
Maximizing the Utility of Data and Emerging Technology with System of Systems and Big Data Analytics

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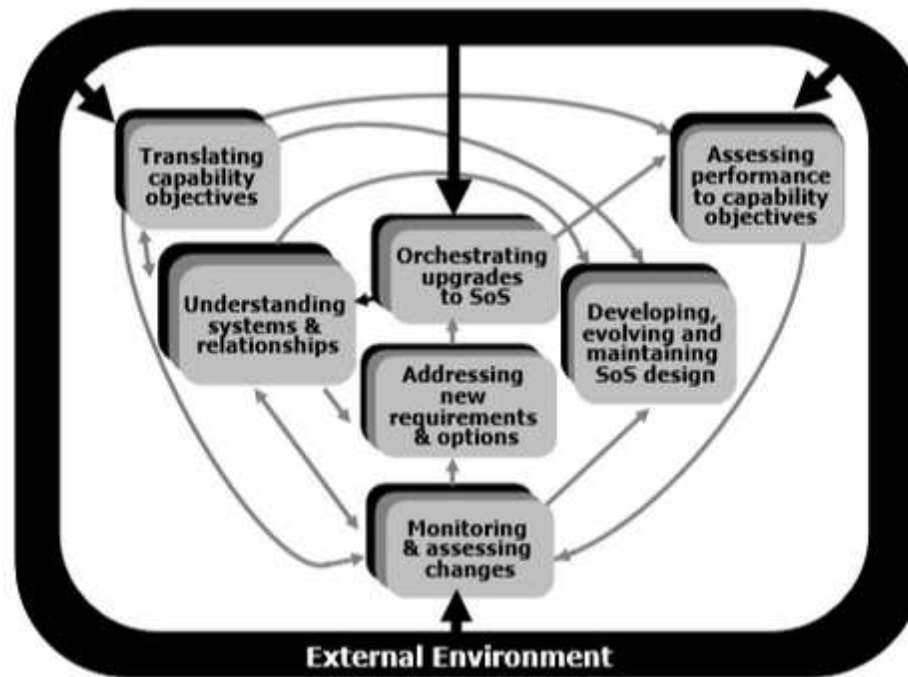
Claudia Rose

I am an enthusiastic Enterprise Architect and Systems Engineer with a background in combat and weapons systems development. I see the world in models and am excited that today we can actually automate machines to help us make sense out of data.

We can use the models that were used all this time for engineering to actually drive data analytics to gain a deep understanding and ability to predict behaviors over an extended problem space.



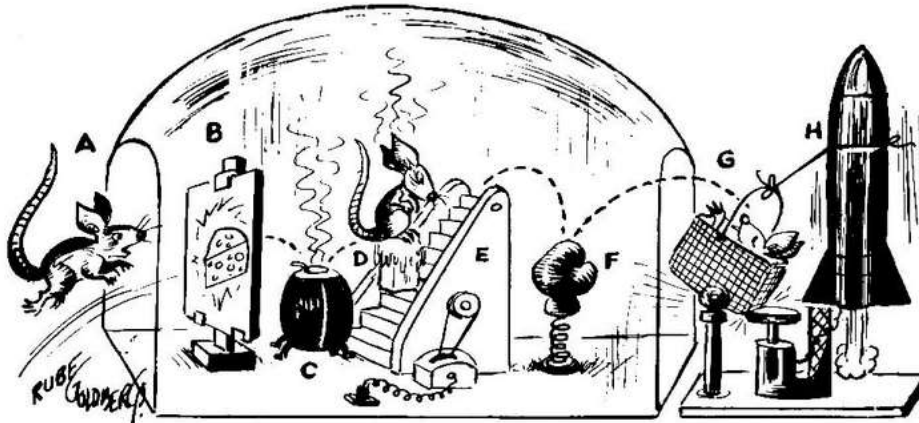
SoS Models, Machines for a Third Offset Solution



“A Model of Systems Engineering in a System of Systems Context” Baldwin, Dahmann, Lane and Rebovich (paper # 215 CSER)

The System

How to Get Rid of a Mouse



Drawn for Newsweek by Rube Goldberg

RAT PATROL

Humane, Effective, Long-term Solutions

The Tree House Cats at Work Project is a "green" humane program that removes sterilized and vaccinated feral cats from life-threatening situations and relocates them to new territories where their presence will help control the rodent population. Caretakers humanely manage the cats for the entirety of their lives with ongoing support from Tree House, as mandated by Cook County's "2007 Managed Care of Feral Cats Ordinance." The cats' presence alone repels rodents, causing them to leave the cats' new territory. Cats will also hunt and catch rodents on occasion, but when they are fed regularly (as mandated by the program), they usually won't eat them.

