

Use of an Executable Workflow Model to Evaluate C2 Processes

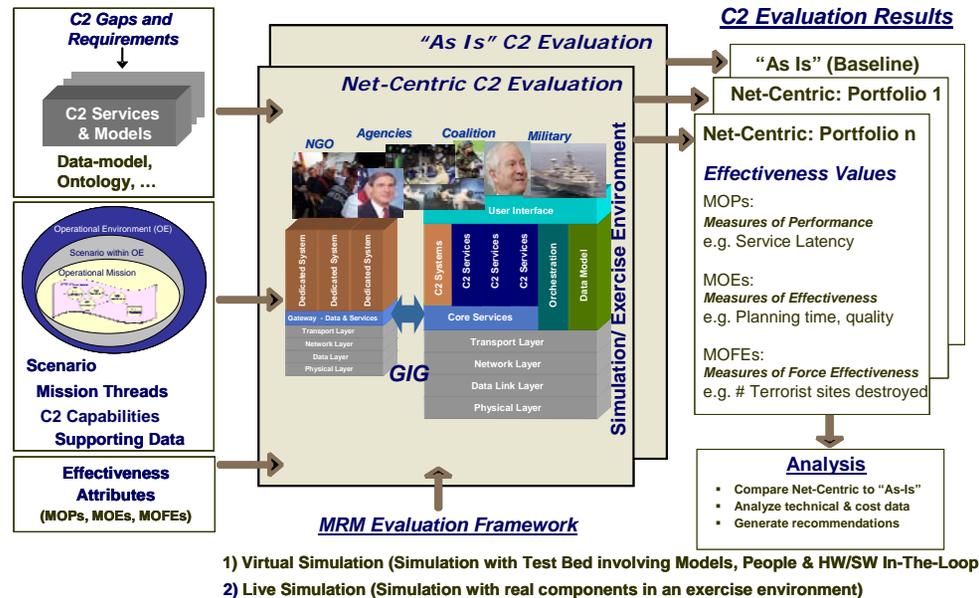
Paul North
paul.north@jhuapl.edu



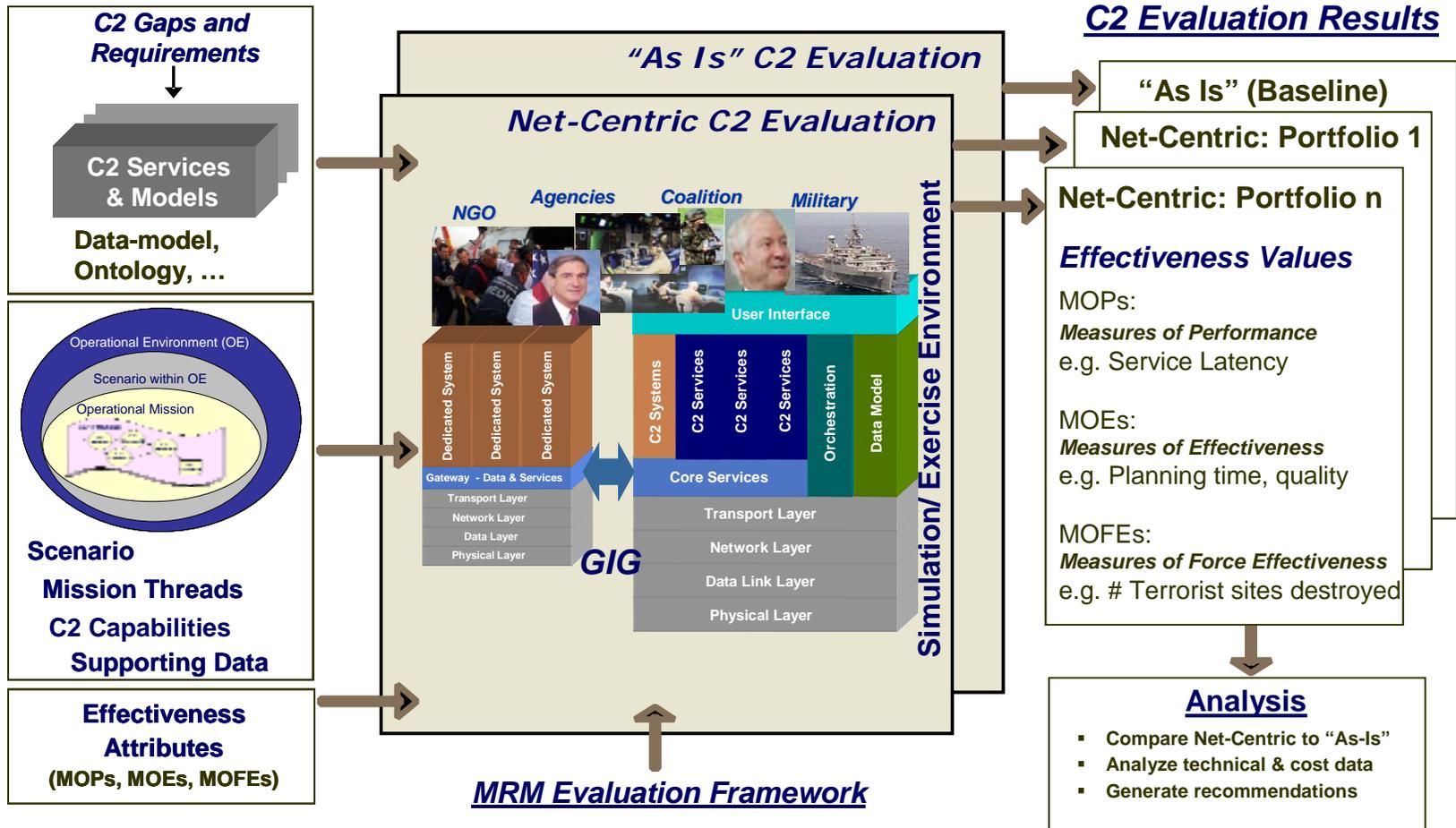
C2 Evaluation - Critical Challenges & Need

