



Lessons Learned from Developing Orange Flag Evaluation Data Analysis Tools

ITEA Test Instrumentation Workshop
May 2019

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Lesson Learned Overview

- Orange Flag Evaluation (OFE) Overview

← Context

- Next Steps (from ITEA 2018 Workshop)

← Background

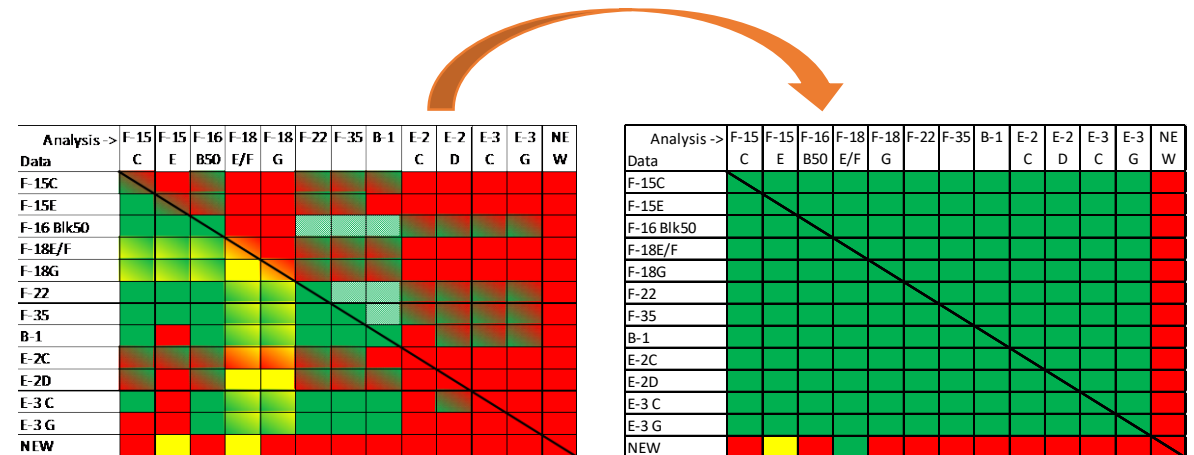
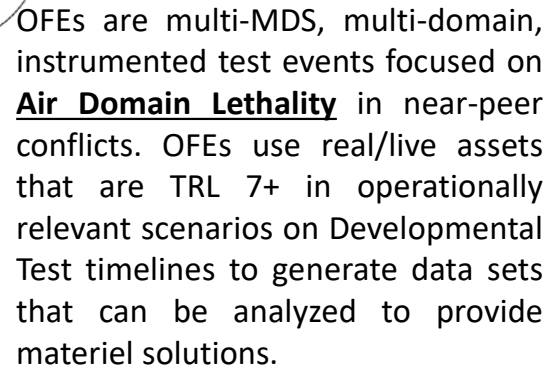
- Multi-MDS Analysis Objective & Philosophy

- Foundational Data Analysis Tool (FDAT)

- Updated Challenges & Opportunities

- Strategic
- Tactical
- Governance

Lessons Learned
Since May 2018





Next Steps (From 2018 ITEA Workshop)

- Challenges

- Subject Matter Experts (SMEs) Gap

- Can co-locate Multi-MDS LFEs data but lack the SMEs to analyze it
 - Data science (Big data/analytics/ML) SMEs lack T&E expertise

- **Industrial Age** Governance for **Information Age** Challenge

Industrial Age:	Info Control	Limit/Define	Rank	Compartmental
Information Age:	Info Exchange	Empower	Connections	Systematic

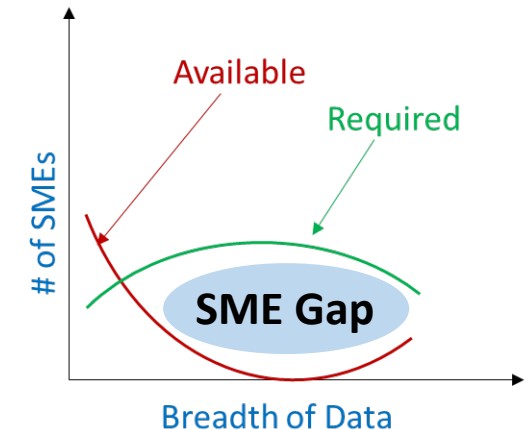
- Opportunities

- The Software and Hardware Technologies Exists at the Commodity Level

- Do not need to invent a quantum computer, Hadoop (or similar), or new language

- Collaborative Workforce and an Empowering Senior Leadership

- Millennials/Digital Natives are good at this & will soon be the majority of the workforce
 - Senior DoD leaders want to know how our systems work together -> Big data/analytics/ML





