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Data & Mission Modernization

**Introducing Target Mission Architecture & Cogent Way Project
Dual-use Title 10/50 Data Modernization**

**Joint Staff J2F/J28
08 June 2022**

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Overview

- **Description**
- **Emphasis**
- **Scoping & Implementation**
- **Discussion**



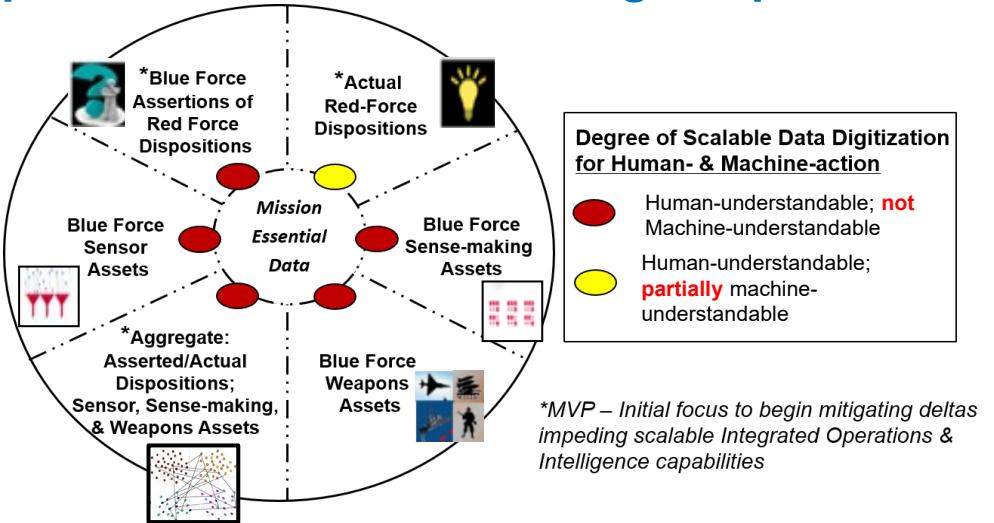
Description

- Target Mission Architecture – Cogent Way conveys an envisioned end-state for cross-cutting DOD and IC mission environment; JADC2 is “an” ecosystem among multiple in this context
- Design affords dual-use Title 10/50 concentration-of-force and economy-of-scale impact
- Imperative for machines to understand and act on aggregate information derived from disparate data currently stored in siloed systems and domains . . . on par with how people understand and act
- Combined instantiation of Dictionaries, Ontologies, and Linked Data and Semantic Web standards and technologies – essential for scalable data fabric and Artificial Intelligence (AI) enabling integrated operations and intelligence (IO&I) at scale and speed
- Tailorable in scope for interagency and intra-agency capabilities
- Diverse government, military, industry, and academia Team transforming DOD and IC data, systems, and tradecraft in support of Joint Fires-, Information-, and Decision Advantage expectations

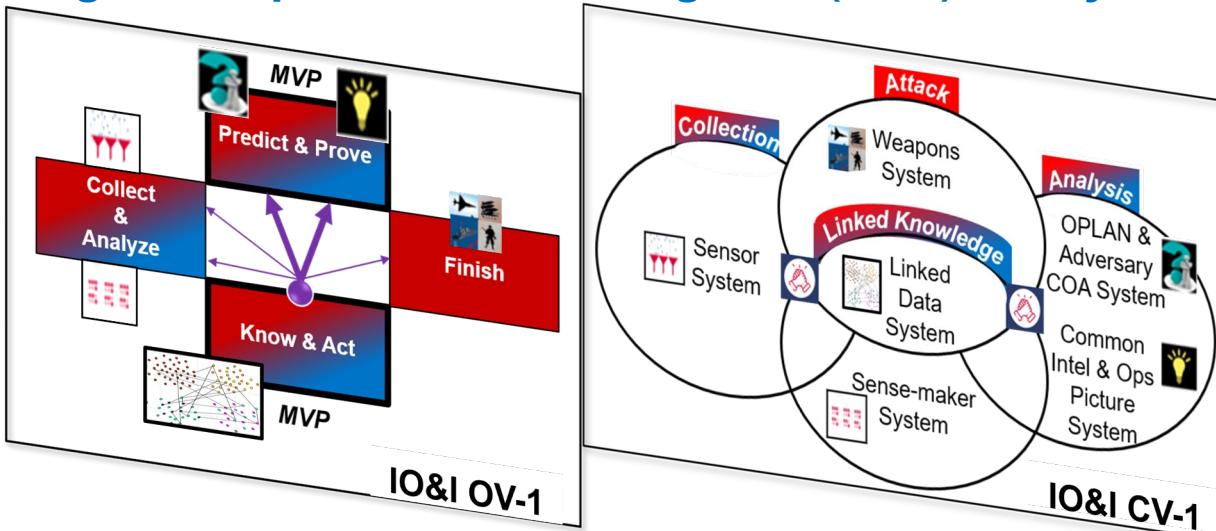


Target Mission Architecture – Cogent Way

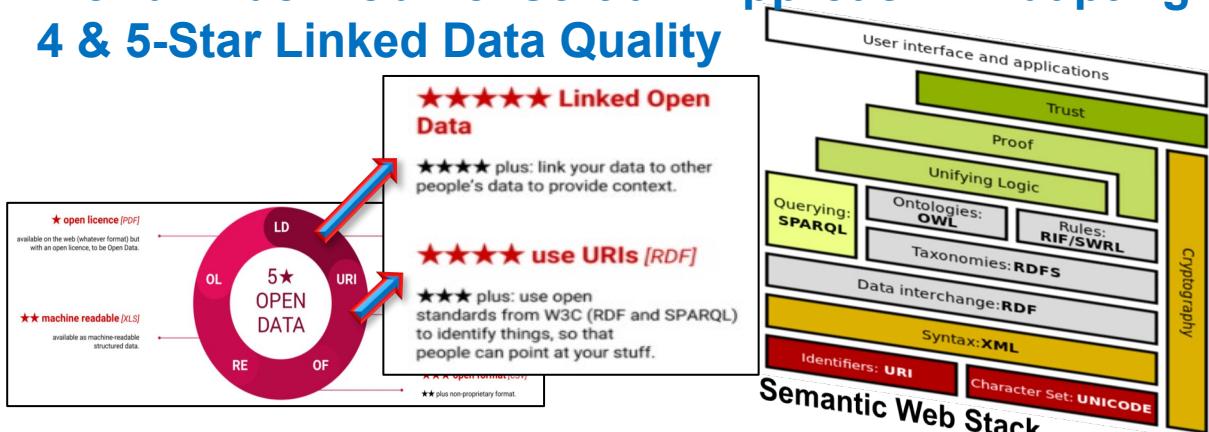
• Emphasis on Data-to-Knowledge Capabilities Gaps



• Integrated Operations & Intelligence (IO&I) Ecosystem



• World Wide Web Consortium Approach – Adapting 4 & 5-Star Linked Data Quality



- **Oversight:** Joint Staff Futures (JS J2F)
- **Minimum Viable Product (MVP):** System-of-systems NIPR & JWICS prototype; IO&I Target Mission Architecture portfolio
- **Initial Data Digitization:** Blue Force assertions (OPLANs & Adversary COAs); actual Red Force dispositions (CIP/COP)
- **Informs Modernization:** DOD Data Strategy; Herald; CIP/COP; JADC2; AI Data Acceleration; DTRA, CCMDs, . . .



Context: Linked Data/Semantic Web

- Commercial sector investments since 2009 are realizing value of a machine-actionable world-wide semantic web
- Driven largely by World Wide Web Consortium (W3C) standards and technologies
- Technology companies and government institutions amass actionable knowledge from data silos and fuel AI with it
- Motivation:
 - Data efficiency – minimizes data duplication
 - According to IDC [International Data Corporation] over 60 zettabytes of data were produced last year [2020], and this is forecast to increase at a CAGR [Compound Annual Growth Rate] of 23 percent until 2025. Worse, the ratio of unique to replicated data is 1:10, which implies that most organizations' data management methods are based on copying data." [Improving Machine Learning: How Knowledge Graphs Bring Deeper Meaning to Data | 7wData](#)
- AI and Machine Learning Scale: Siri, Alexa, Hey Google, Uber Eats, Linked-In, Facebook, Netflix, You-Tube, Biomedical Industry, and more employ this approach
 - Google: Google Knowledge Graph powers "Hey Google" and "Knowledge Panel" returns on web queries that derive knowledge from Internet silos – conveys **500 billion facts about 5 billion entities** [Google's Knowledge Graph and Knowledge Panels \(blog.google\)](#)
 - Uber Eats: Equips customers with dynamic decision-enabling for cuisines, dishes and restaurants from **320,000 restaurants in 500 cities across 36 countries** [Food Discovery with Uber Eats: Using Graph Learning to Power Recommendations - Uber Engineering Blog](#)

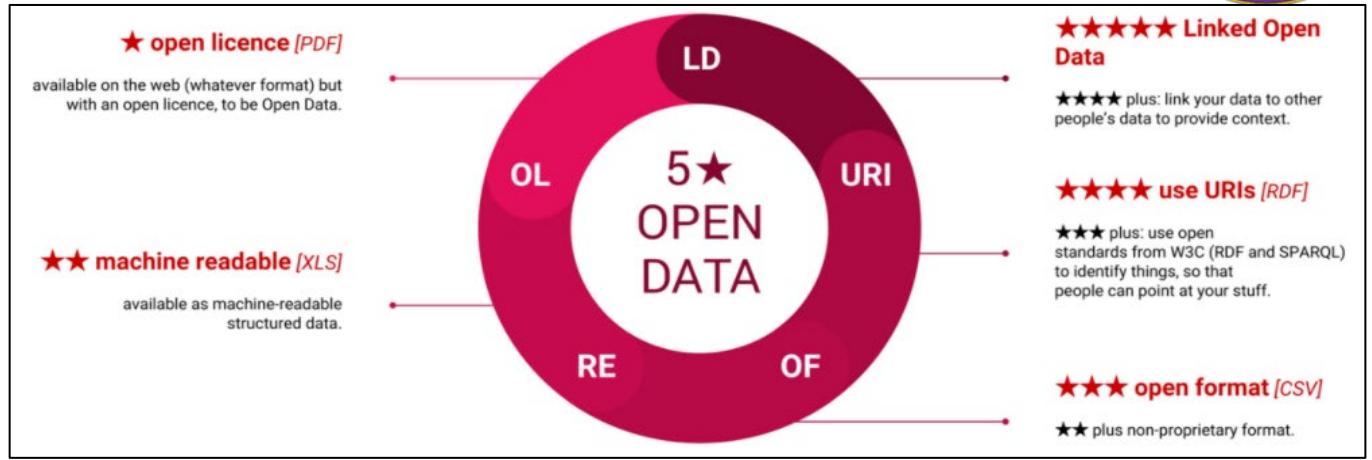
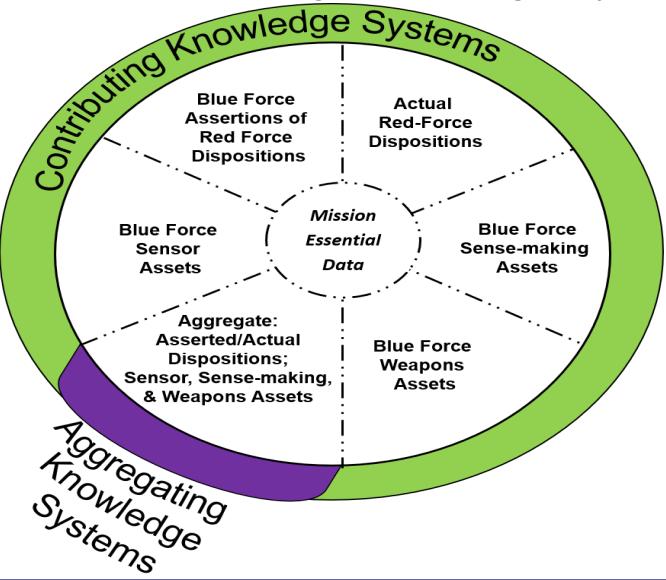
Google Knowledge Panel
Output from their Knowledge Graph

The screenshot shows a Google search result for "Lake Anna". The top part of the page has a standard search interface with a magnifying glass icon and dropdown menus for "All", "Maps", "News", "Images", "Videos", and "Tools". Below the search bar, there's a snippet of the search results page showing a link to the DCR website and some descriptive text. To the right of the search results, a large blue arrow points down to a "People also ask" section. Another blue arrow points right to a detailed information card for "Lake Anna". This card includes a small thumbnail image of the lake, a map showing its location, a star rating of 4.7 from 516 reviews, and a brief description stating it's one of the largest freshwater inland reservoirs in Virginia. The card also lists activities like boating, fishing, and swimming, along with links to the Lake Anna State Park website and Wikipedia.