Critical Challenges:

- Evaluating command & control (C2)
- Evaluating the impact of net-centricity on force effectiveness
- Decision makers require quantitative methods and metrics for measuring the extent to which:
 - Net-centricity improve C2 and related applications
 - The GIG infrastructure and Core Services effectively and efficiently support C2 and related applications



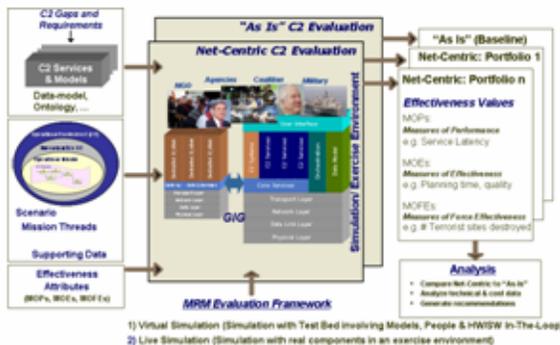
Multi-resolution Modeling Evaluation Framework



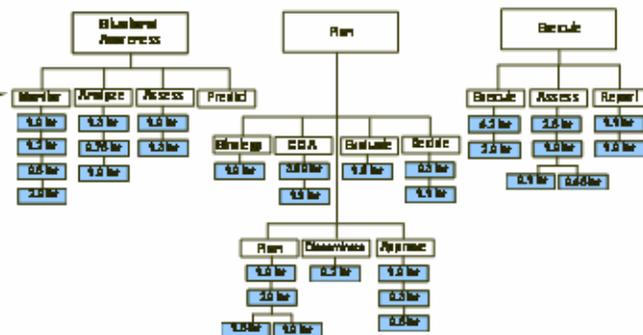
- 1) Virtual Simulation (Simulation with Test Bed involving Models, People & HW/SW In-The-Loop)
- 2) Live Simulation (Simulation with real components in an exercise environment)

Net-centric C2 Evaluation: Key Elements

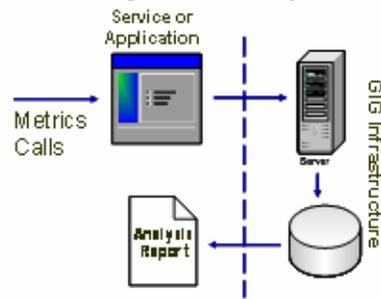
Multi-resolution Modeling Evaluation Framework