Multi-MDS Analysis Objective & Philosophy

- Objective: Make the Data Accessible in a Scalable Way

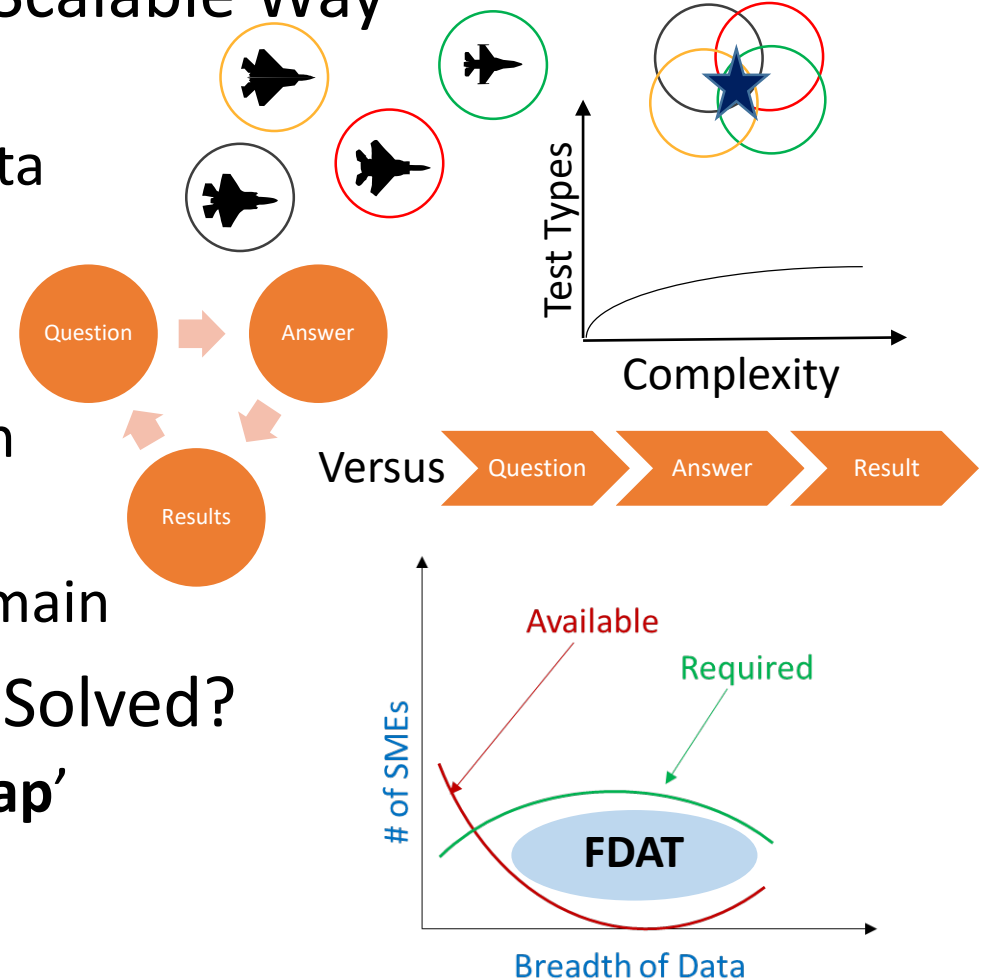
- **Accessible:** Physically and logically
- **Scalable:** In complexity for self describing data

- Multi-MDS Data Analysis Philosophy

- Answer “**Any**” question v. “**Many**” questions
- **Analysis friendly** format v. data manipulation
- Enable **generalists** v. specialist or lay-person
- **Open source** and applicable to any MDS/Domain

- What Fundamental Problem Needs to be Solved?

