# Composable Environments

A systems architecture for agile user-driven command and control

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# A simple task, right?

- For C2 Systems, we try to…
  - Gather requirements
  - Understand the requirements
  - Make a plan
  - Build it
  - Field it

- But, it often doesn't work out

**Our failures often outweigh our successes**

# Why is it so hard???

- Complexity (Complication)
  - Existing systems evolved over decades
  - Often, they are too difficult to understand, decompose or replace, commonly leading to *analysis paralysis*
- Dynamics
  - Missions and the environment change faster than legacy processes can deliver capabilities

# PROBLEM

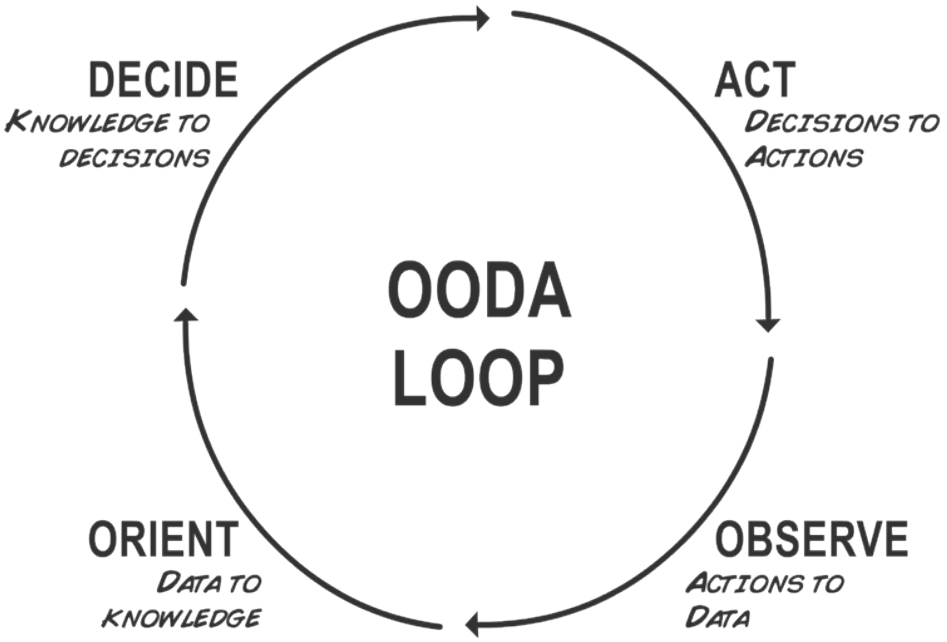
How can we **better** handle complexity and dynamics?

# SYSTEMS MUST RAPIDLY EVOLVE

Current *"Intelligent Design"* C2 approaches fail when the environment is **unknowable** (too complex) and/or rapidly **changing** (too dynamic)

# Starting Over

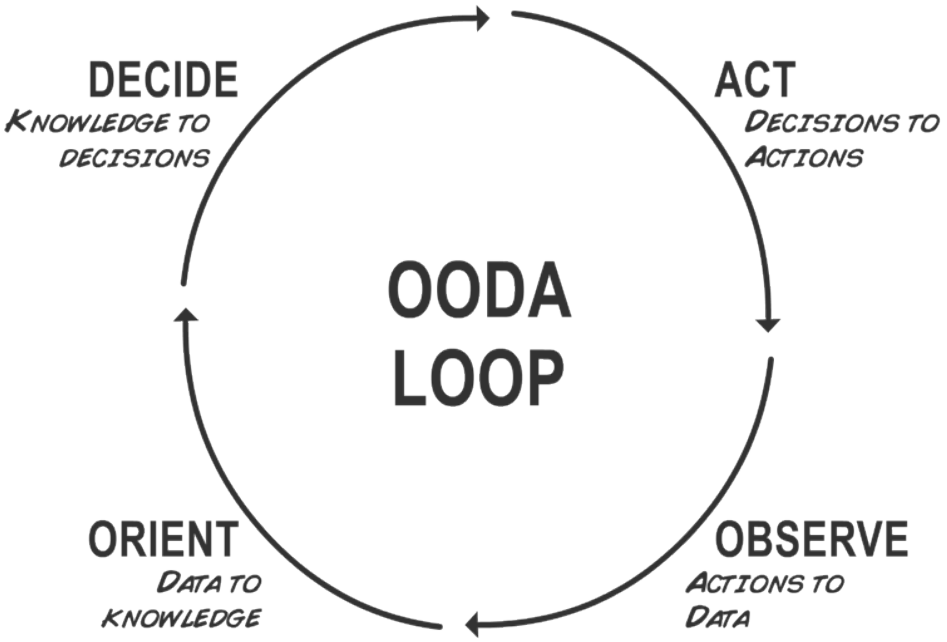
- Applying Boyd's OODA Loop
- Proven model for dealing with an "*evolving reality that is uncertain, everchanging, unpredictable*"
  - (quote from Col John Boyd)