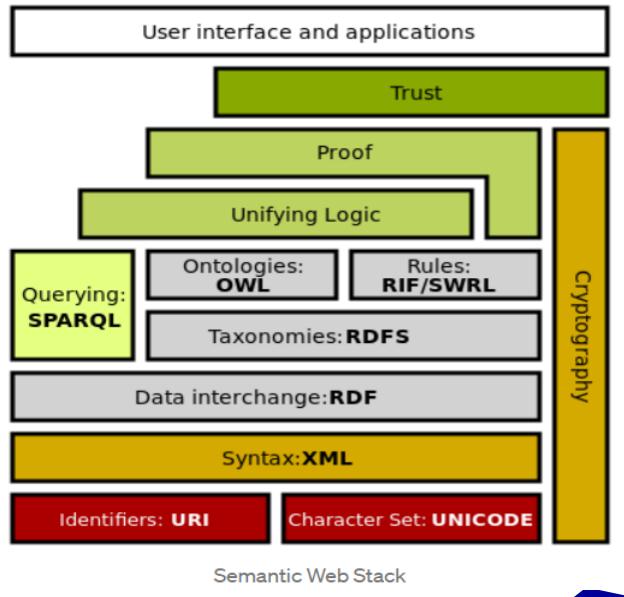


Getting to Semantic Web State

- DOD and IC can capitalize on progress
- Getting to this state:
 - Set sights on 4- and 5-star states
 - Work the Semantic Web Stack for machine-actionable, interconnected data
 - Introduce new “Aggregating Knowledge System” -- interoperable with existing “Contributing Knowledge System” . . .



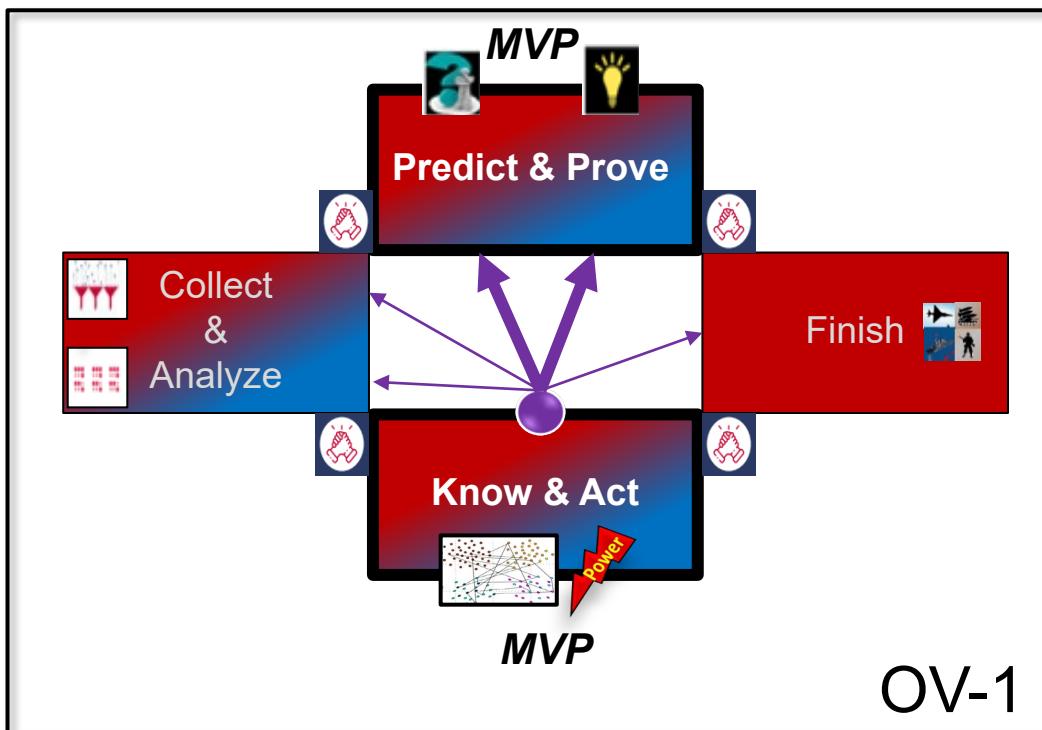
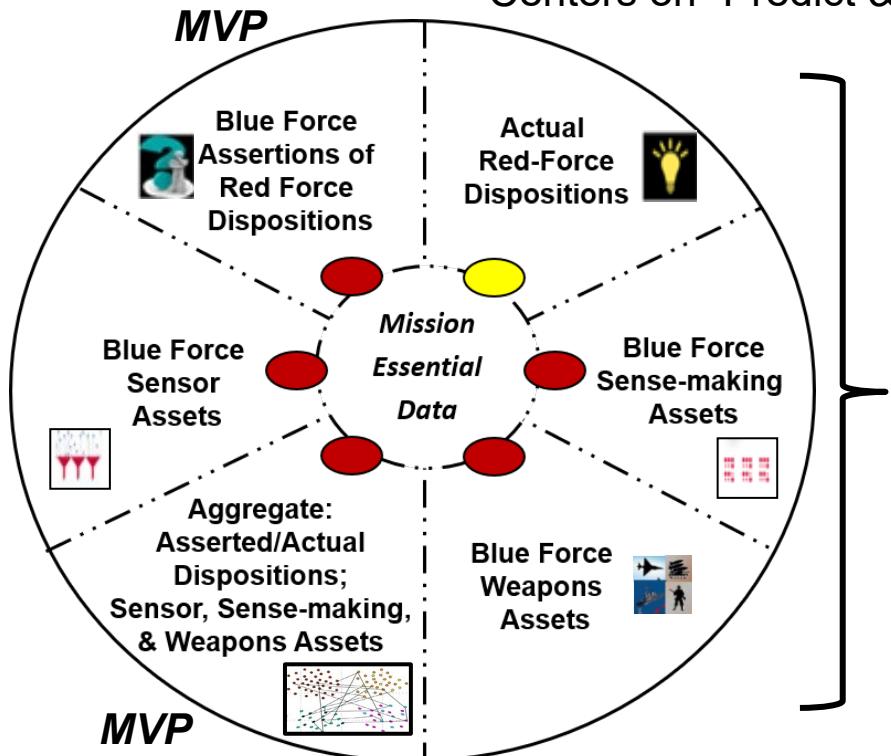
- . . . In conjunction with National Information Exchange Model (NIEM) compliance, instantiate Linked Data & Semantic Web standards
- Develop new Aggregating Knowledge System
 - Linked Data Environment (LDE)
 - LDE is system-of-systems construct
 - No monopoly provider or single hub & spoke constraints
- Adjust existing Contributing Knowledge System





Initial Focus

- MVP takes initial steps to mitigate data gaps impeding machine-action
- Centers on “Predict & Prove” and “Know & Act” OV-1 components of TMA



Tacit Knowledge Prediction
(OPLAN & Adversary Course of Action)



Truths:
Patterns-of-Life
(Object Based Production)



Linked Data Environment / Semantic Web



Human-Machine Teaming



Sense-making Assets--Analytics



Sensor Assets Collection



Title 10



Dual-use Title 10/50



Shooter Assets Weapons

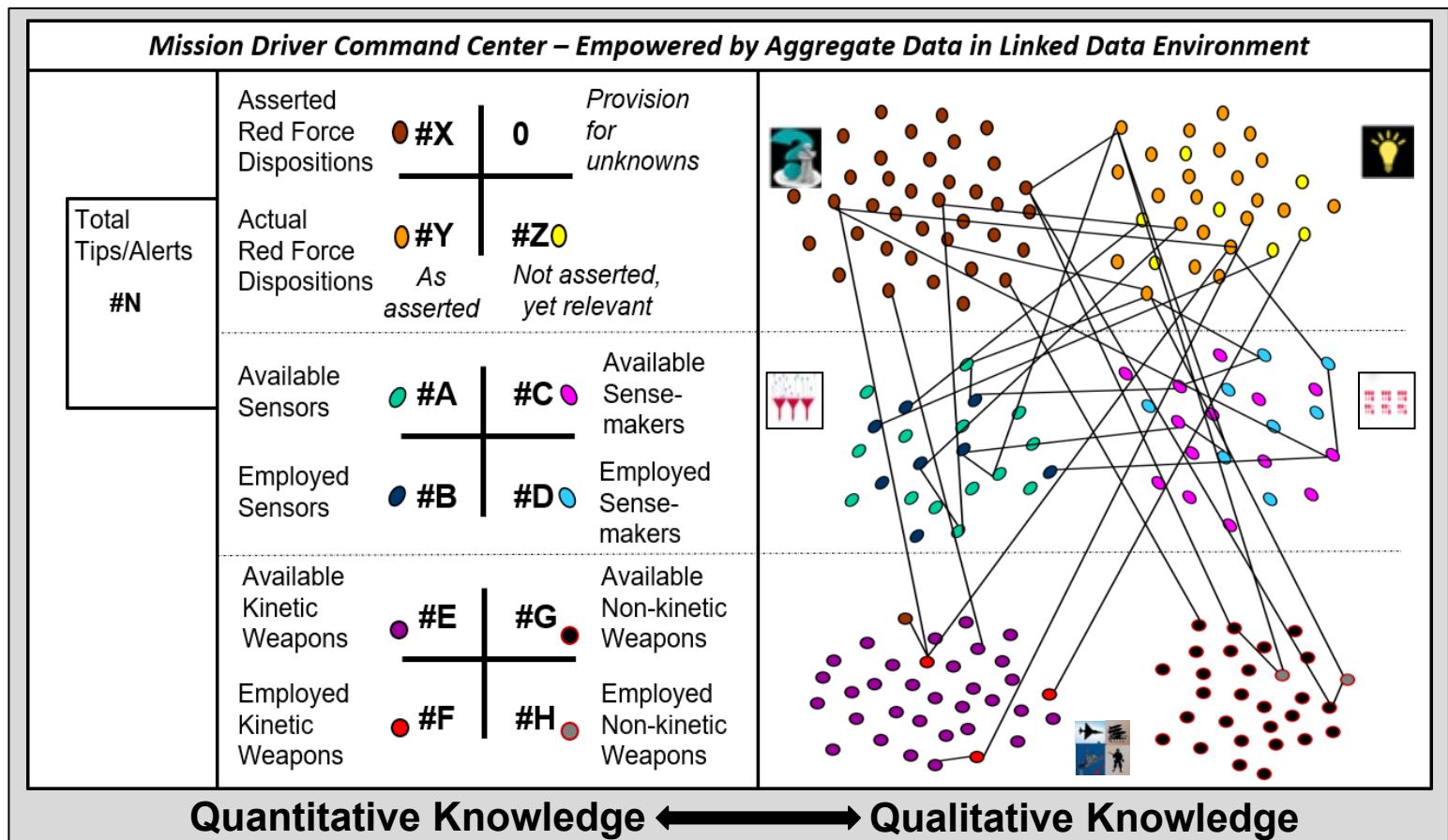
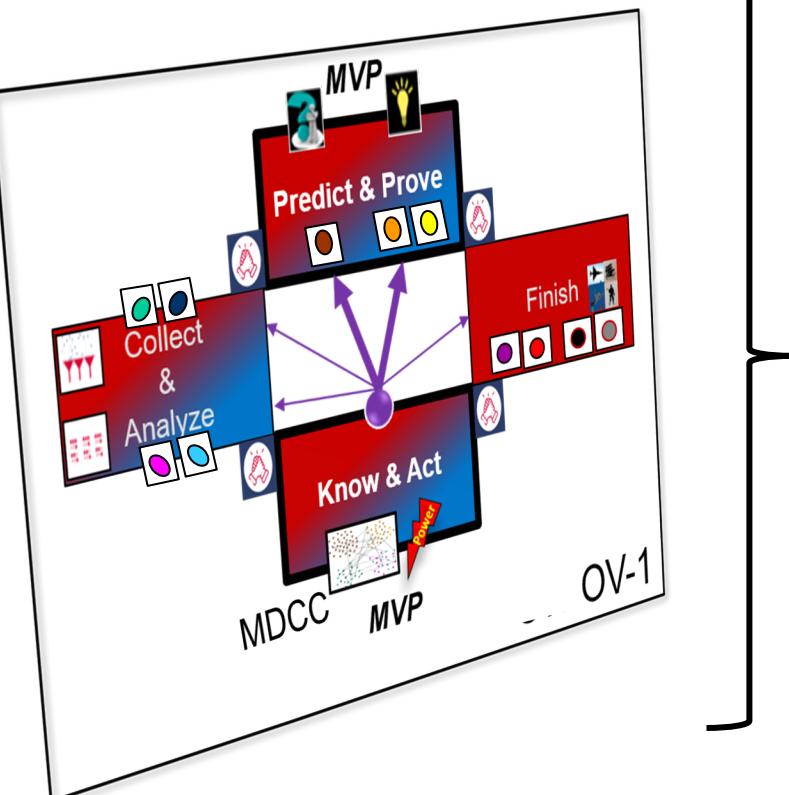