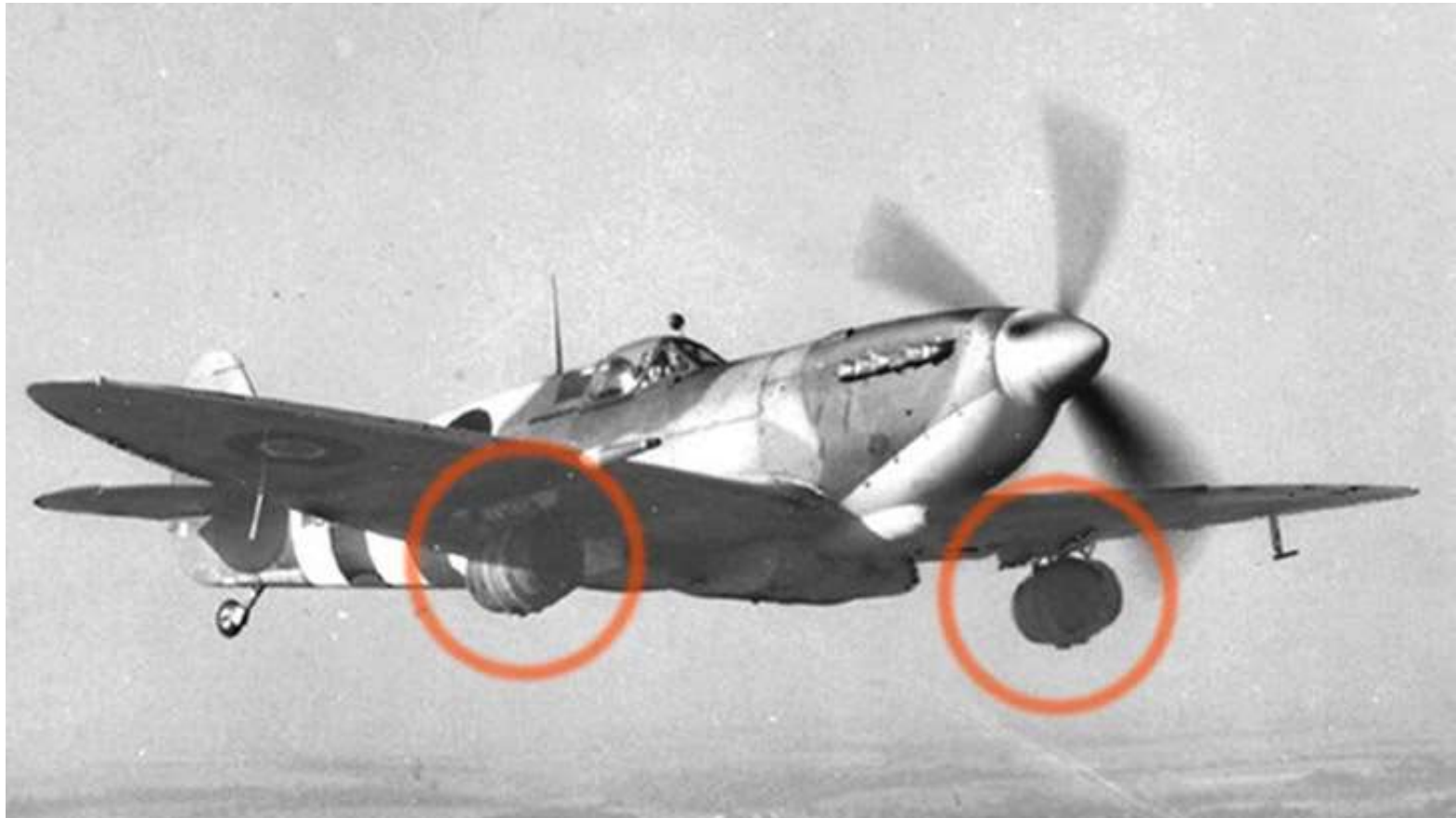
<http://www.treehousecats.org/site/AboutUs/AboutUs.aspx>



Tree House
Humane Society



A Spitfire Delivers Kegs of Beer To The Troops In Normandy



Live, Virtual, Constructive Model



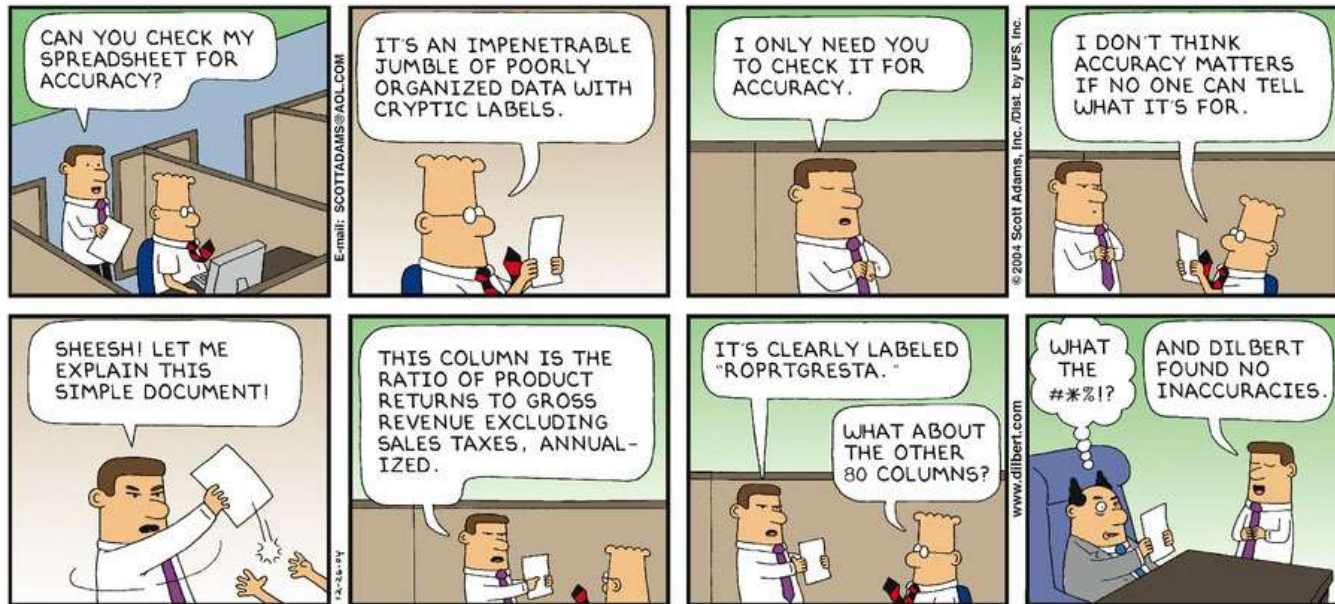
What do I mean by “Big Data”?