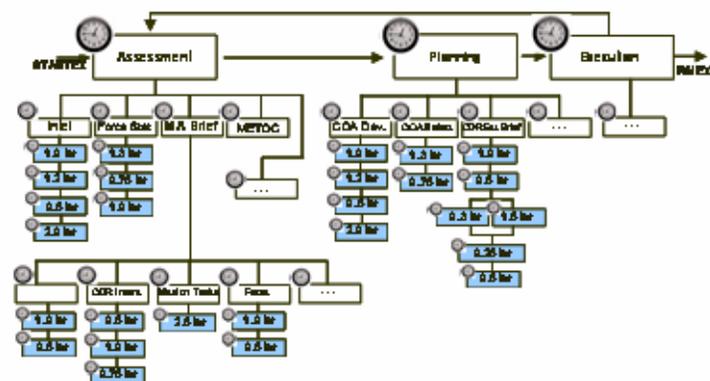
Process Decomposition & Assessment



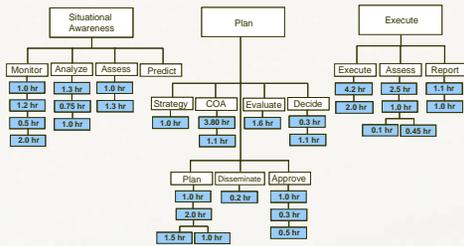
Automated Data Collection, Analysis, & Reporting