Decision Advantage



Bringing it Together: Mission Impact

- Introduces Mission Driver Command Center (MDCC) innovation – powered by LDE
- Leverages aggregate information for human- and machine-action



*MVP focus – Asserted vs. Actual Red Force Dispositions via MDCC hosted in Linked Data Environment Prototype

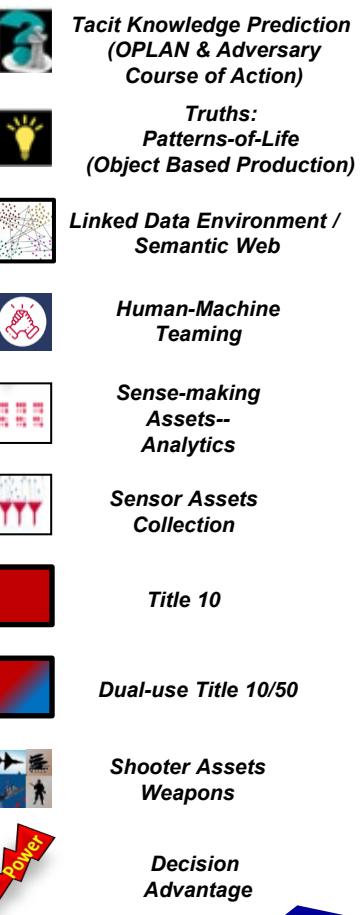
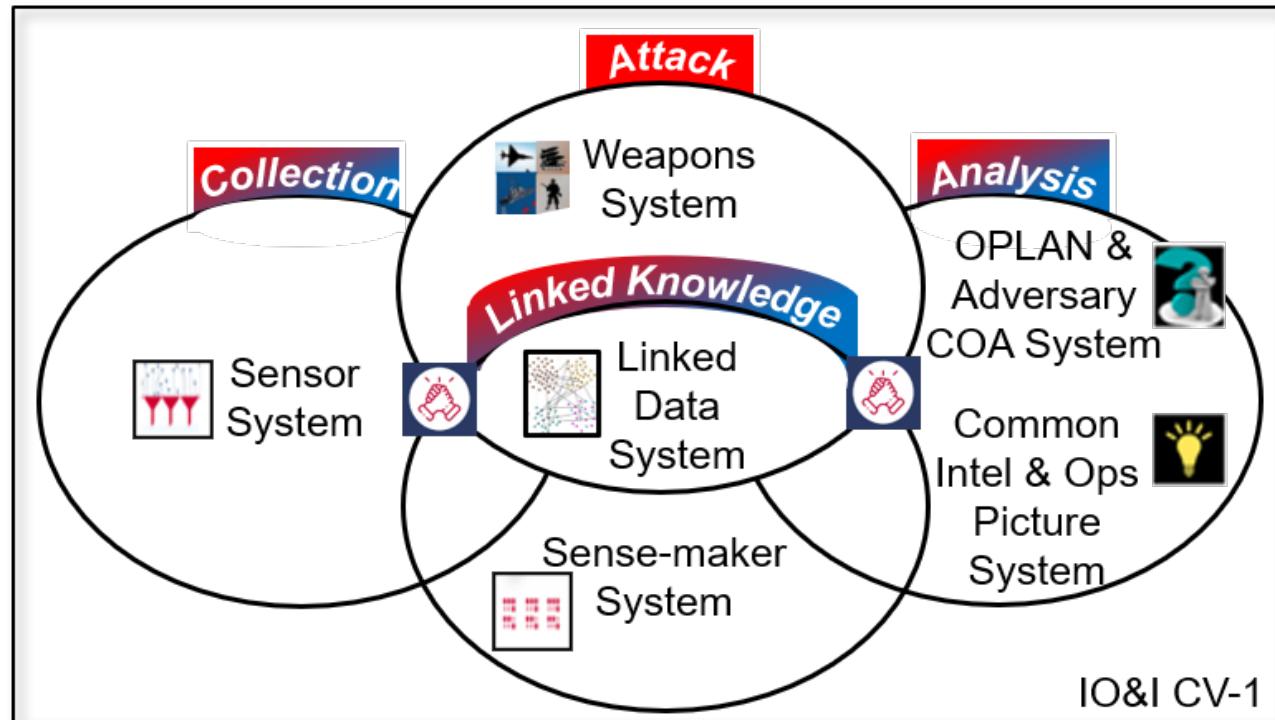
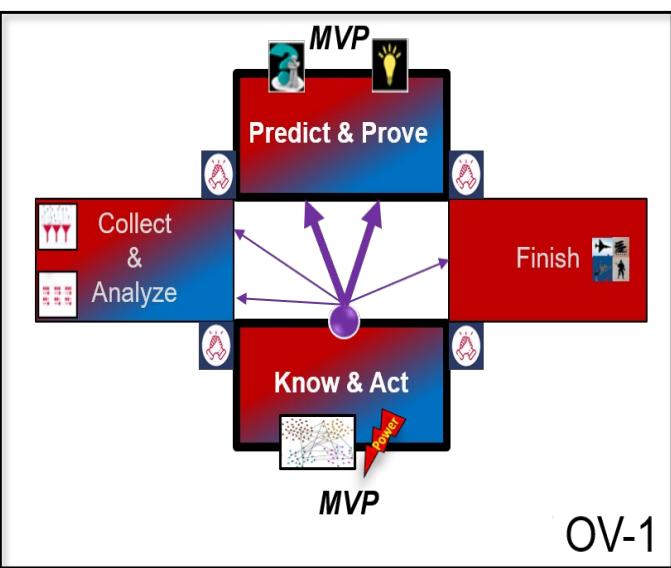


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System Enabling

- CV-1 TMA component brings into focus material solution investments and priorities
- Initial engagement with JADC2 Partners offer opportunity for cross-cutting machine-actionable ecosystem enabling comprehensive Collection, Analytics, and Weapons orchestration

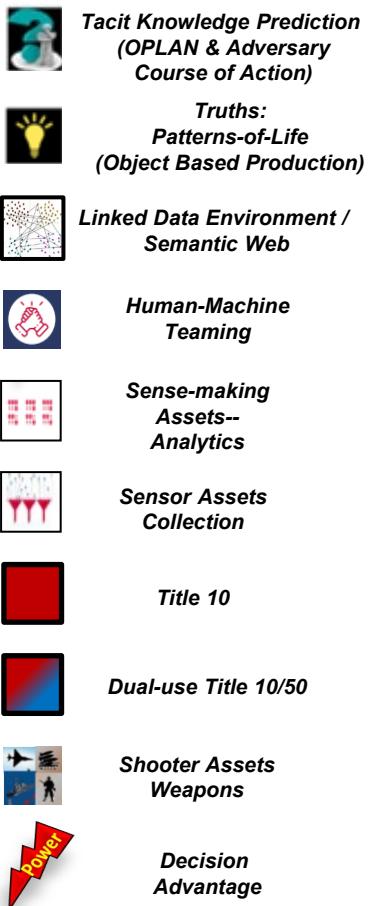
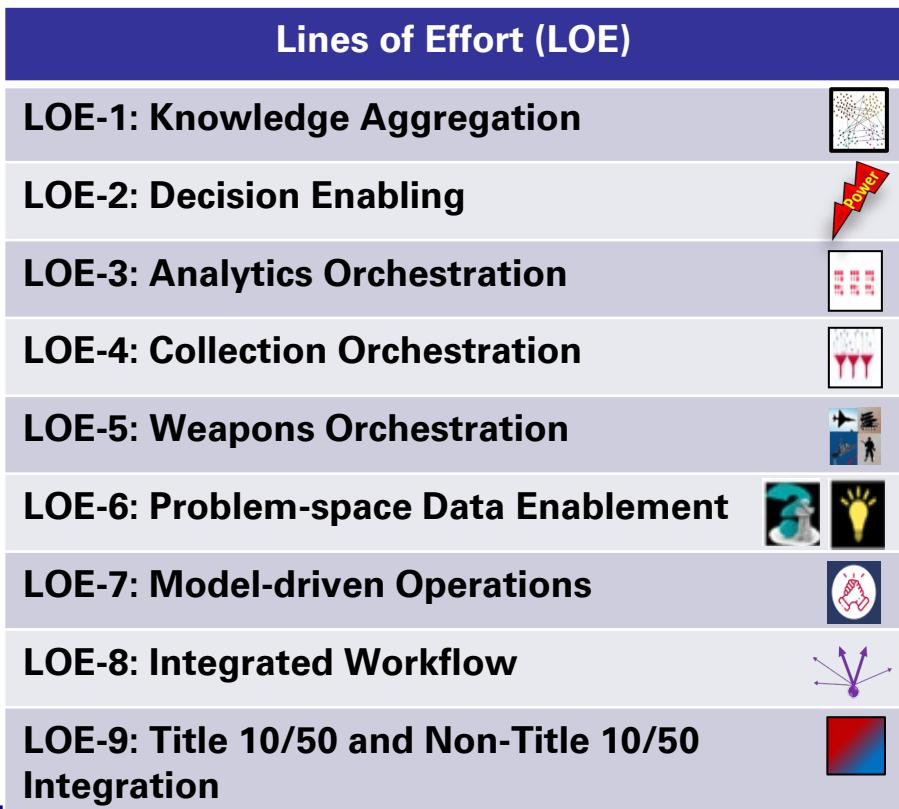


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Scoping and Implementation

- Lines of Effort (LOEs) aligned to the TMA help to define and scope work
- Progress from tangible products within each LOE supports TMA-derived needs
- LOEs are designed so that respective product deliverables enable seamless workflows for people and machines





