDF of handwritten test data or to transcribe the data yourself in a notepad. Both of these data collection methods are prone to user error. Such substandard practices could be eliminated or formalized with better planning and procedures.

Our contribution is a set of recommendations that we believe – if implemented and resourced – would result in better test data management and distribution. Most importantly, we advocate that testers include data management and distribution plans in test plans. The following is a complete list of testing data principles:

- 1. Data should be discoverable and accessible to analysts.
- 2. Data should come with documentation.
- 3. Data should be stored in open-source or interoperable formats.

First given at the Joint Statistical Meetings in Toronto, on 7 Aug 2023

- 4. Operational test agencies and test ranges should develop and use standard, consistent data formats or schemas.
- 5. A data management and distribution plan should be included as part of a program's test plans.

For each of the proposed data principles, we discuss the specific problem that the principle addresses, our recommended implementation of the principle, and our motivation for including it. We end the presentation by determining which data principles strengthen specific aspects of the test data workflow.



Data Principles for Operational and Live-Fire Testing

Dr. John T. Haman Dr. Matthew R. Avery

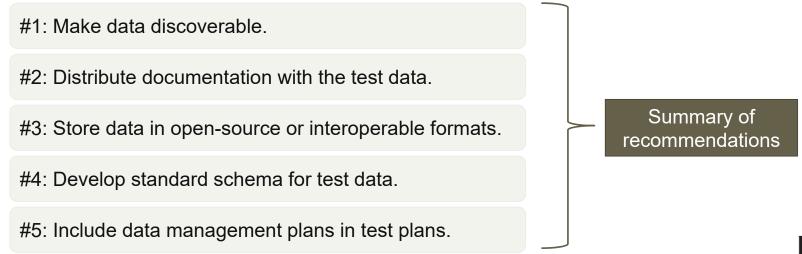
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Summary

- In recognition of data as a strategic asset, DOD issues five Data Decrees in 2021.
 - How best to apply the data decrees to test and evaluation remains a work in progress.
- IDA works on guidance to DOD on data standardization and other data issues.



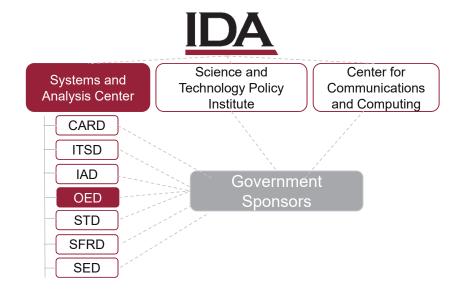
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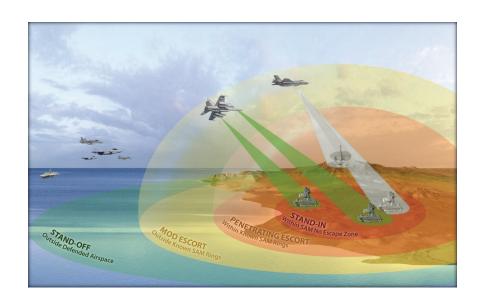


IDA operates three Federally Funded Research and Development Centers.



Goal of operational test: Evaluate operational effectiveness and suitability.

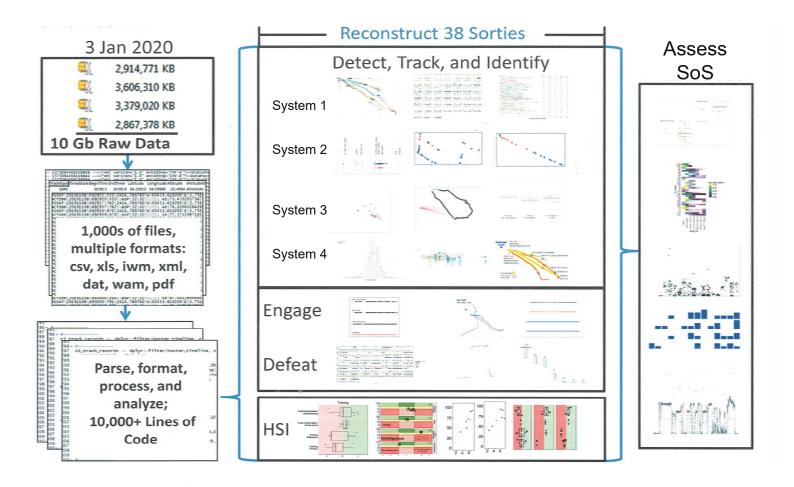
- Operational environment
- Representative users
- "Real" threats
- Conduct missions against a red team with intent to win



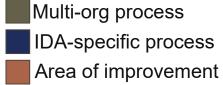
Operational evaluation depends on trustworthy data!