What is exciting about the Big Data Concept are the tools surrounding the management of many complex data systems, including managing unstructured data, reusing data, easily finding data, and most important, finding new patterns in all the existing information and new insights form when our needs and understanding change.

Graphic copyright 1-9-13 Scott Adams, Inc

Unstructured Data



The value of vast data stores and new BD tools is the ability to find meaning, connections and structure. This requires an understanding of systems and users that can capture many viewpoints and adapt quickly. Engineers have been modeling the world around them for centuries in order to understand elements too large or complex for them to easily grasp. SoS Models allow us to manage larger pools of information and harness computers to help us find manage the “mess” and find meaning and relationship patterns. We drive the process with models.

Why do We need these tools now?

Growing information streams

Rapidly changing technology based threats

Need to reconfigure and reuse capabilities quickly

The need to manage vast sets of relationships and data sets to control our cyber and physical space and defend against diffuse and adaptive threats.

What is the Sizzle?

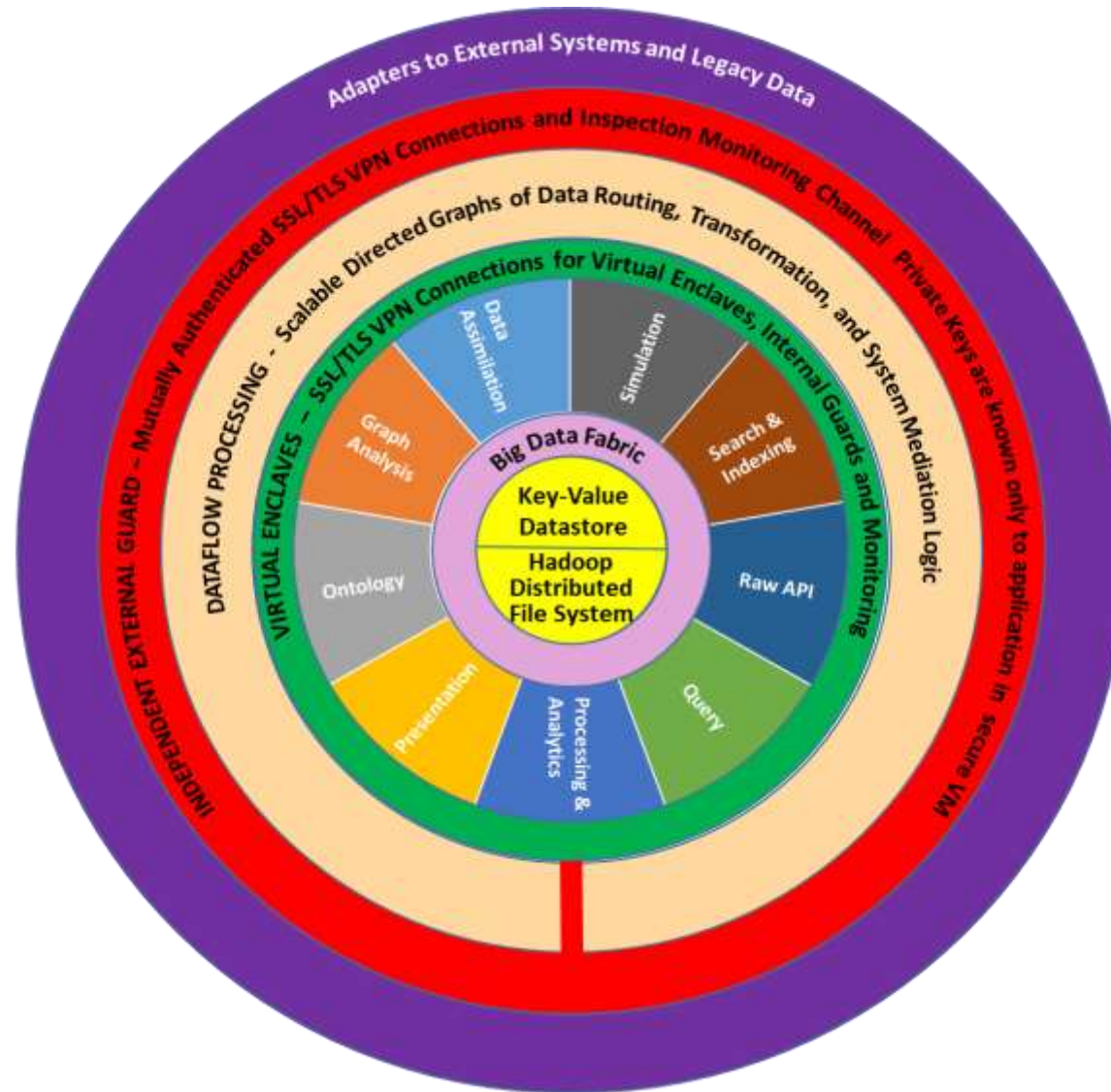


Source: Gartner (July 2016)

Figure 1. Hype Cycle for Emerging Technologies, 2016

Source: Gartner (August 2016)

Big Data Infrastructure and Analytics



SoS models and MBSE are endorsed by “everyone” but rarely understood..