Mission-specific Workflow Evaluation



Process Decomposition & Assessment



Process Decomposition & Assessment

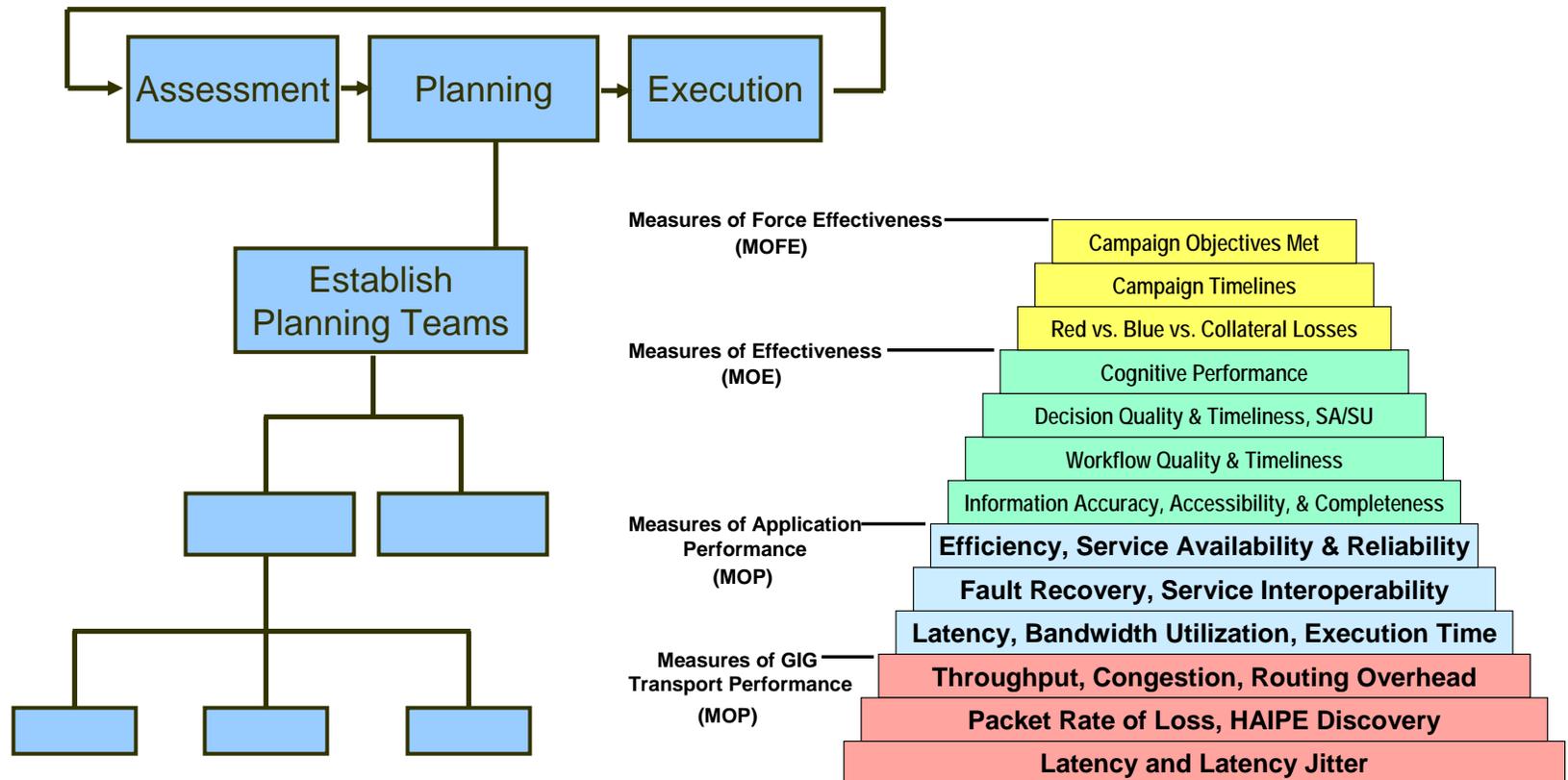
APL

The Johns Hopkins University
APPLIED PHYSICS LABORATORY

C² Process Decomposition

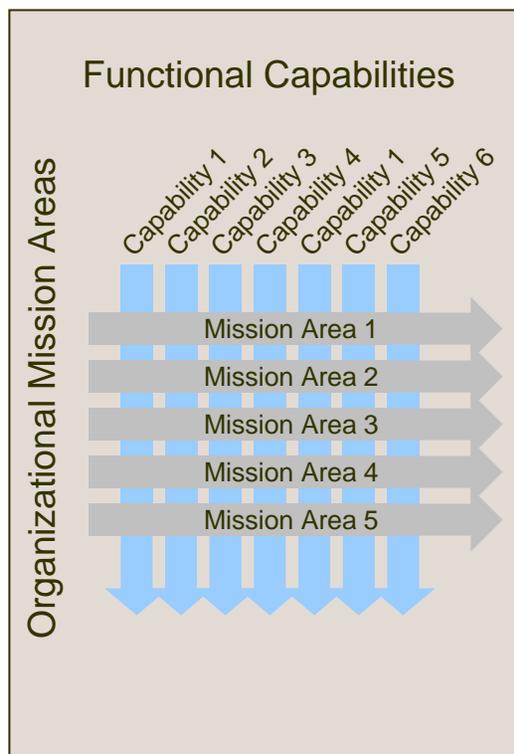
Serves as the basis for measuring end-to-end performance

Example: Global Strike Mission End-to-End C² Process



Define detailed measures and metrics to measure and evaluate the quality and execution time of COA Development tasks at the MOE and MOP levels

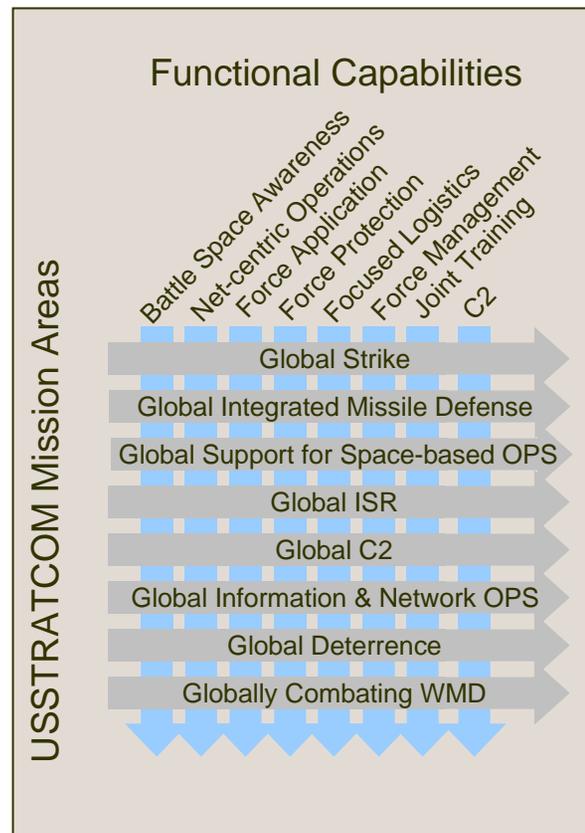
Mission Area/Functional Capabilities Map