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Discussion

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Additional Reference

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Description

- Supports DOD/IC-Wide Interagency Modernization

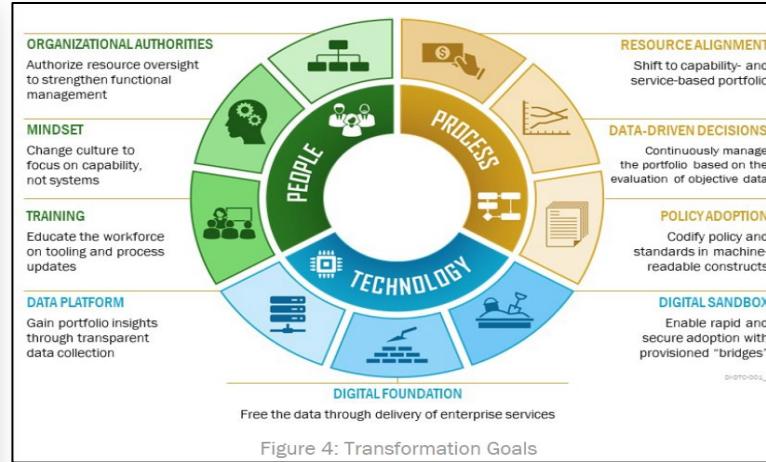
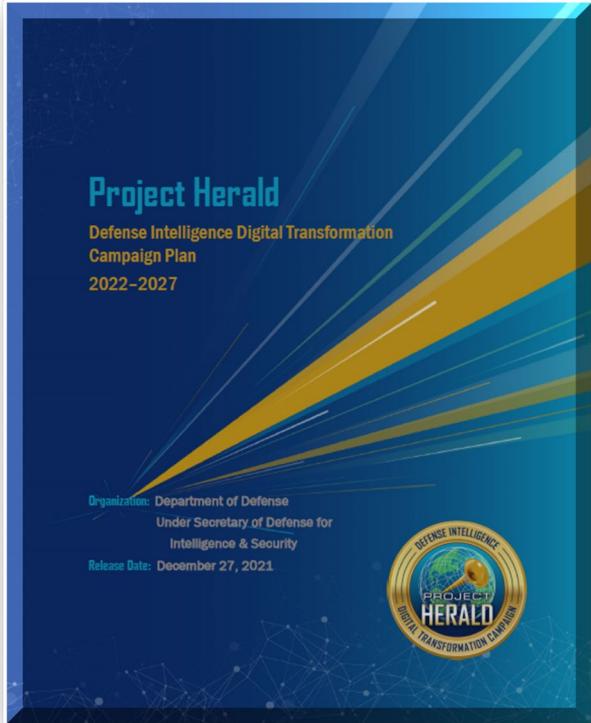
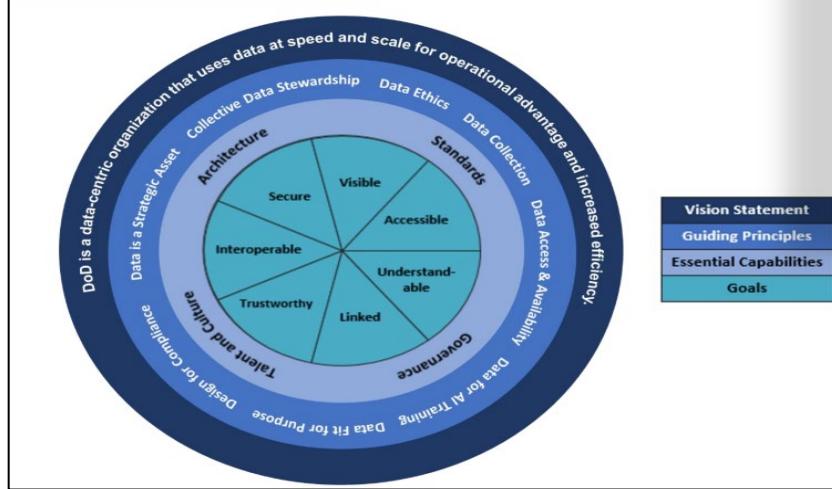


Figure 1: DoD Data Strategy Framework



USD (I&S): Dec 2021
2022-2027 Defense Intelligence
Digital Transformation Campaign

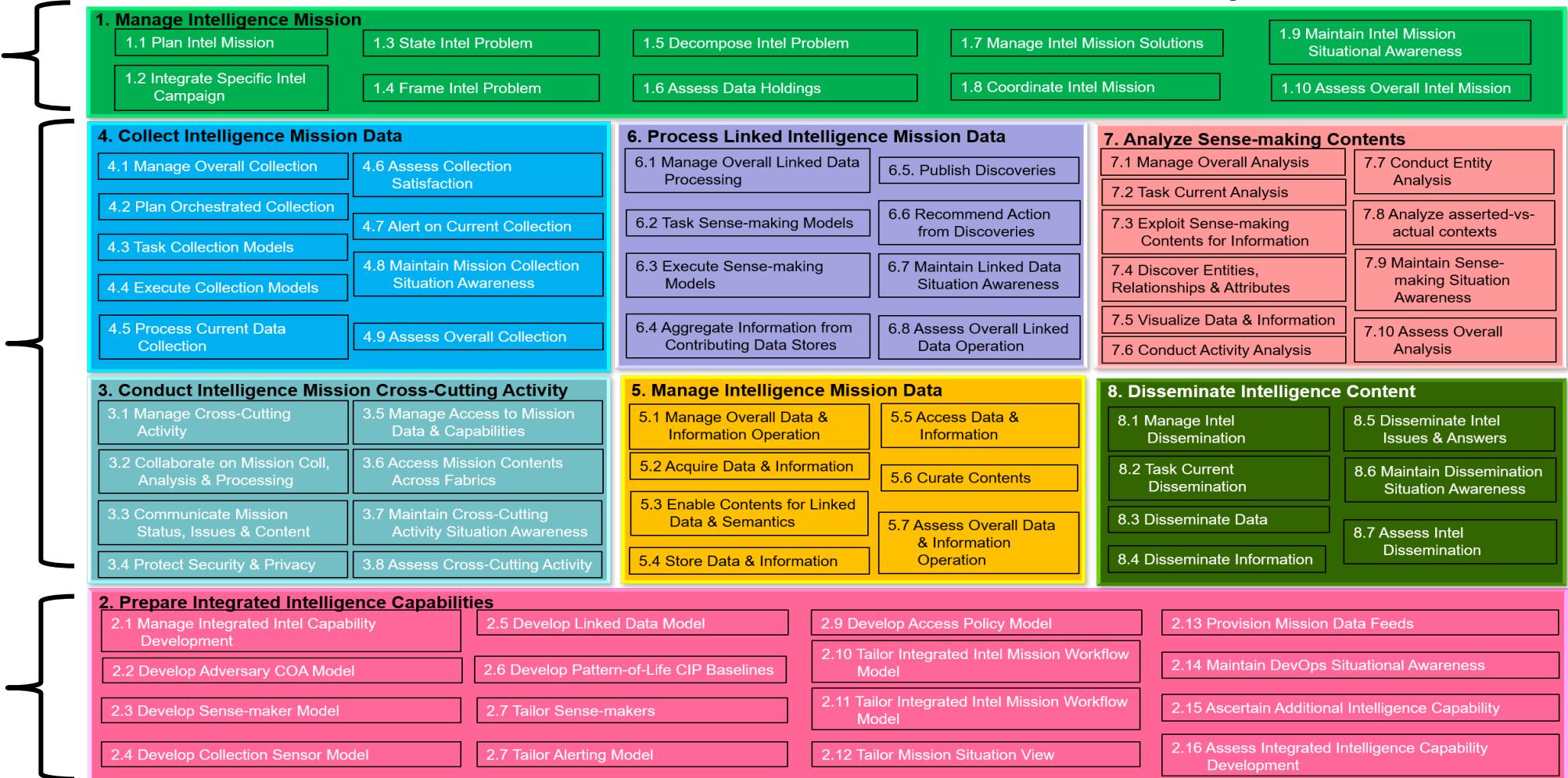
DEPSECDEF: Oct 2020
Unleashing Data to
Advance the National
Defense Strategy
[DOD Data Strategy \(defense.gov\)](https://doddatastrategy.defense.gov)



Emphasis

- Aligned with the OV-1 and CV-1, the OV5a shown here introduces 8 Functional Groups & 76 Activities

Mission Management



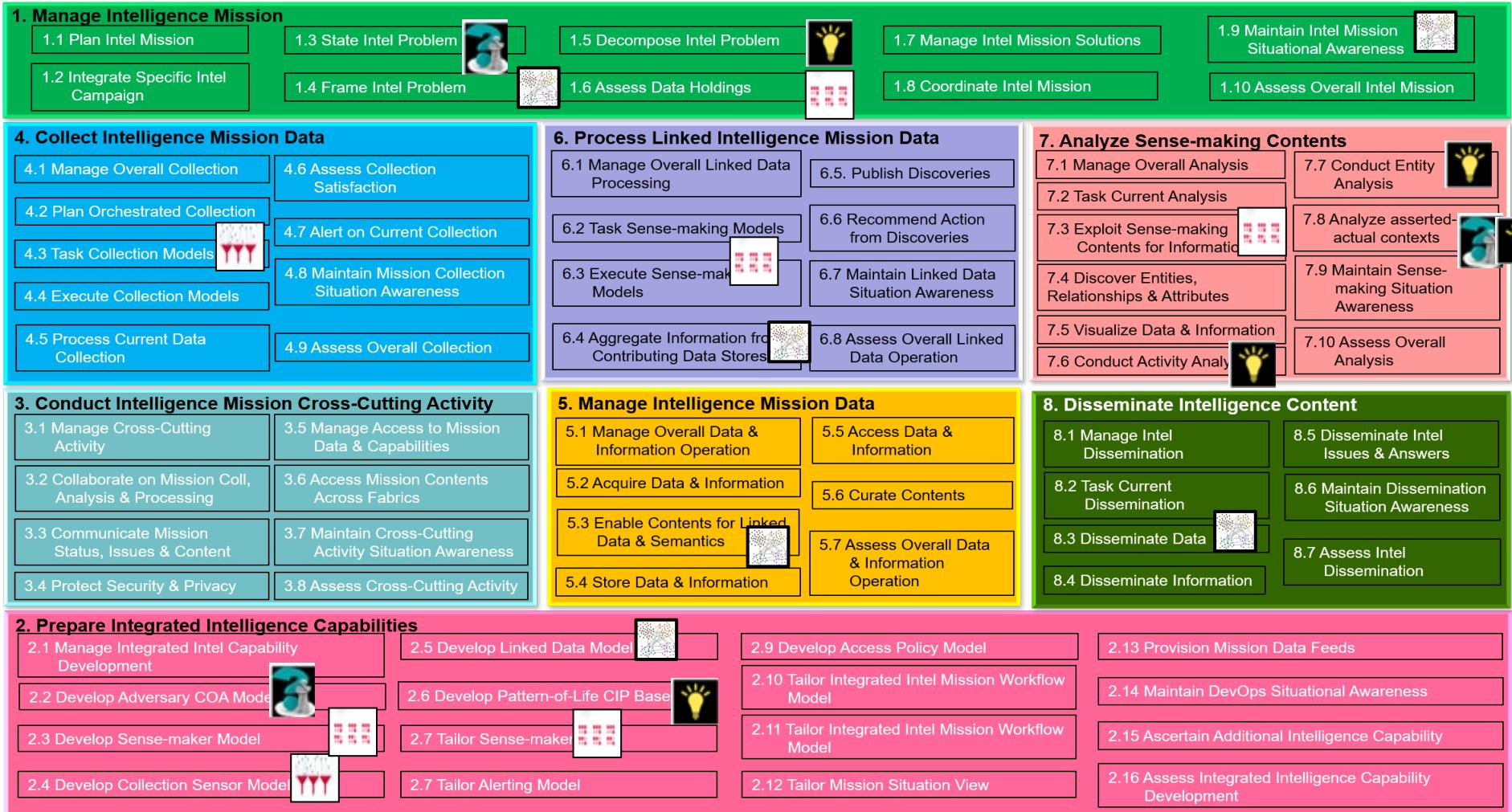
Operations

DevSecOps



Emphasis

- OV5a guides investments and focus in context of seamless end-to-end capabilities