- Models must capture behaviors and functions of the system, represent the needs of the stakeholder and express them in the language(s) of the analyst and their end user.
- Models enable Discovery and understanding
- Models representing knowledge of how things work and relate
- Models for navigation
- Models can join diverse understanding into single viewpoints
- Models for housekeeping
- Models support trust including provenance and transformation mechanisms.

Using Models for Data

- Provide structure based on experience and knowledge of best practices
- Use as a tool to discover the users perception and needs
- Repository of connected Knowledge to allow discovery
- Do the housekeeping of relating elements that is otherwise impractical
- Bridge the gaps between those that need information and those that generate it
- Create the links between data and management tools
- In other words serve as a translator between my customer, the system, the data, and the machines that can help

Information Model, practical breakdown of the elements

Identifying and Classifying the elements (Elephants)



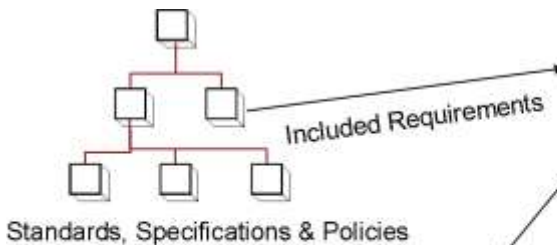
Situational awareness * Combat capacity "extreme performance"

Software defined aircraft "information fusion"

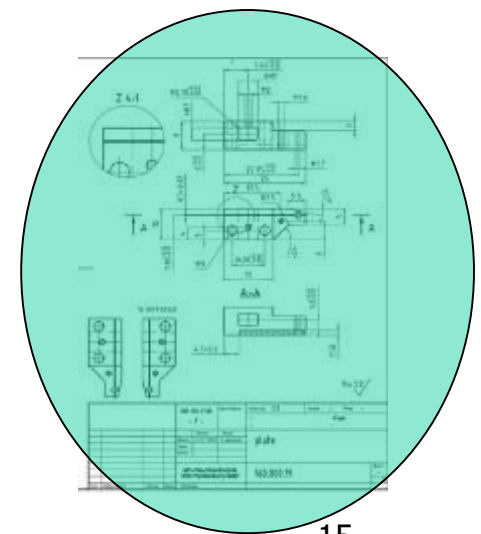
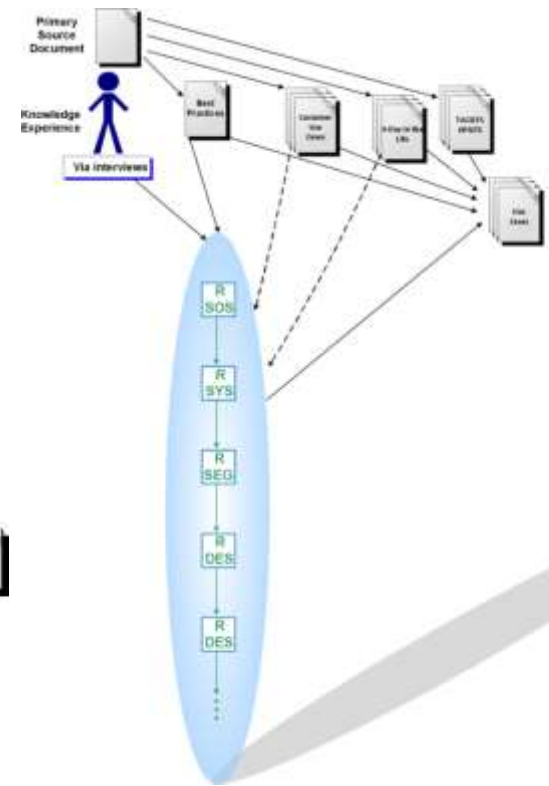
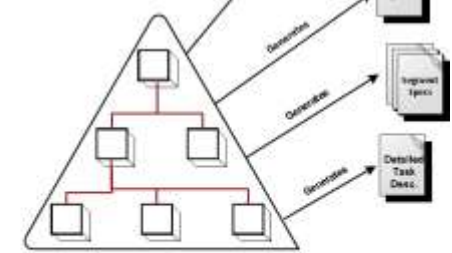
All Aspect stealth * Advanced sustainment