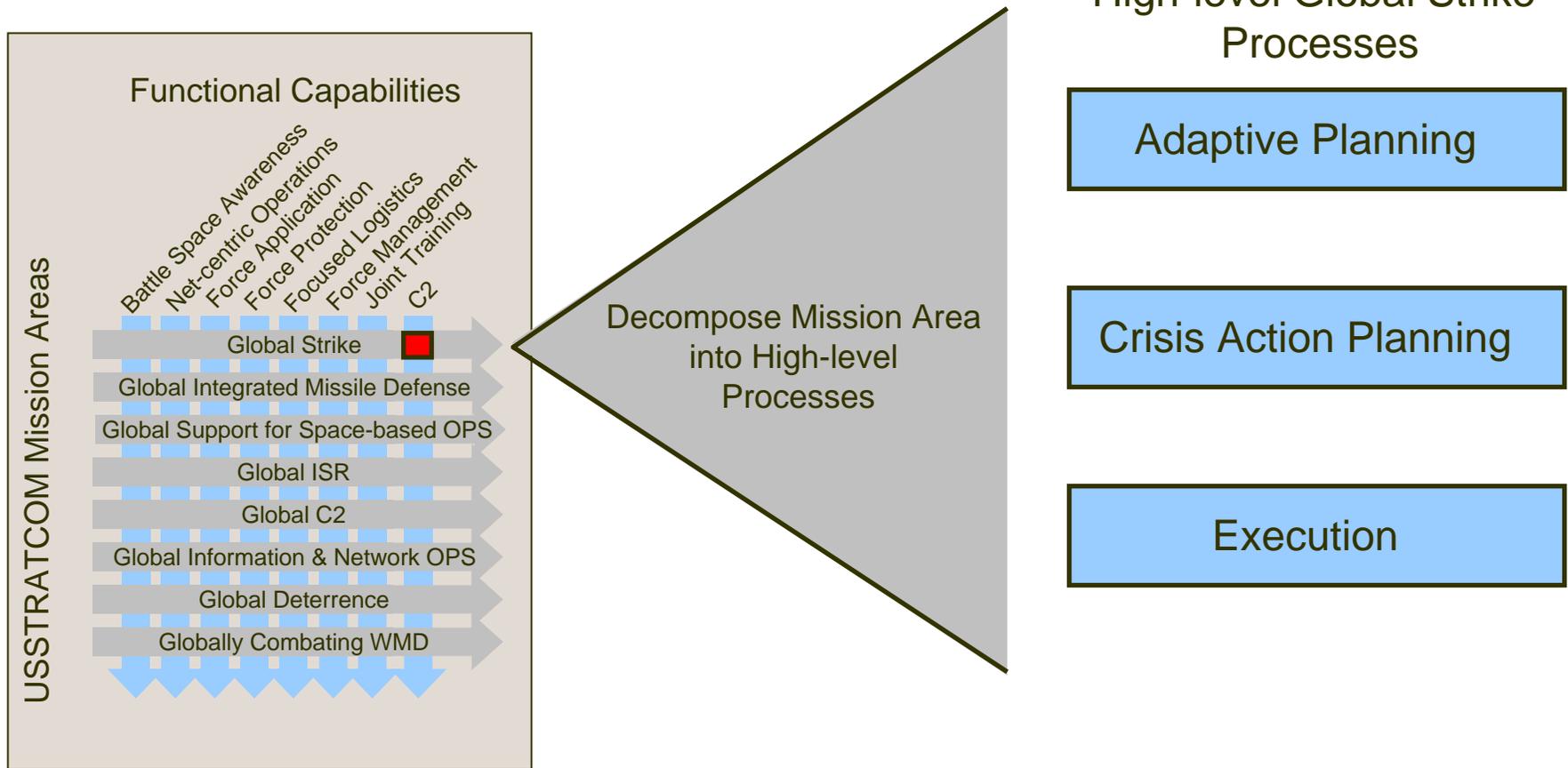
Mission Area
Domain Mapping

A large, hollow arrow points from the left diagram to the right diagram, signifying the application of the mapping process to a specific example.