 **Tacit Knowledge Prediction (OPLAN & Adversary Course of Action)**

 **Truths: Patterns-of-Life (Object Based Production)**

 **Linked Data Environment / Semantic Web**

 **Human-Machine Teaming**

 **Sense-making Assets--Analytics**

 **Sensor Assets Collection**

 **Title 10**

 **Dual-use Title 10/50**

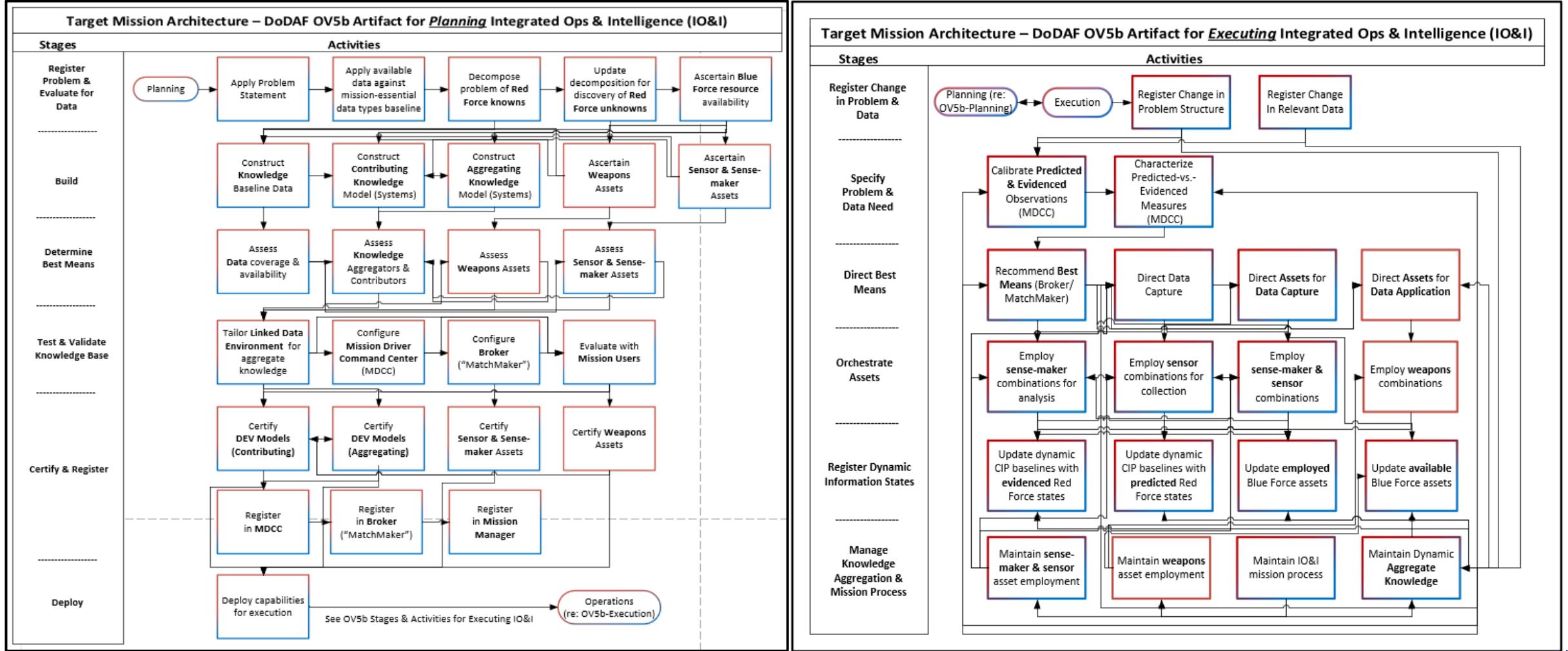
 **Shooter Assets Weapons**

 **Decision Advantage**



Emphasis

- OV5b introduces workflow Stages & Activities – modernizes legacy TCPED & Find/Fix/Track Finish

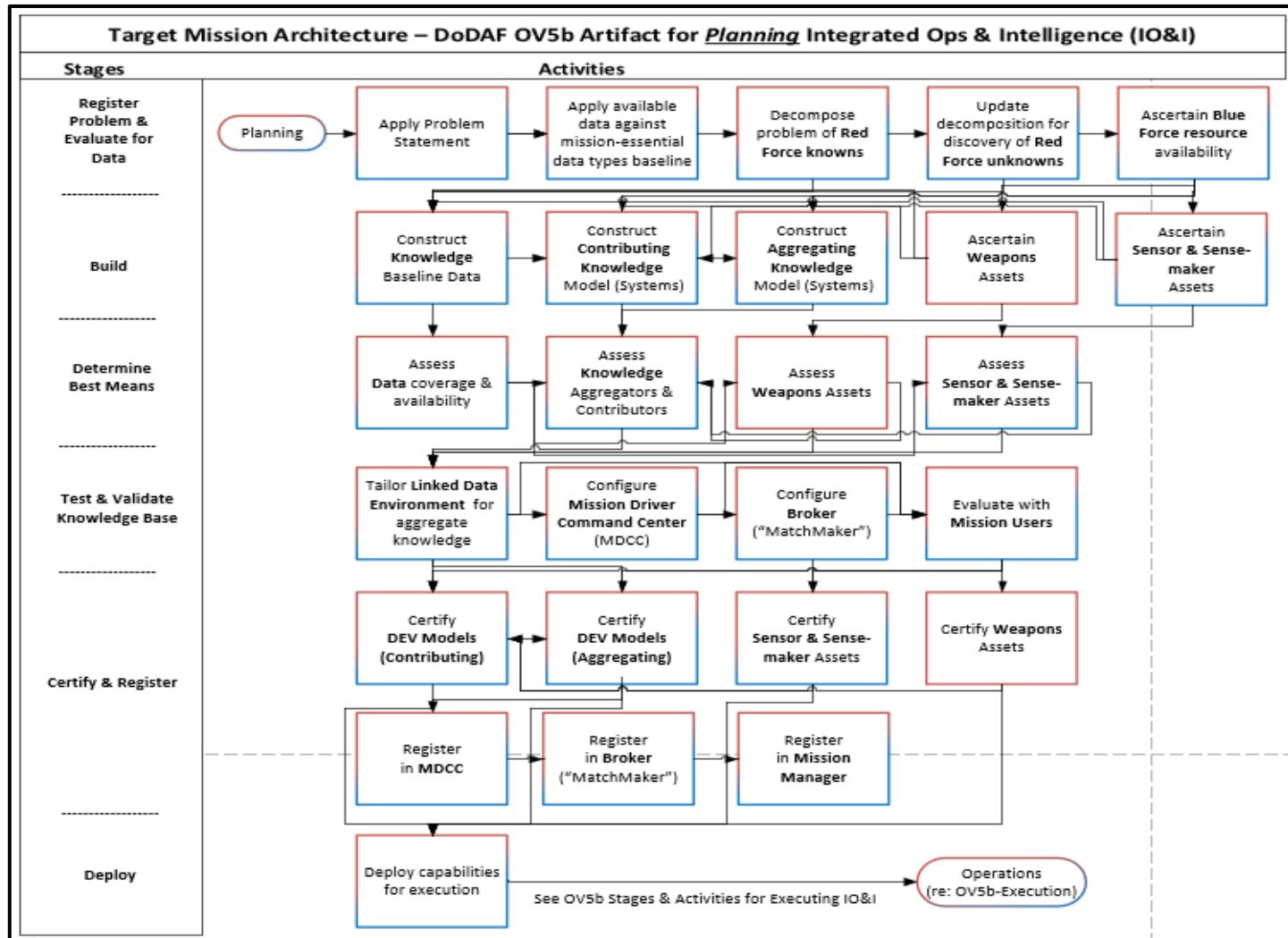


Note: OV5b Execution (Right) updated 10 Feb 2022 – OV5b-Planning updated 16 Feb 2022



Emphasis

- OV5b for ***Planning*** Stages & Activities for IO&I
- Expectation for rapid set-up and deployment/re-deployment between DevSecOps Planning & Ops Execution Mission Flow



*Dual Use Title 10/50

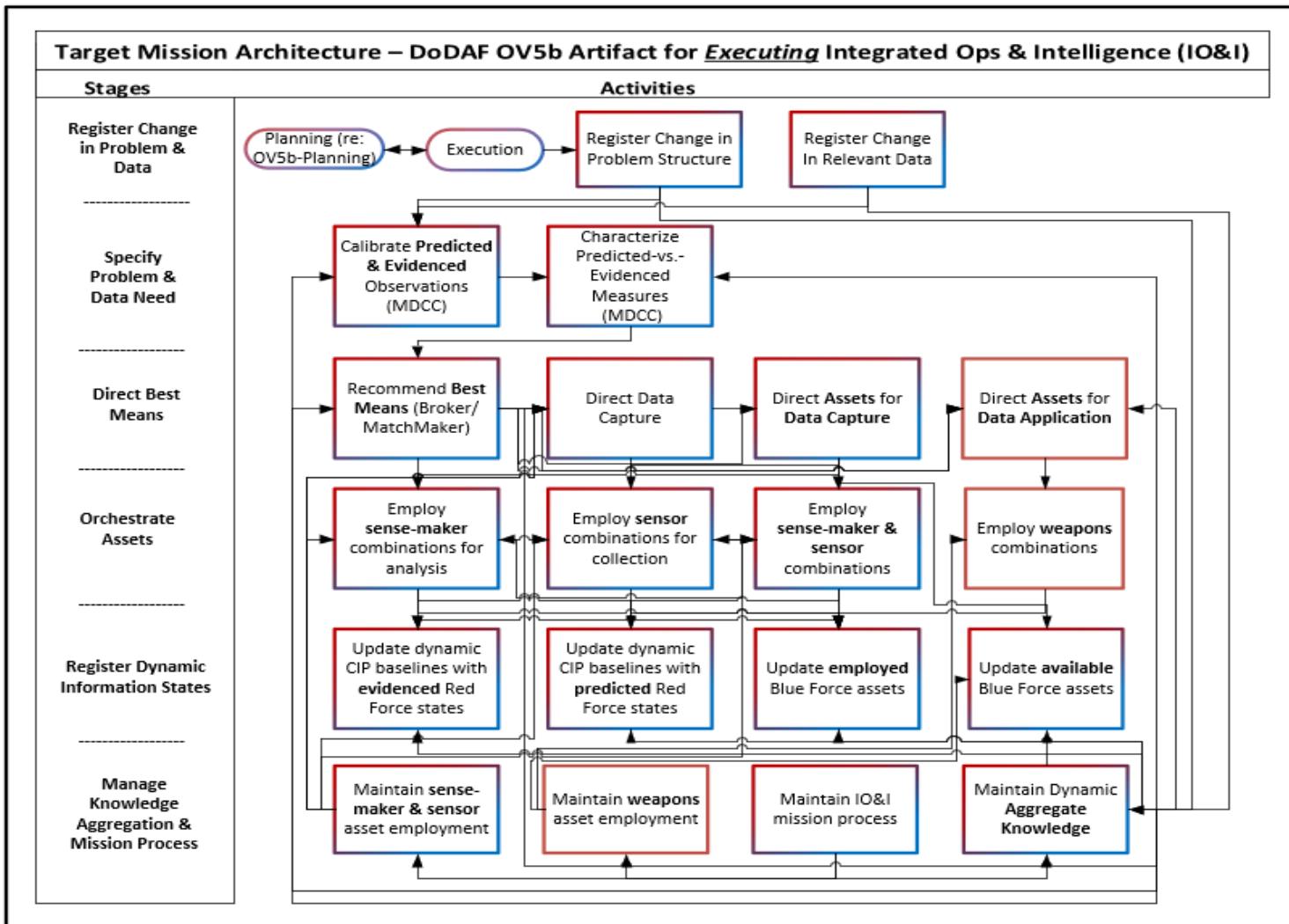
*Title 10 Use

*Consistent Process & Technology for Economy-of-Scale Concentration-of-Force Title 10/50 capabilities



Emphasis

- OV5b for **Execution**
Stages & Activities
for IO&I
- Expectation for rapid set-up and deployment/re-deployment between DevSecOps Planning & Ops Execution Mission Flow