- Communications,
- Ground station,
- Payload,
- Increment

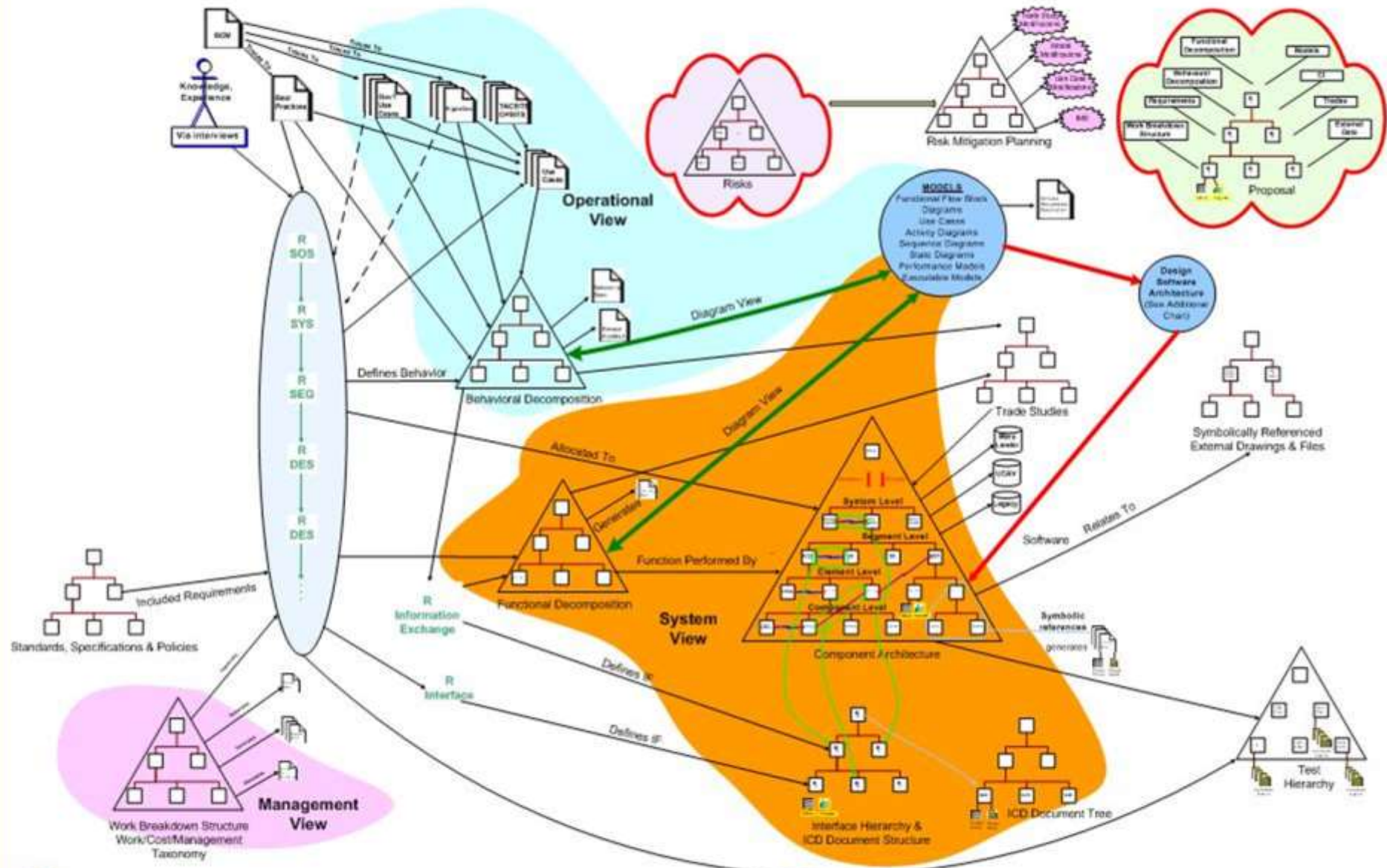




Standards, Specifications & Policies

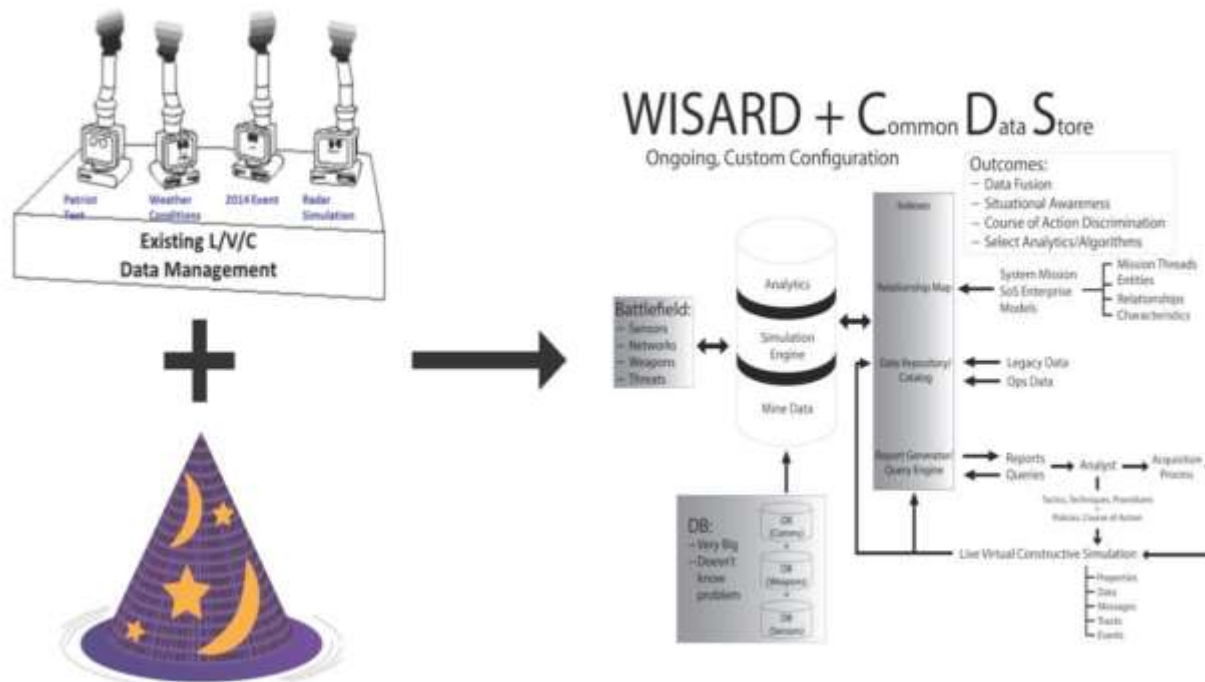


Information Model (Sample)