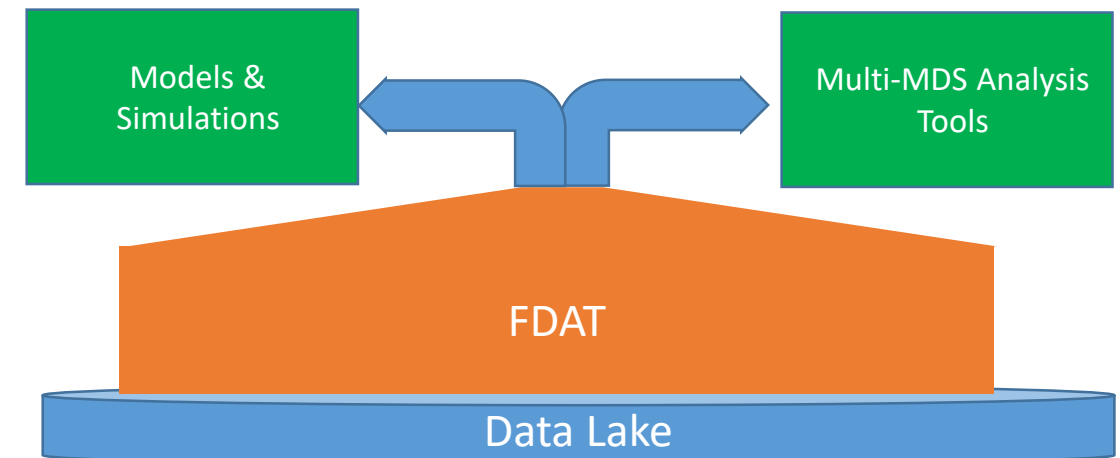
- Provide a **technology solution** to the ‘SME gap’





Foundational Data Analysis Tool (FDAT)

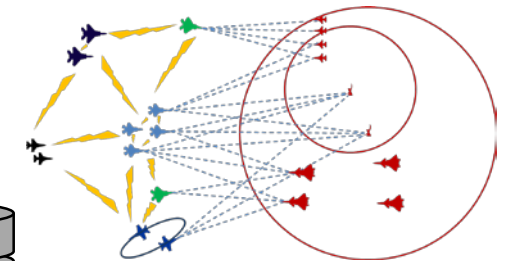
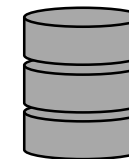
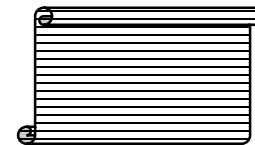
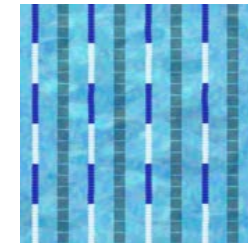
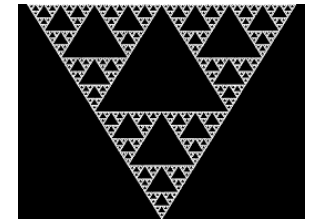
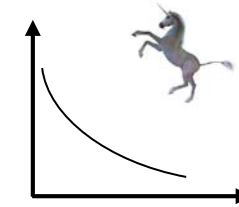
- Developed a **Python** Based Tool
 - Python is widely approved & essentially free
 - Open source, easy to learn, & powerful
- Stored Data in **HDF5** Format
 - Read-efficient, analysis friendly, & self-describing
 - Converted raw data to HDF5 files
- Machine Readable Logical Interfaces
 - Searchable **sqlite3** database
 - Linked database to HDF5 files
- **Model, View, Controller** Based





Updated Challenges & Opportunities

- Strategic
 - Approach – Go Big or Go Small?
- Tactical
 - Knowledge – Connecting SMEs
 - Information – Accessibility
 - Data Models – Mission Systems
- Governance
 - Ownership – Everyone = No One
 - Info Age – Learn from Others





Strategic – Approach (Go Big or Go Small?)



Pros

Cons

Go
Big:

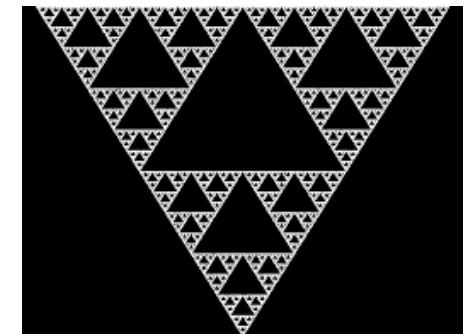
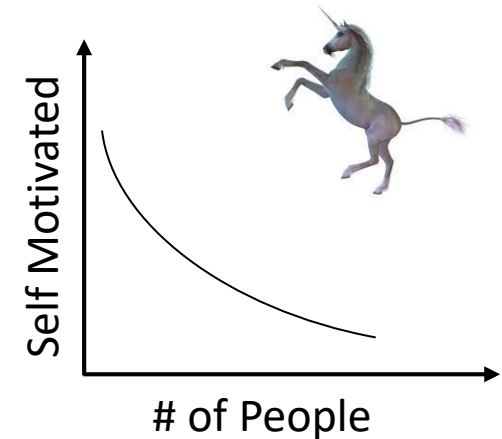
- Data Sci. SME Driven
- Enterprise Product
- Guaranteed* Success

- Resource Intensive
- Requirements Based
- Momentum/Visibility

Go
Small:

- Minimal Resources
- Rapid Build/Learn Cycle
- Scale with Knowledge

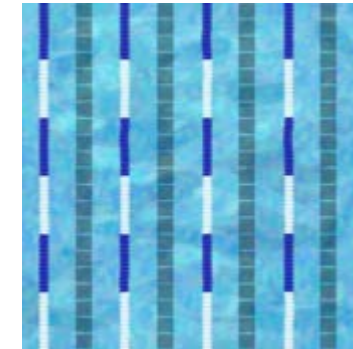
- Person Dependent
- May Not Succeed
- Not Enterprise Product



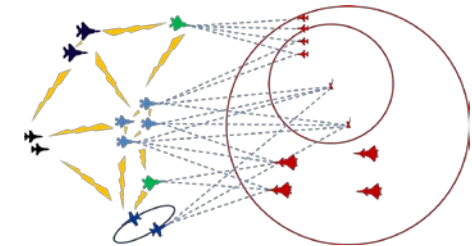
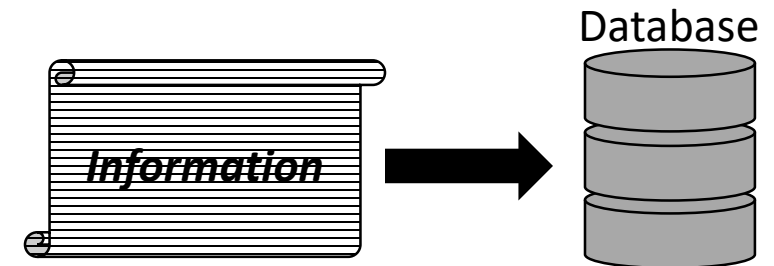


Tactical – Knowledge, Info, & Data Models

- Knowledge – Connecting SMEs
 - **Challenge:** SME's Staying in Their Swim Lanes
 - Data Scientists Know Data Science
 - Flight Testers Know Flight Test
 - **Opportunity:** Grow a Collaborative Workforce
 - Cross-Discipline Engineers are Invaluable & #'s Are Growing
- Information – Accessibility
 - **Challenge:** Information is Costly to Access
 - Converting Information to Searchable / Machine Readable Data
 - **Opportunity:** Easily Accessible Information
 - Google/Facebook-like Multi-Domain Data Analysis Capability
- Data Models – Mission Systems
 - **Challenge:** No Multi-MDS/Domain Mission Systems Models
 - Advanced Data Analytics Tend to Require Mathematical Models
 - **Opportunity:** Predictive Machine Learning Tools
 - The Data Exist to Create Models of Integrated Mission Systems
 - Advanced Data Analytics Tools Can be Applied to Flight Test Data



Versus





Governance – Ownership & Information Age

- Ownership Across Organizational Lines
 - **Challenge**: Structured to Acquire Decomposable Systems
 - Air Domain Lethality now includes **non-decomposable** systems
 - From an organizational perspective **Everyone** leads to **No One**
 - **Opportunity**: A Collaborative Workforce Will Cross Organizational Boundaries
 - Empower the collaborative, organization-agnostic workforce (**Millennials**)
- Information Age v Industrial Age Governance
 - **Challenge**: Industrial Age Governance for Information Age Problems
 - Structure, control, & decomposable **assumptions** do not apply to complex systems
 - **Opportunity**: The Engineering Workforce Can Solve Information Age Problems
 - **Technology** is mature, but needs to be **applied** to flight test – **definition of engineering!**
 - Alternative organizational **examples** of what to do (or not do) already exist



Questions / Discussion



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