*Dual Use Title 10/50

*Title 10 Use

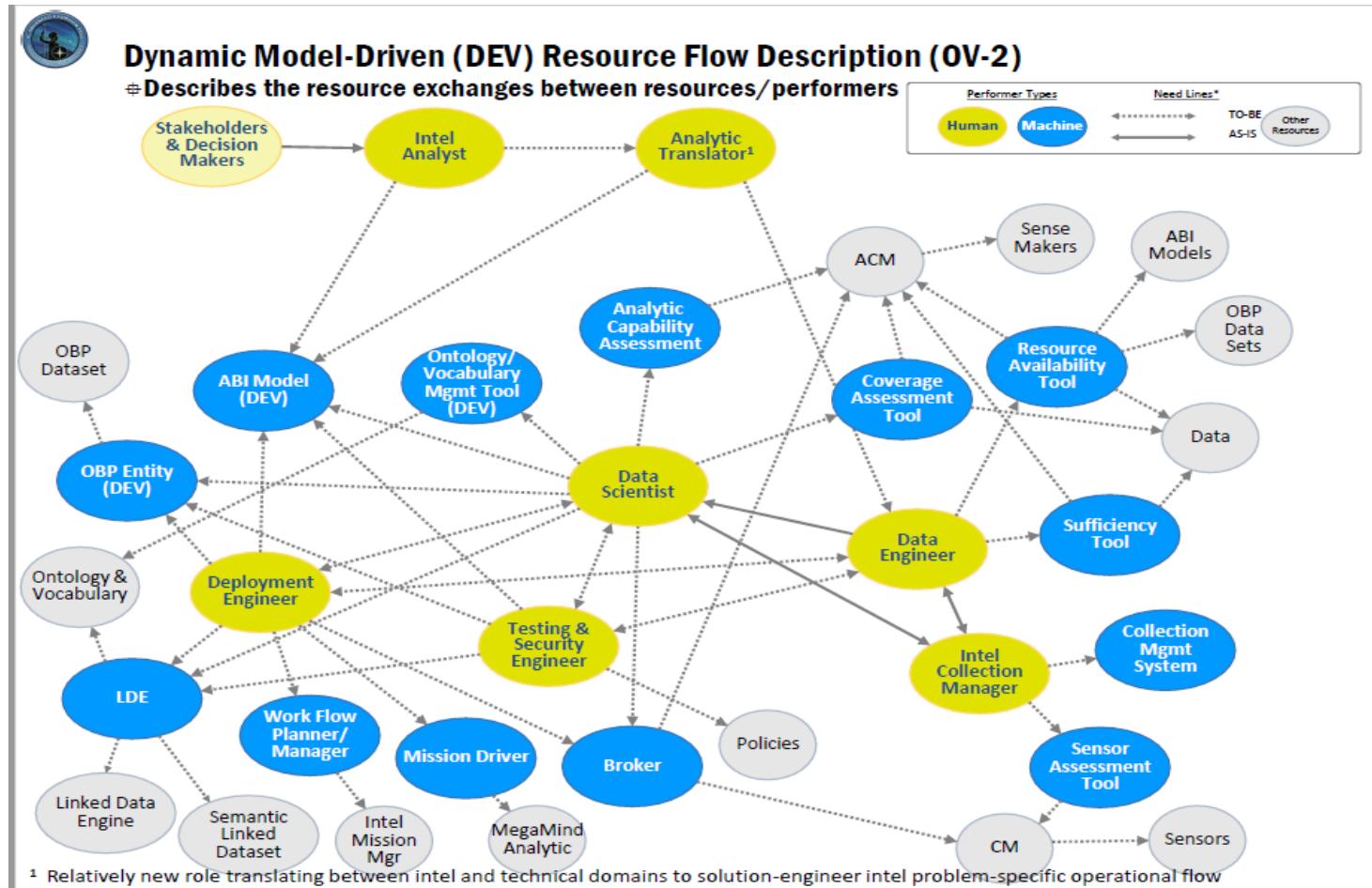
*Consistent Process & Technology for Economy-of-Scale Concentration-of-Force Title 10/50 capabilities

Note: Draft OV5b-Execution shown here current as of 10 Feb 2022 (historical reference in back-up slides)



Emphasis

- OV2 places emphasis on workflow roles of human and machine performers



Note: OV2 shown here in process of being updated to align with IO&I portfolio updates – in work as of 25 Jan 2022



Data Modernization

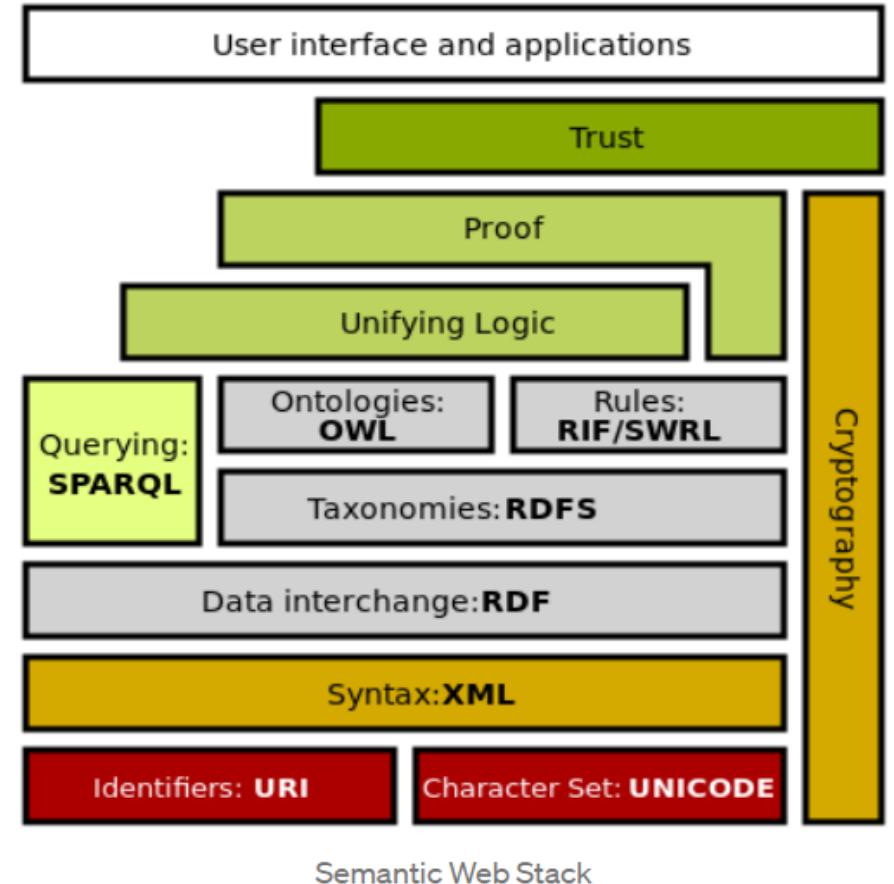
- **Data modernization activities guided by TMA introduces interdependencies for workforce, infrastructure, and enterprise architecture innovation**
 - Linked Data and Semantic Web Practices compliant with W3C standards and technologies
 - Information Technology composition for On-premise and Cloud infrastructures
 - Classes of systems aligned to at least two main categories: Contributing Knowledge systems; and Aggregating Knowledge systems
 - Knowledge Engineering talent with emphasis on Ontologies
 - Data Engineering talent with emphasis on Graph Analytics
 - Policy for sharing models comprising knowledge gained by accessing and deriving meaning from disparate systems in data silos hosted in On-premise and Cloud infrastructures



Data Modernization

- Data strategy and implementation introduces compliance with W3C standards for Linked Data and Semantic Web

- Includes and is not limited to components of the “Semantic Web Stack”:
 - Uniform Resource Indicators (URI)
 - Ontology
 - Ontology implementation technologies
 - Semantic enablers
- Knowledge Engineering Talent is integral to achieving this data transformation and establishes meaning to contents via Ontology and URI implementation for machines to understand contents like their human Partners do





Data Modernization

- DevSecOps and Production Environments are configured to support system-of-systems compute and storage of data types hosted in siloed On-premise and Cloud infrastructures

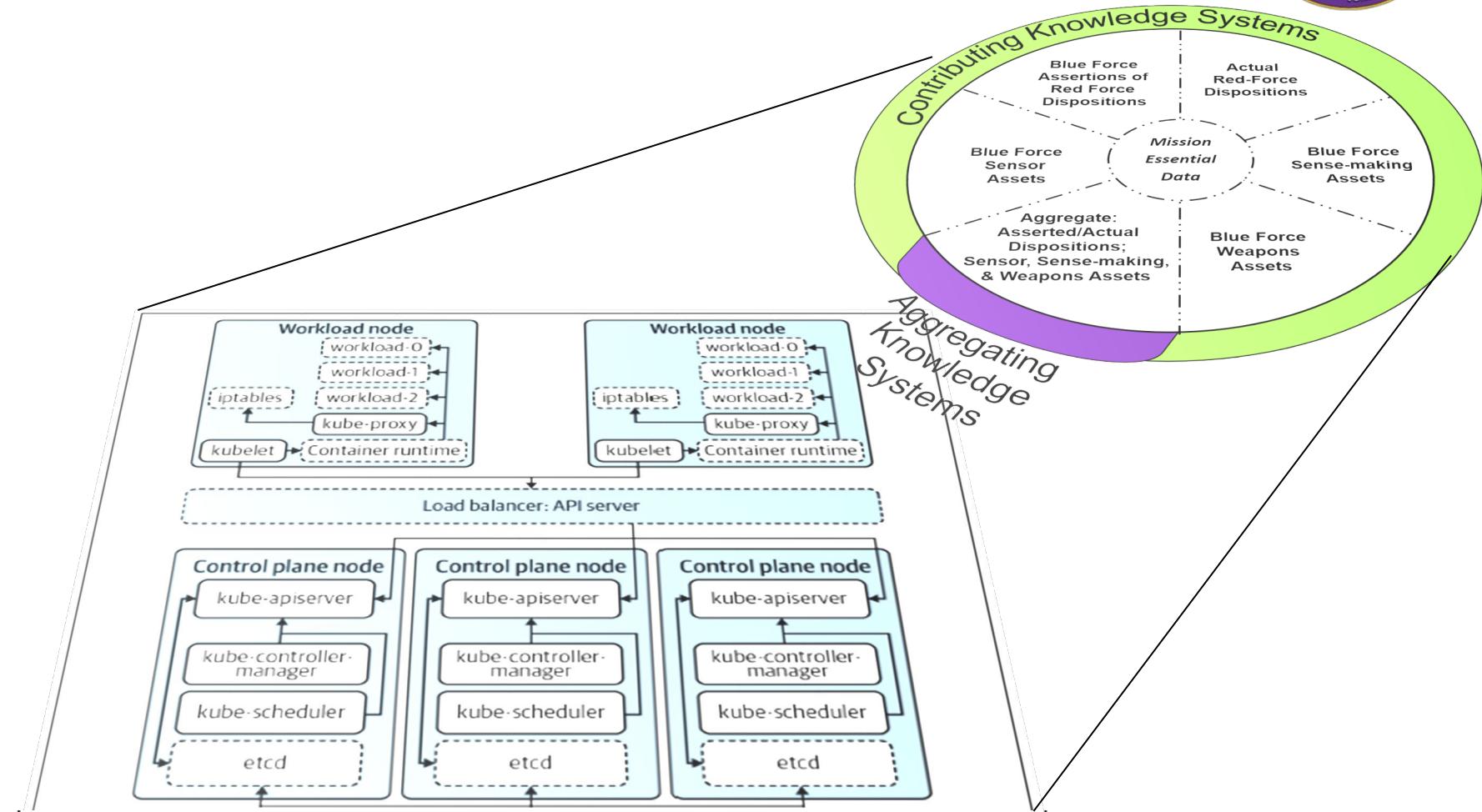
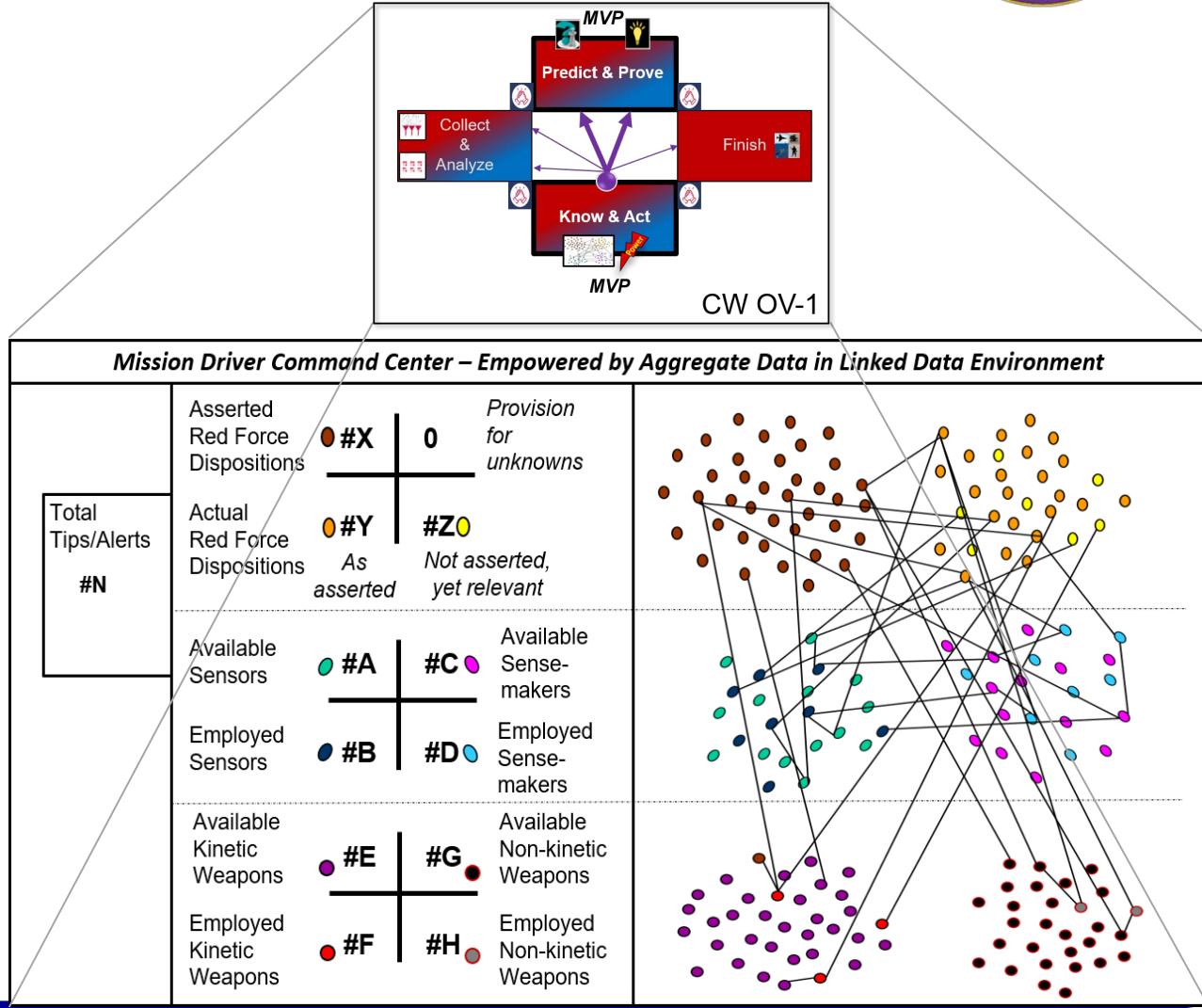