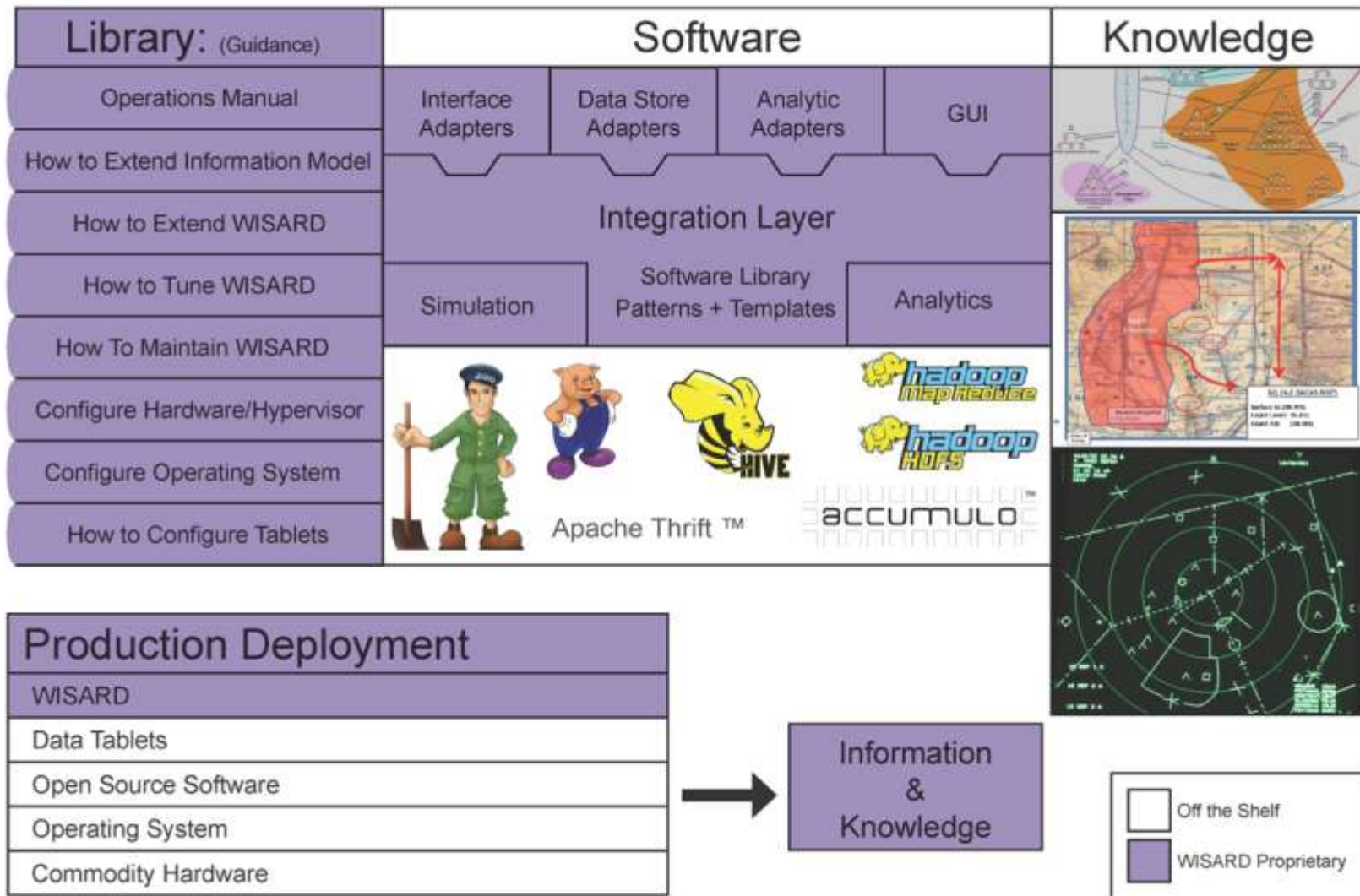
WISARD

Developed under an MDA SBIR utilizes tailored models to drive data fusion and utilization.