# Data to Knowledge Value Chain

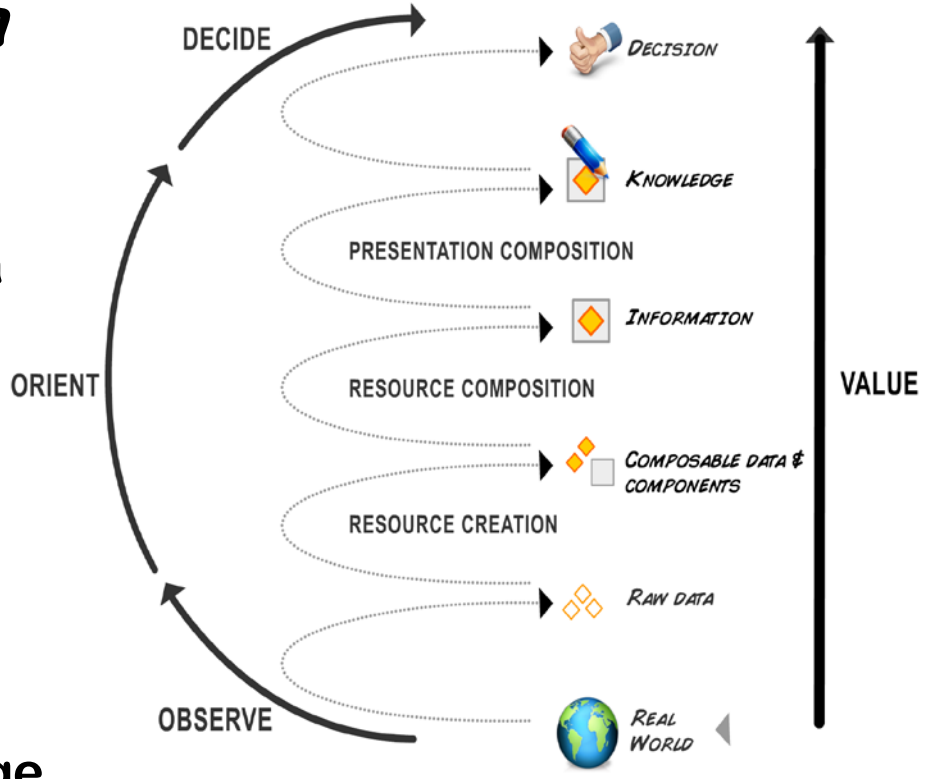
- Each step in the OODA loop is a *transformation*
- To cycle through the OODA Loop, users need to complete the value chain