Figure 1-1. The primary components that make up the Kubernetes cluster. Dashed borders represent components that are not part of core Kubernetes.



Data Science Modernization

- Multi-Tiered, multi-faceted sense-making analytics run against unstructured and structured data in horizontal and vertical workflows
- Data Scientists/Engineers build and deploy these sense-making analytics to augment human mission managers and operators
- The MDCC serves as a starting point, concentrating on deriving actionable knowledge from Linked Data to “Know & Act”:
 - Anticipated vs. actual adversary dispositions
 - Available vs. employed collection & analytics assets
 - Available vs. employed weapons assets
- Graph Analytics Talent is integral to achieving actionable knowledge from the complex contents available in Linked Data Environment





Data Science Modernization

- **Graph Analytics Types**

- Path Analysis
- Connectivity Analysis
- Centrality Analysis
- Community Analysis
- Link Prediction

- **Graph Applications**

- Directed
- Undirected
- Weighted
- Cyclic
- MultiGraph
- HyperGraph
- HyperNodes

- **Graph Network Architectures**

- Spectral Method
 - Graph Convolutional Network
- Spatial Method
 - Message Passing Neural Network
 - Graph Attention Network
- Sampling Method
 - Graph Sage
 - Pin Sage
- Dynamic Method
 - Temporal Graph Network

- Which types, applications, and network architectures are applied to contents hosted in ***Contributing Knowledge Systems*** and ***Aggregating Knowledge Systems***?
- Which ***mission-essential data*** types are machine-actionable and being sense-made via these Graph Analytics practices?
- To what degree are contents being contributed, aggregated, and sense-made using these practices in ***Interagency*** and ***Intra-agency*** contexts?



Data Science Modernization

- **Interagency Opportunity for Data Scientists/Engineers in collaboration via CW (non-inclusive)**
 - DOE Los Alamos National Laboratories
 - SOUTHCOM Enhanced Domain Awareness (EDA) Team
 - Air Force Intelligence Systems Support Office (ISSO)
 - Air Force Air Combat Command Analysis Enterprise Management
 - NSA Chief Data Architect and Combat Support Modernization initiative
 - DIA Object Based Production Committee and related Common Intelligence Picture (CIP) modernization initiatives
 - NRO Mission Integration Directorate and related CIP modernization initiative
 - CCMDs including INDOPACOM, AFRICOM, STRATCOM, NORTHCOM, and SOUTHCOM (mentioned above)
 - ODNI Augmenting Intelligence Using Machines (AIM) iHUB modernization initiatives
 - JAIC Artificial Intelligence Data Acceleration
 - DOD Chief Data Officer – DOD-IC Ontology Working Group (DIOWG)
 - DTRA CXQ Lead Engineer leads the new DIOWG Subgroup: W3C Linked Data & Semantic Web



Data Science Modernization

- **Intra-Agency Opportunity for Data Science/Engineering leveraging Target Mission Architecture (TMA) guiding CW innovation**
 - Collaboration with:
 - R&D Directorate: Linked Data Contents and Graph Analytics innovation
 - Operations: WMD Use Cases and Mission User engagement
 - Information Technology: Compute, Storage, Security, Access
 - Policy: Expectations for compliance to W3C standards for Linked Data; modernized implementation of Joint Doctrine (e.g., Joint Pub 2-01.3 (JIPOE); traceability/support to Project Herald, DOD Data Strategy, and DTRA Strategy
 - Use TMA CONOPs, DoDAF Systems Engineering Portfolio for Integrated Operations & Intelligence (IO&I), and MDCC
 - CONOPs: Proposed Mission and Technical Capabilities
 - IO&I: Initial emphasis on OV-1, CV-1, OV5a, OV5b (8 Functional Groups and 76 Activities transcending Mission Management, Operations, and DevSecOps)
 - MDCC: Implementation of CONOPs and DoDAF Portfolio coalescing our Linked Data Contributing Knowledge & Aggregating Knowledge components (CW MVP)



Scoping and Implementation

LOE	Description
LOE-1: Knowledge Aggregation	Information derived from semantically-enabled data in siloed contributing knowledge systems is available in scalable Enterprise aggregating knowledge systems – Enterprise Knowledge Graph and Semantic Web capabilities
LOE-2: Decision Enabling	User-facing applications visualize insights from contributing and aggregating knowledge systems for alerting, situational awareness, and decision-making by people
LOE-3: Analytics Orchestration	Information about Artificial Intelligence (AI), Machine Learning (ML), Analytic Models, and Analytics and contributing knowledge systems hosting this information that drive nomination, prioritization, synchronization and use of AI/ML combinations in support of adversary and environmental issues
LOE-4: Collection Orchestration	Information about sensors and contributing knowledge systems hosting this information that drive nomination, prioritization, synchronization and use of sensor combinations in support of adversary and environmental issues
LOE-5: Weapons Orchestration	Information about kinetic and non-kinetic assets and contributing knowledge systems hosting this information that drive nomination, prioritization, synchronization and use of weapons combinations in support of adversary and environment issues
LOE-6: Problem-space Data Enablement	Information and contributing systems hosting the information about OPLAN and Adversary Course of Action decomposition conveying anticipated/predicted adversary and environment issues in context of evidenced/actual dispositions as revealed through Common Intelligence and Operations Picture baselines
LOE-7: Model-driven Operations	Transaction capabilities among aggregating and contributing knowledge systems and respective hosted information for dynamic coverage of anticipated-vs.-actual and available-vs.-employed Red and Blue Force dispositions
LOE-8: Integrated Workflow	User engagement comprising two areas of emphasis in context of exercising Model-driven Operations workflows. First areas is the practical application of tradecraft and processes, irrespective of specific tools and services available – helping Mission Users experience approach. Second area is the systems engineering activity guided by the novel TMA that conveys envisioned Integrated & Operations Intelligence state.
LOE-9: Title 10/50 and Non-Title 10/50 Integration	Technically consistent approaches designed for economy-of-scale and concentration-of-force capabilities within and across enterprises serving operations under various U.S. Code Title authority. Purpose-built for problem agnostic, domain agnostic capabilities viable for myriad Operations, Intelligence, and Law Enforcement issues at whole-of-government scale

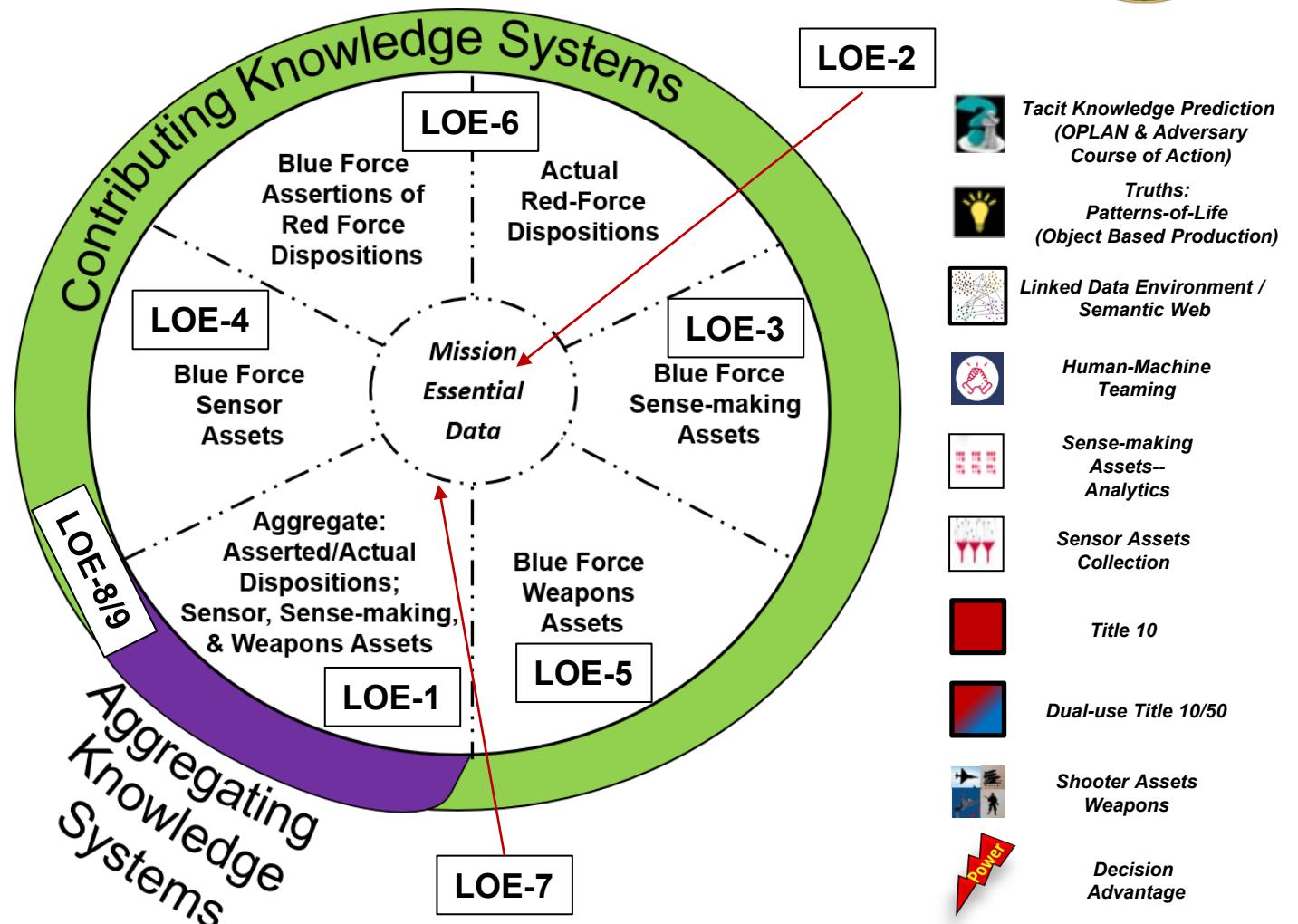


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LOE Alignment to Data Types

Lines of Effort (LOE)	
LOE-1: Knowledge Aggregation	
LOE-2: Decision Enabling	
LOE-3: Analytics Orchestration	
LOE-4: Collection Orchestration	
LOE-5: Weapons Orchestration	
LOE-6: Problem-space Data Enablement	
LOE-7: Model-driven Operations	
LOE-8: Integrated Workflow	
LOE-9: Title 10/50 and Non-Title 10/50 Integration	