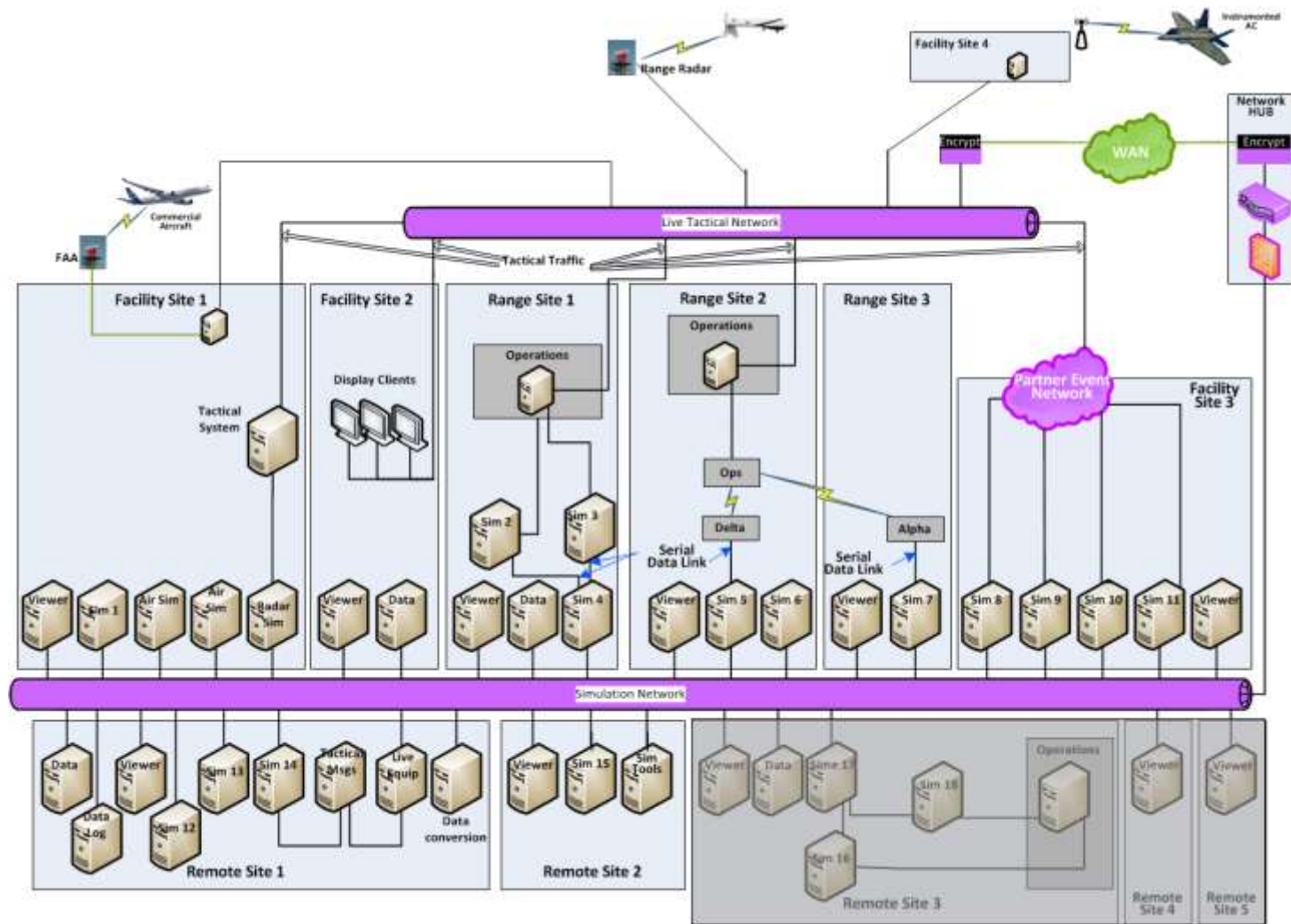




WISARD Components



Reusing experience with a System of Systems Approach



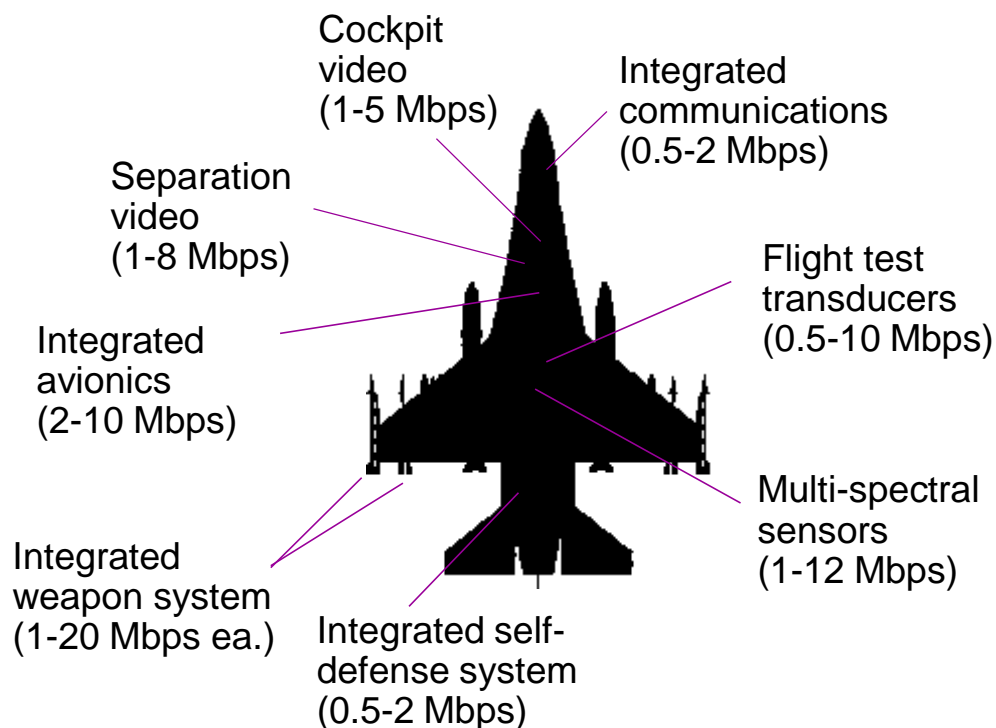


Test & Evaluation Growth of Data



T&E Mission: Acquire data and discern into knowledge

Increased System Complexity



Total Throughput: 7.5Mbps – 70Mbps+

• Larger Test Footprints

- 4-on-4 test flights (more systems per test)
- Much faster weapons systems
- Geographic separation not as effective as it used to be

• Demand for Shorter Acquisition Cycles

- More concurrent testing
- More real-time analysis

• Increased System-of-Systems Test Complexity

- “Five Futures” (EW, UAV, NCO/W, DE, Hypersonics)
- Integrated fleet (F-18E/F, E-18G, F-35, SM VI, UAV)
- “Swarming” UAVs



Big Data / Knowledge Management (KM) Challenges & Needs



Big Data Analytics depends on effective Knowledge Management

T&E Infrastructure Challenges:

How do we conduct T&E of increasingly complex, data-driven systems?

How do we enable more efficient & continuous system evaluation?