Decision
⇧
Knowledge
⇧
Information
⇧
Data
⇧
Action



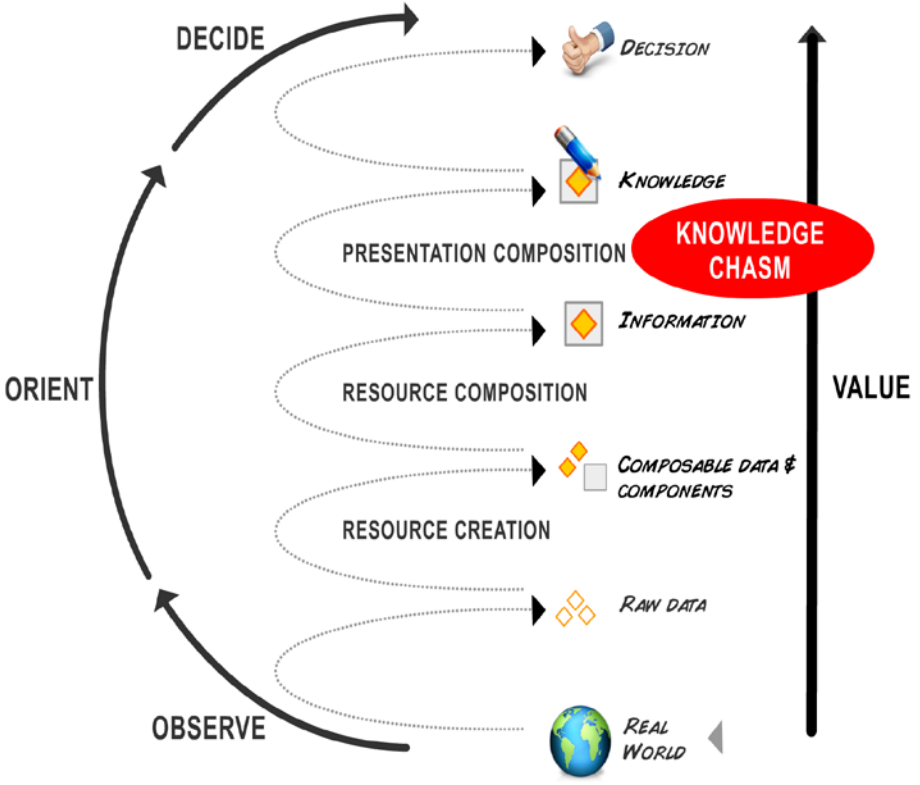
# Criticality of the Orient Phase

- **Most value is created in the Orient Phase *(Data to Knowledge)***
  - **Resource Creation**
    - **Raw data → usable data**
  - **Resource Composition**
    - **Data → information**
  - **Presentation Composition**
    - **Humans add context & assessments**
    - **Information → knowledge**



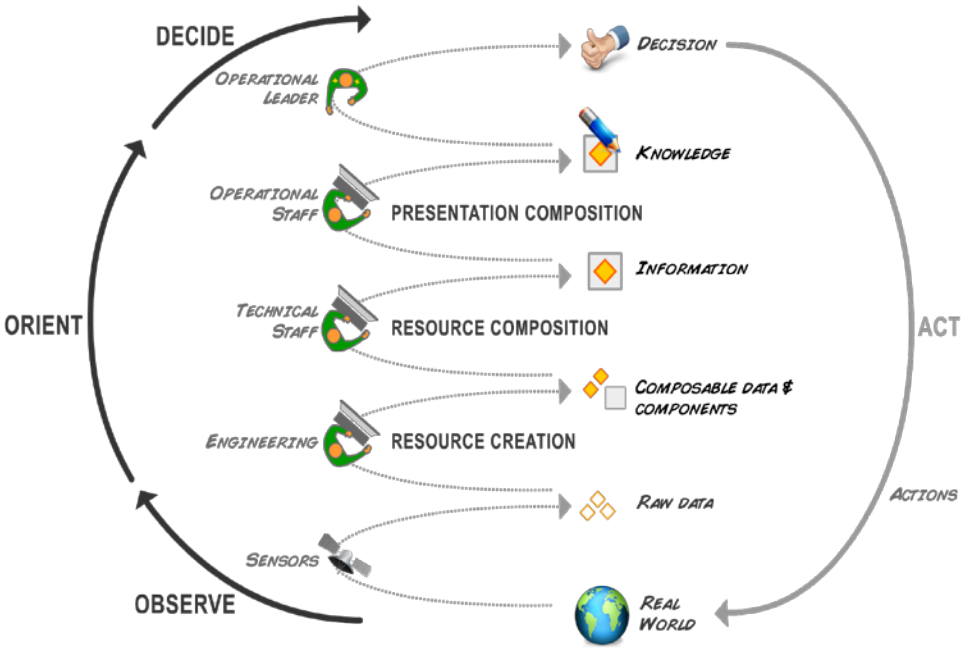
# The Knowledge Chasm

- Current C2 systems rarely support the full value chain
  - Stop at *Information*
  - Users can't communicate knowledge by adding assessments or context
- Thus, users laboriously shift to presentation systems (e.g., PowerPoint)