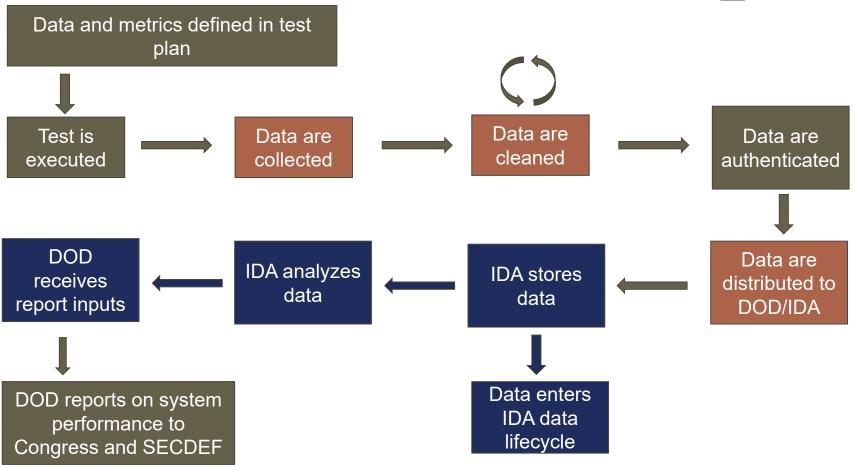


Multimillion-dollar program decisions depend on our data management procedures!



The test data workflow





State of the art of DOD data management and distribution practices





Phone call from observer at range



You get a hard drive in the mail 3 months later





Transcribe the data yourself (prone to user error!)

Date	Open	High	Low	Close / Last	Volume
01/04/2017	117.55	119.66	117.29	118.69	19.594,560
01/03/2017	116.03	117.84	115.51	116.86	20.635,600
12/30/2016	116,595	116.83	114.7739	115.05	18.668,290
12/29/2016	117	117.531 116.06		116.35	9,925,082
12/28/2016 118.19		118.25	116.65	116.92	11.985.740
12/27/2016	116.96	118.68	116.864	118.01	12,034,590
12/23/2016	117 117.56 11		116.3	117.27	10,885,030
12/22/2016	118.86	118.99	116.93	117.4	16.226,770
12/21/2016	118.92	119.2	118.48	119.04	10,747,610
12/20/2016	119.5	119.77	118.8	119.09	13,673,570
12/19/2016	119.85	120.36	118.51	119.24	15,871,360
12/16/2016	120.9	121.5	119.27	119.87	25,316,220
12/20/2016	121,1	A23.5	119.27	719.87	25,316,220

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But DOD is trying to do better...

Recent History:

- DOD Data Strategy in 2020
- DSD Kathleen Hicks issued "Creating Data Advantage" memo in 2021.
 - DOD names first Chief Data Officer
 - Five "Data decrees"
 - DOD Data Counsel
- Several DOD offices merge to form CDAO in 2022.
- CDAO issues Guidance on Metadata in 2023.

And why does this matter?

Lack of standards results in inconsistencies across the test and evaluation (T&E) community and, in many cases, within organizations.



IDA has documented several data recommendations to DOD.

- We drafted a memo to DOD: "Data Principles for Operational and Live Fire Test and Evaluation."
- Key word is "principles" we are making baby steps in the department.

#1: Data should be discoverable and accessible to analysts.

What is the problem?

Only way to get access is to know who to talk to.

What we recommend:

Test organizations should provide fast and simple access to test data for stakeholders.

Programs could do this by establishing data repositories.

Why it matters:

Current onboarding process to a program depends on your org's data management practice.

Provides a common operating picture of program data

Improves visibility and transparency

#2: Data should come with documentation.

What is the problem?

Lots of analyst time is spent on determining what the data means and how it is structured.

What we recommend:

Documentation should be distributed alongside and stored with the test data.

Data should come with documentation that includes the following:

- A complete description of the data, the steps taken to process data
- A dictionary that provides plain descriptions of each data field
- A description of the context and conditions for the collection of a dataset
- Markings for data that have passed a data authentication group

Why it matters:

Metadata would help query and archive data, extend the "shelf life" of data, and help the analyst come back to the data more easily.

This aids in reproducibility.

#3: Data should be stored in open-source or interoperable formats.

What is the problem?

Data formats can lock the government and all partners into software.

What we recommend:

Use open-source, or interoperable data formats.

Why it matters:

Data format should be "future proof."

Software can change independent of data format changes.

#4: Operational test agencies and test ranges should develop and use standard, consistent data formats or schemas.

What is the problem?

Some analytic effort expended just due to using different data formats for similar situations

What we recommend:

DOD, mainly the Range Commanders Council, has worked to standardize numerous kinds of test data and metadata. We should amplify this work.

Why it matters:

Procedures foster consistent approaches, improve analyses, and maximize opportunities to find errors.

Standardized formats can reduce the amount of custom data cleaning code needed.

#5: A data management and distribution plan should be included as part of a program's test plans.

What is the problem?

Lack of planning slows down evaluations, because problems with management and distribution will occur.

What we recommend:

Programs should create a plan to manage and distribute all the test data produced.

The data management and distribution plan should describe who controls access to data and how users gain access.

It should also account for special handling of sensitive data.

Why it matters:

Approaching data management with intentionality should allow the test community to eliminate reliance on ad hoc procedures.

#1: Make data discoverable. The test data workflow #2: Distribute documentation with the test data. #3: Store data in open-source or interoperable formats. #5 #4: Develop standard formats. Test is planned – data measures #5: Include data management plans in test plans. defined #1 #2 #3 #4 #3 #4 Data are Test is Data are Data are cleaned collected executed authenticated #5 DOD Data are IDA analyzes **IDA** stores receives distributed to data data report inputs DOD/IDA Data enters DOD reports on system **IDA** data performance to Lifecycle Congress and SECDEF

Where to go from here?

- Guidance is easy compared to implementation.
- Implementation requires studying the problems and getting concurrence from all stakeholders.
- Change needs resourcing.

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