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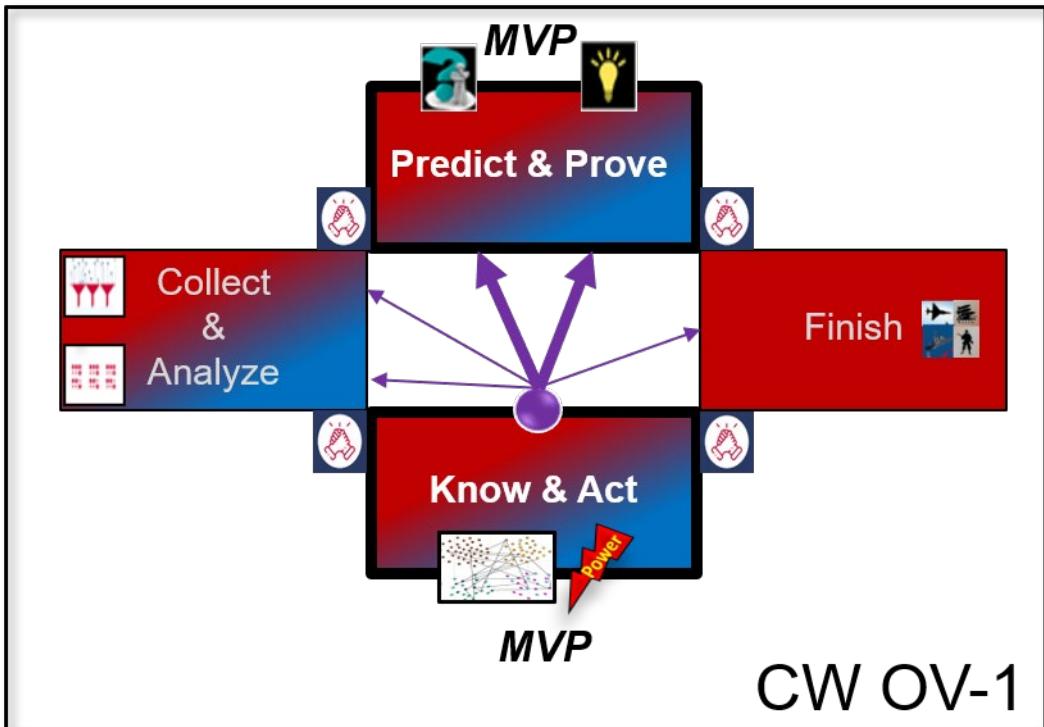


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LOE Alignment to OV-1

Lines of Effort (LOE)	
LOE-1: Knowledge Aggregation	
LOE-2: Decision Enabling	
LOE-3: Analytics Orchestration	
LOE-4: Collection Orchestration	
LOE-5: Weapons Orchestration	
LOE-6: Problem-space Data Enablement	
LOE-7: Model-driven Operations	
LOE-8: Integrated Workflow	
LOE-9: Title 10/50 and Non-Title 10/50 Integration	



- Tacit Knowledge Prediction**
(OPLAN & Adversary Course of Action)
- Truths:**
Patterns-of-Life
(Object Based Production)
- Linked Data Environment / Semantic Web**
- Human-Machine Teaming**
- Sense-making Assets--Analytics**
- Sensor Assets Collection**
- Title 10**
- Dual-use Title 10/50**
- Shooter Assets Weapons**
- Decision Advantage**

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LOE Alignment to CV-1

Lines of Effort (LOE)

LOE-1: Knowledge Aggregation



LOE-2: Decision Enabling



LOE-3: Analytics Orchestration



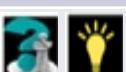
LOE-4: Collection Orchestration



LOE-5: Weapons Orchestration



LOE-6: Problem-space Data Enablement



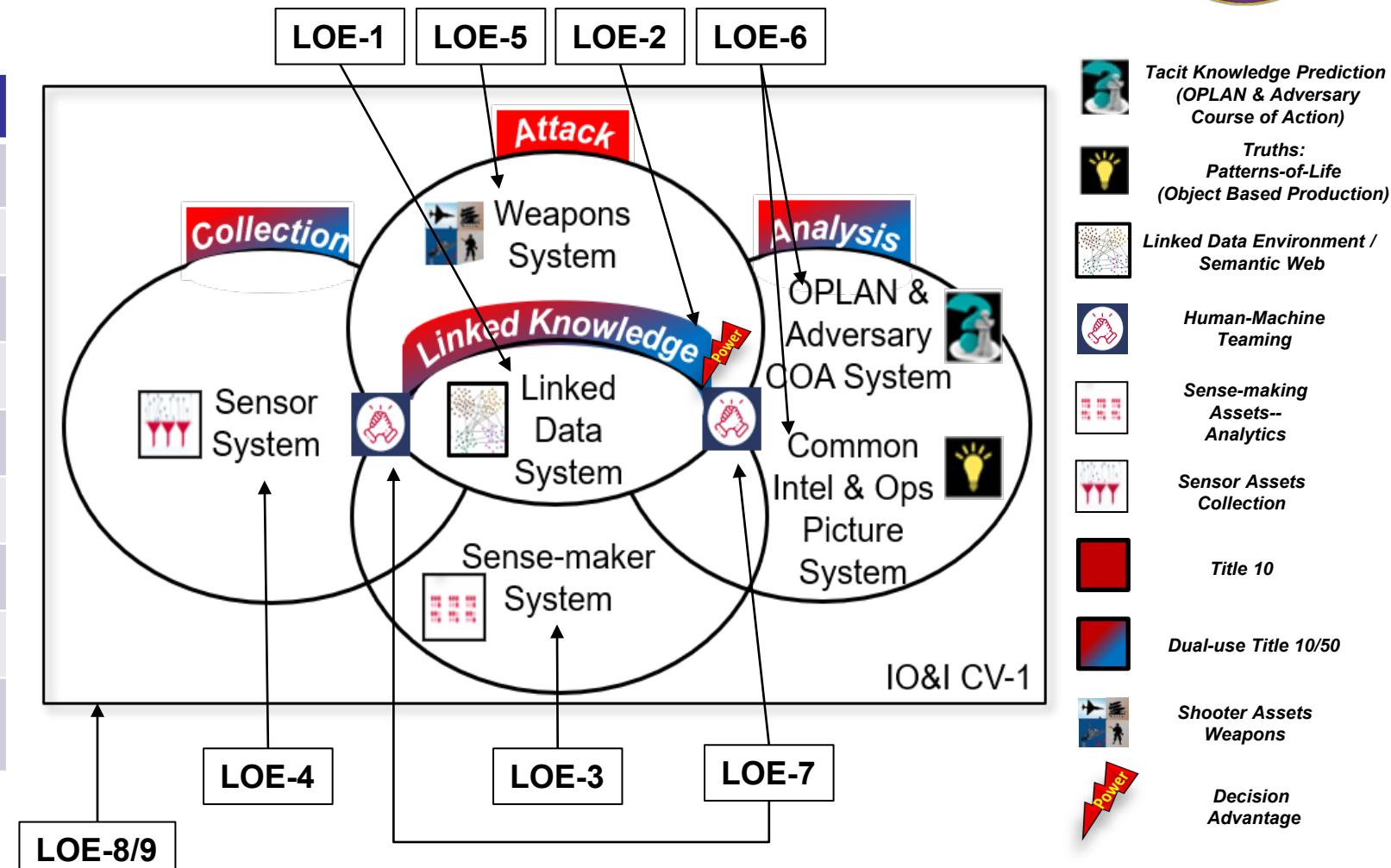
LOE-7: Model-driven Operations



LOE-8: Integrated Workflow



LOE-9: Title 10/50 and Non-Title 10/50 Integration



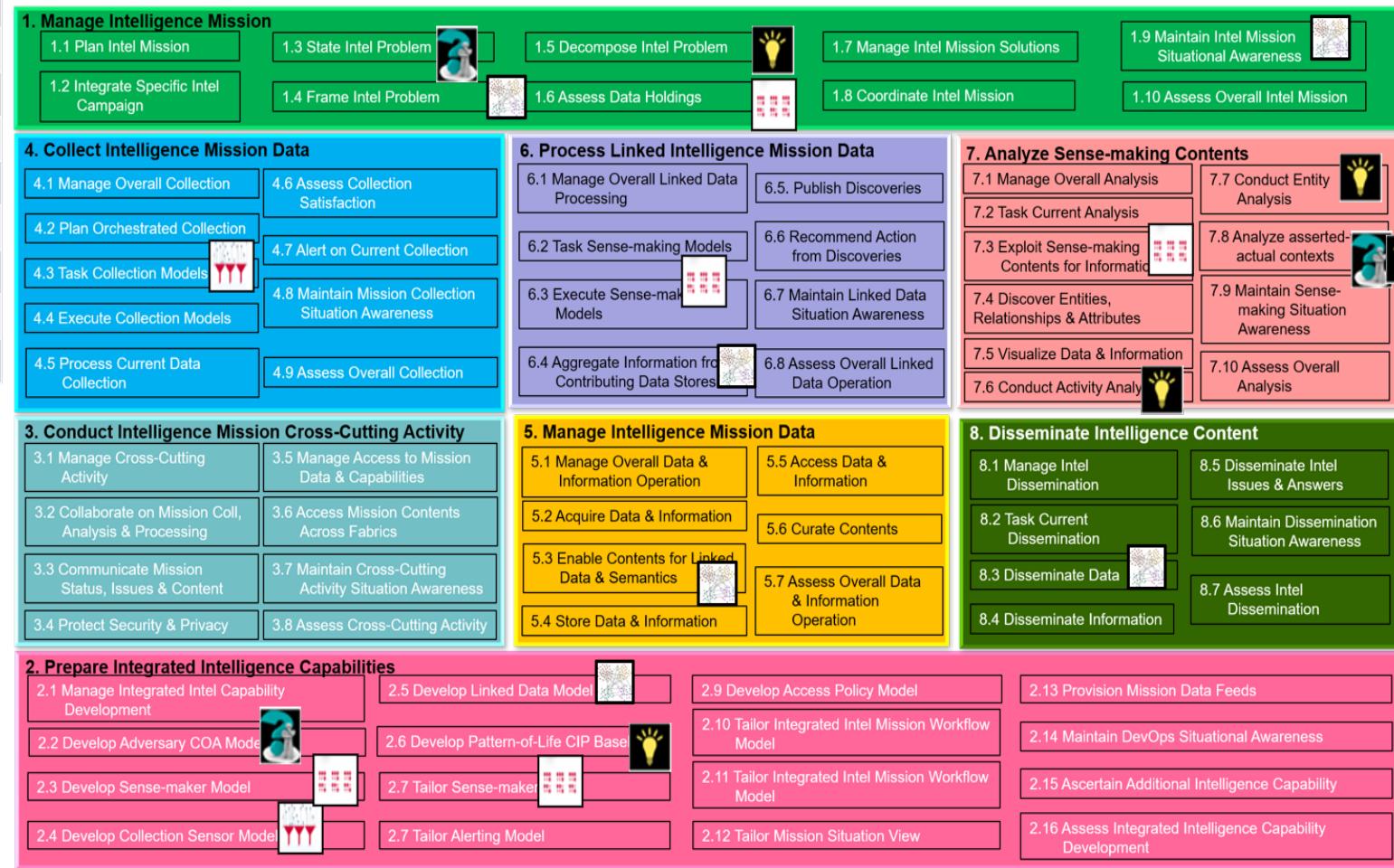
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LOE Alignment to OV5a

In-work (as of 07 Feb)

Lines of Effort (LOE)	
LOE-1: Knowledge Aggregation	
LOE-2: Decision Enabling	
LOE-3: Analytics Orchestration	
LOE-4: Collection Orchestration	
LOE-5: Weapons Orchestration	
LOE-6: Problem-space Data Enablement	
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