# Composable Ecosystem Tenets

- **Capabilities** and **Roles** aligned with Value Chain and transformations (i.e., mimics the OODA Loop)
  - e.g., Resource Composition by Technical Staff = Transformation of Data ➔ Information
  - e.g., Presentation Composition by Operational Staff = Transformation of Information ➔ Knowledge
- Simple, Seamless & Intuitive for end users
  - Users can perform tasks previously requiring engineers
  - No need to shift to presentation tool (e.g., PowerPoint)
- Modularity and composability enable agility



# Roles in the Ecosystem

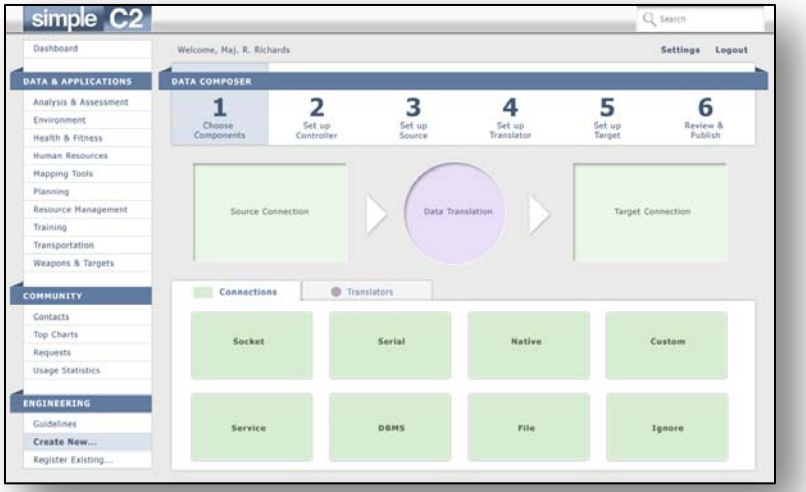
- Persona 1: Operational Staff
  - Primary users of a composable system
  - Analysts, Operators, etc
  - “Get the job done” attitude
- Persona 2: Technical (Operational) Staff
  - More technically proficient staff
  - May or may not have official technical assignment and training
  - Builder of “good enough” workarounds for themselves and colleagues
- Persona 3: Operational Leader
  - Driver of system requirements, consumer of information/knowledge, and primary decision maker
- Persona 4: IT System Administrator
  - Ensures that the composition ecosystem is running as intended
  - Manages and provisions locally
- Persona 5: Engineering Community
  - Indirect support
  - Builds software resources
- Persona 6: Governance & Acquisition Community
  - Polices and monitors the composition environment

# Technical Requirements

- Core Modules
  - Resource Creation Tool
  - Resource Composition Tool
  - Presentation Composition Tool
  - Marketplace

# Technical Requirements

- **Resource Creation** Tool
  - Simple graphical user interface
  - Select and access potential data sources
  - Allow users to select columns, rows or ranges for output in the transformed data resource
  - Combine two data sources to create a data resource based on a common key(s)
  - Enact translation rules or services for fields (e.g., translate between GMT and local times)
  - Format the output data