Need: A DoD-wide KM capability for T&E to help achieve better acquisition outcomes and reduce costs

Trusted processes across government and industry that identify problems sooner rather than later

Accessibility of knowledge & data to legitimate users

Discoverability of knowledge & data obtained over time

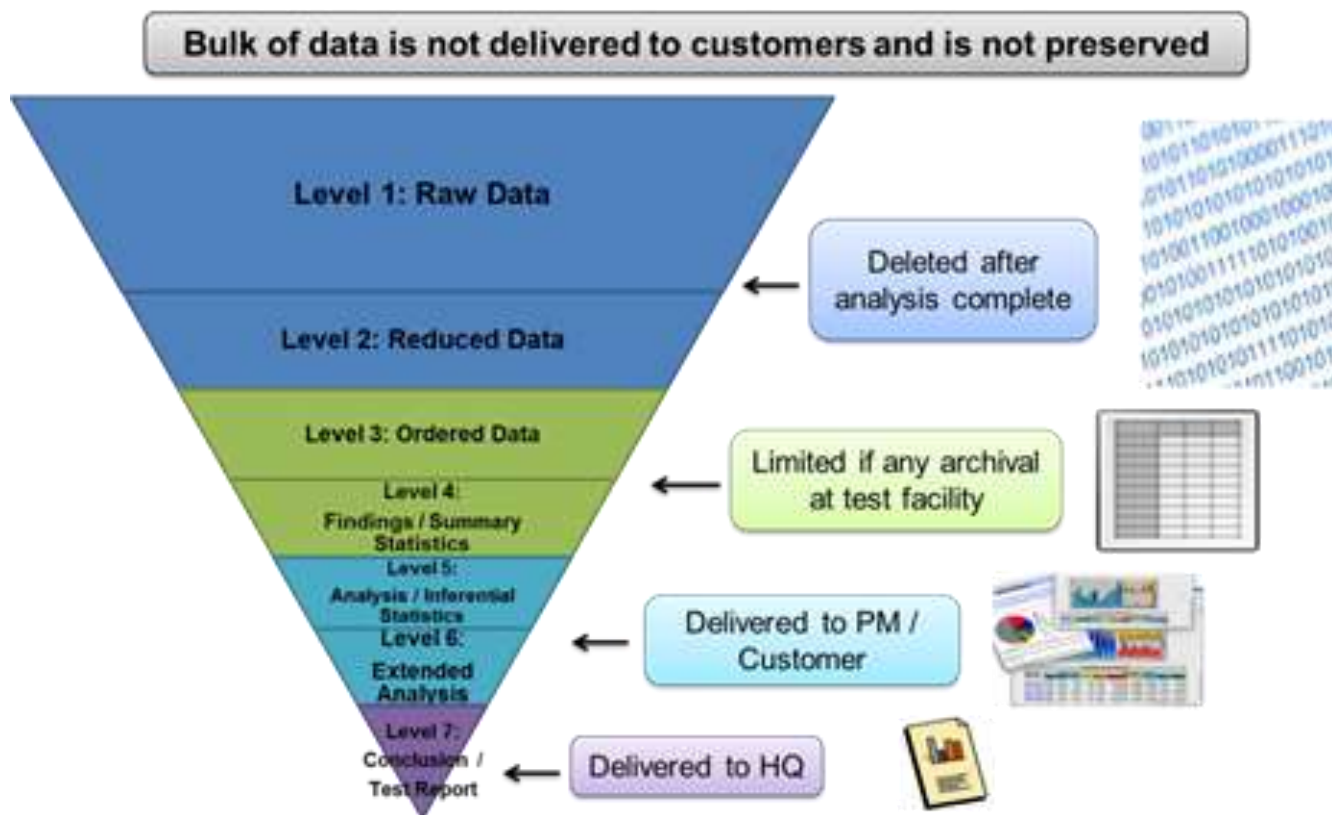
Availability of knowledge through common tools & technologies – including DoD T&E cloud solutions

Leverages proven Industry techniques / practices





Leveraging Big Data Tools for solutions





What (*infrastructure*) do we need?

Individual Range

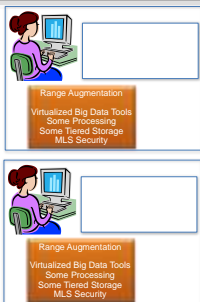
Current Range Infrastructure

Existing Tools
Existing Storage
Existing Ingest Capabilities

Range Data Center
Virtualized Big Data Tools
Some Processing
Some Tiered Storage
MLS Security
Enhance Ingest

Quick-Look
Working Files

4. Skilled Data Science Trained Workforce



1. Integrated Local Data

New
Existing

2. Cloud Analytics Capability

Cloud-Based Big Data Analytics and Knowledge Management System

Regional Analytic Services
Virtualized Big Data Tools
Processing
Tiered Storage
MLS Security
Data Scientists

Regional Analytic Services
Virtualized Big Data Tools
Processing
Tiered Storage
MLS Security
Data Scientists

High-speed intra-data-center connections

Data
Reports
Application Repository
Schedule Info

Regional Analytic Services
Virtualized Big Data Tools
Processing
Tiered Storage
MLS Security
Data Scientists

Video
Audio
Imagery

3. Big Data Tools

- Integrated
- Scalable
- Cost-Effective
- State-of-the-Art

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Reference Number 15-S-2335; 08-14-2015

Big Data Architecture

- Catalog Data for future analysis even when role is unknown at ingest
- Translates human needs to machine learning
- Provides a continuous learning and discovery environment for both man and machine
- Facilitates a deep understanding of data allowing for the ready solutions of emergent problems
- Provides a mechanism for conveying a common picture and understanding to the entire community of users.
- Automates the mechanics of analytics and housekeeping to free the analyst/user to focus on solving and understanding the problem.