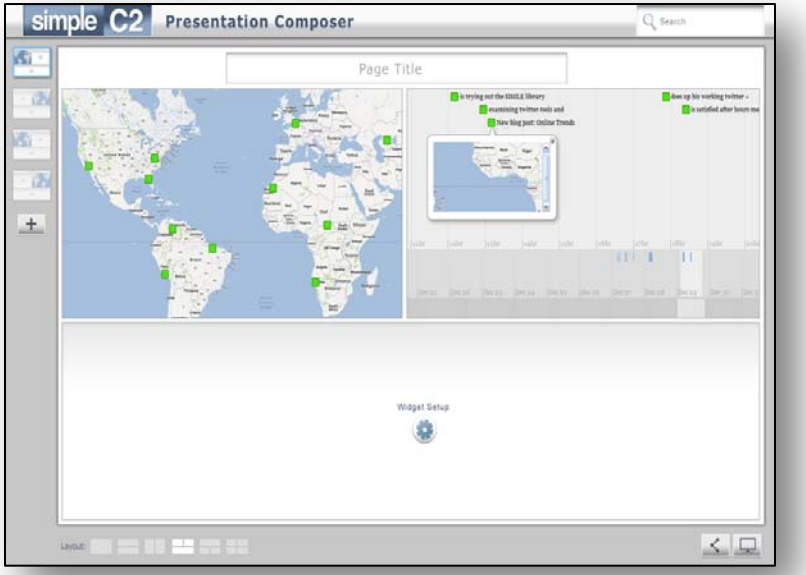

Resource Creation Concept Design

# Technical Requirements

- **Resource Composition Tool**
  - Simple graphical user interface
  - Select a page layout
  - Select widgets to fit within the page layout
  - Combine data sources for each widget
  - Publish the completed composition
  - Decompose existing compositions to change/update resources and/or settings

# Technical Requirements

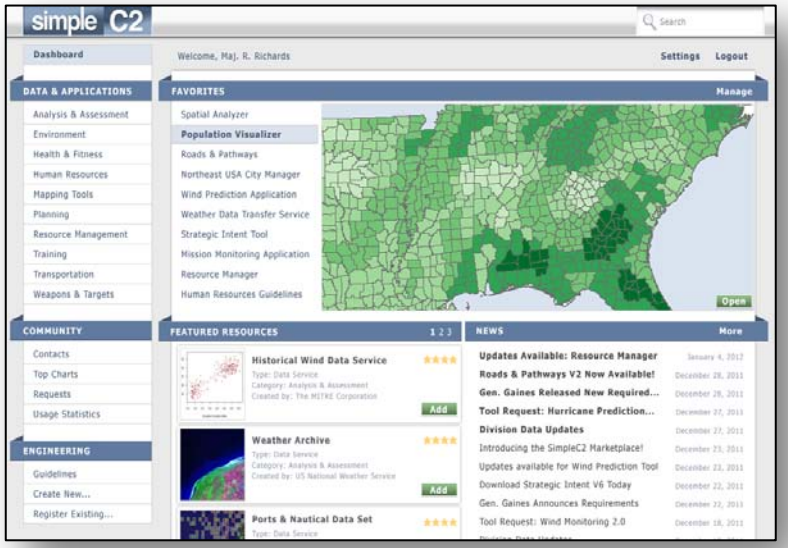
- **Presentation Composition Tool**
  - Simple graphical user interface
  - Build threads of individual pages that can be stepped through like a slide presentation
  - Provide an editable text widget that can be included in pages so that users can add bullet comments, textual comments, etc.




Presentation Composition Concept Design

# Technical Requirements

- **Marketplace**
  - Simple graphical user interface
  - Exchange of resources, compositions and presentations
  - Audit information services to provide insight into system use and trends
  - Federation capabilities to allow marketplaces to cooperate and share information amongst themselves, thus allowing users to search

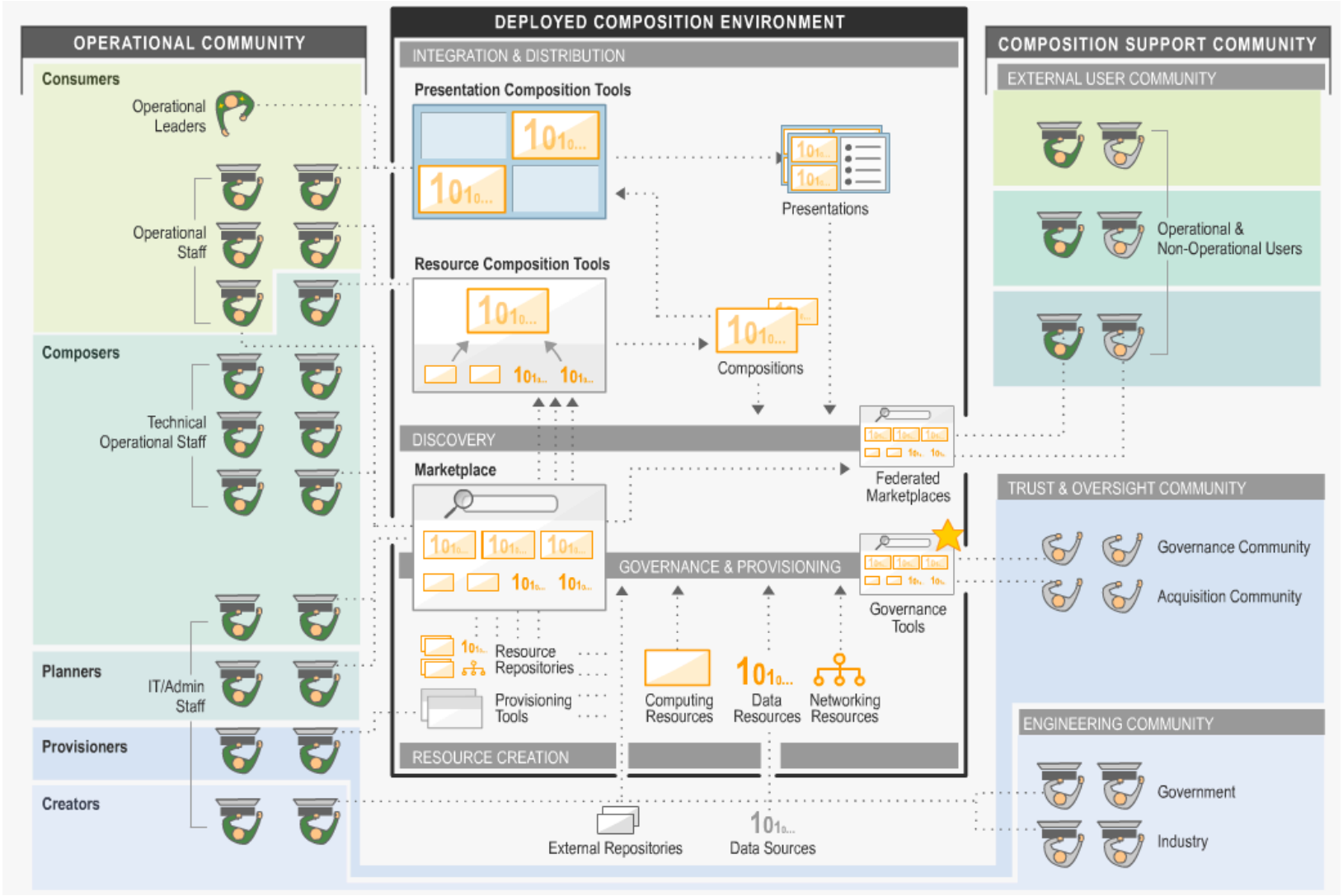


Marketplace Concept Design

# Other System Attributes

- **URL Manager** – assigns URLs to any resource, composition, presentation, user, or any other "entity" within the ecosystem
- **Workflow Manager** – build simple workflows that can trigger compositions and actions by end users
- **Security** – authorize and authenticate with differing levels permissions
- **Pedigree** – trace the origins and readily assess the quality of a resource
- **Vetting** – user groups set their own criteria for the approval, creation, and sharing of resources and compositions
- **Requirements Expression** – expresses new needs or requirements to the acquisition and engineering communities

# Composable Ecosystem Visualization



# Impact of Composable Environment Use

- Far greater C2 Agility
  - Quick arrival at "good enough" solutions
- Evolving capabilities (vs. top-down Intelligent Design)
- Span the Data to Knowledge Value Chain
- Operational community
  - "Users have the stick" – i.e., Directly address most of their own needs with no intermediaries
  - Lowered cost of failure (a failed composition is quickly and easily altered or discarded)
  - Easily to share and innovate
  - Local self-help with reachback for engineering assistance
- Acquisition and engineering communities
  - Create, test and accredit raw materials (i.e., data and computing resources, widgets)
    - Freed from deriving detailed user requirements
  - Monitor usage to spot trends and make proactive changes

# QUESTIONS