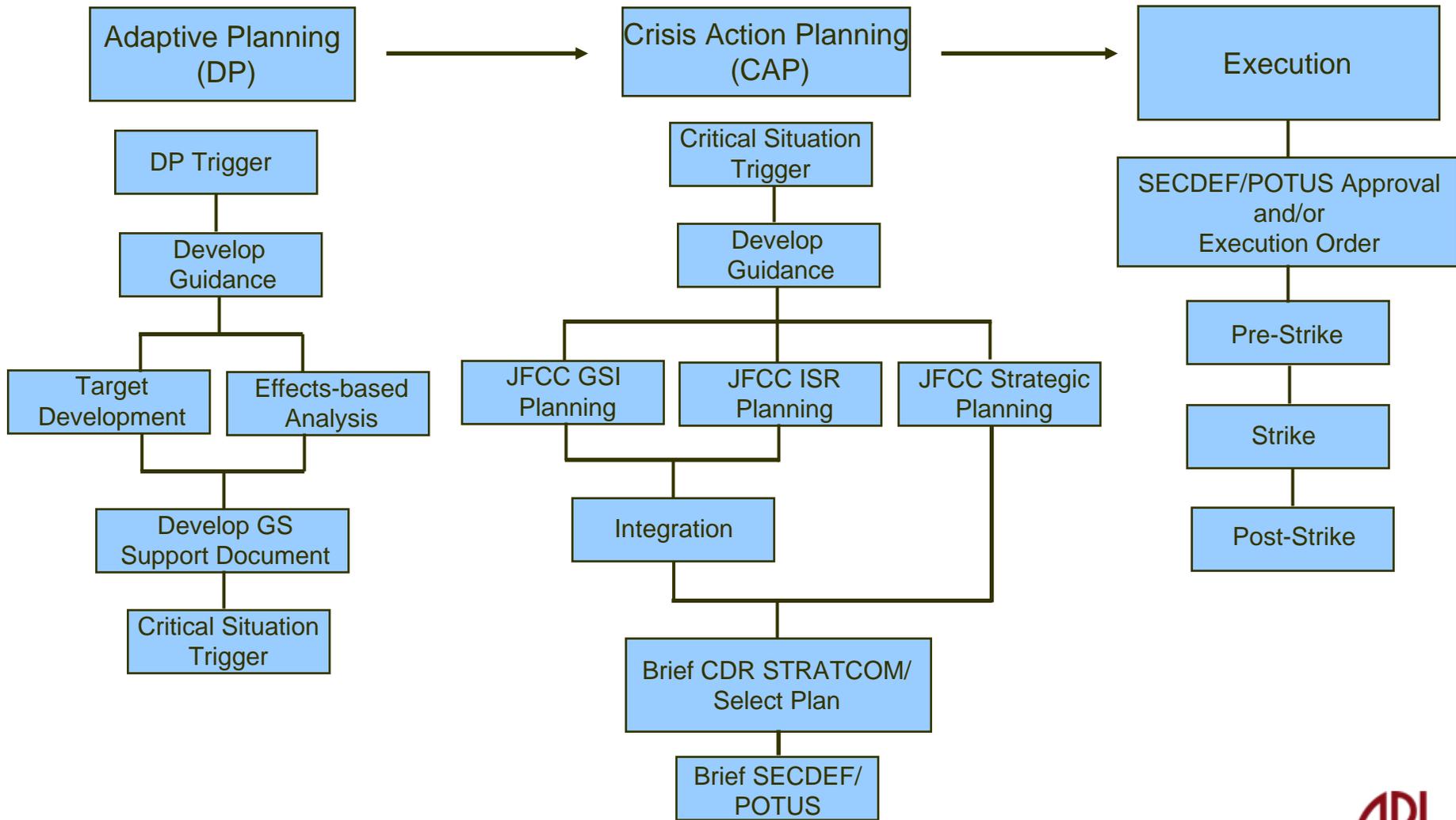
USSTRATCOM Example



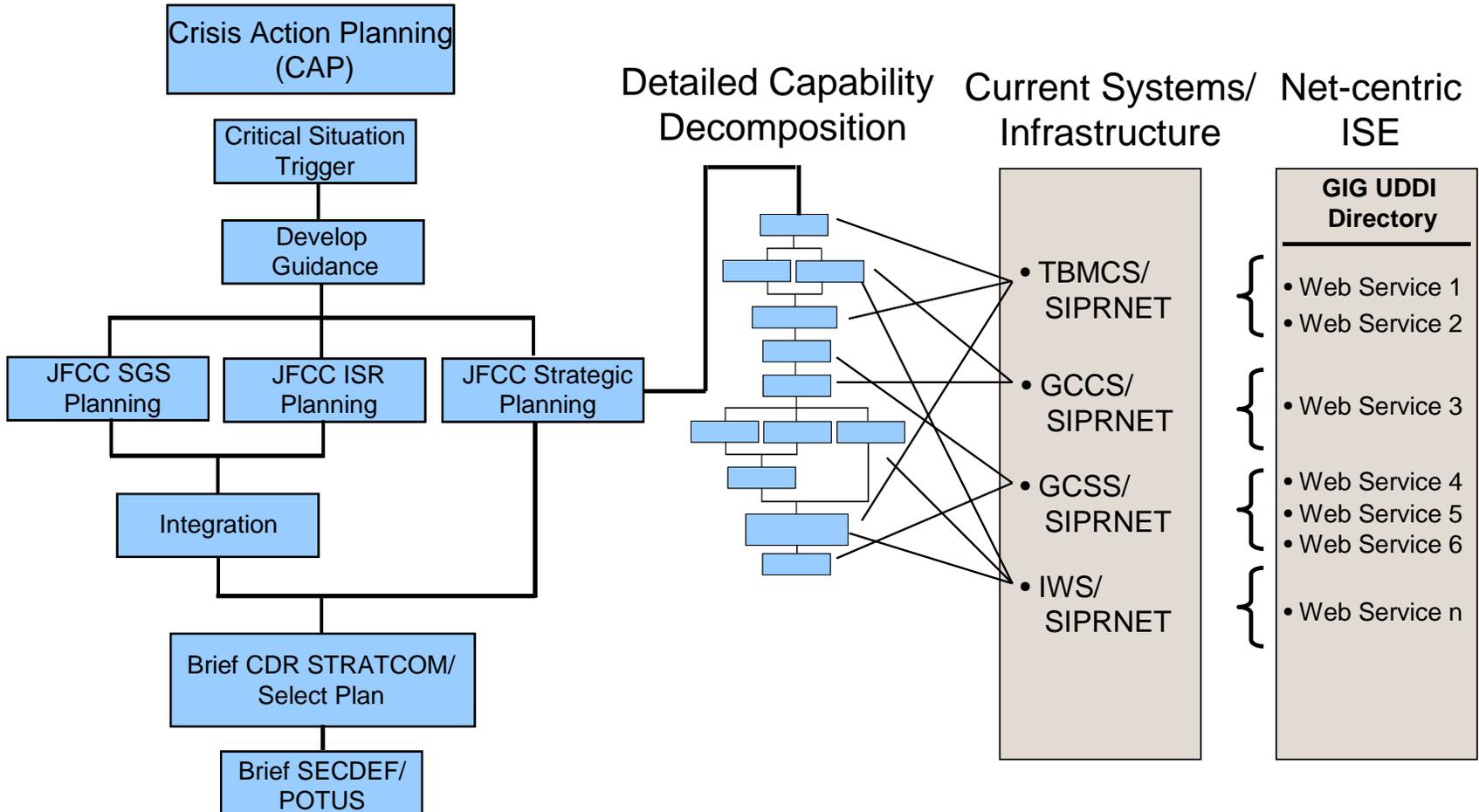
Decompose High-level Mission Area



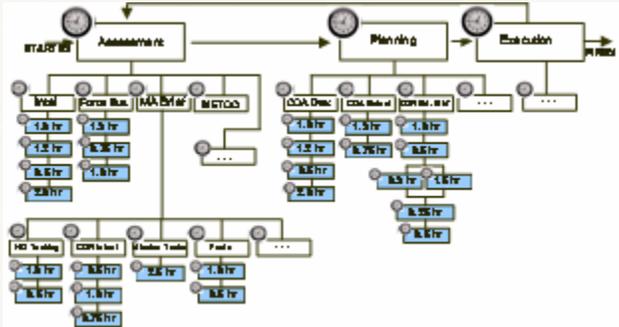
Decompose Global Strike Processes into Functional Capabilities



Map Global Strike Capabilities to Programs of Record & Web Services



Mission-specific Workflow Evaluation

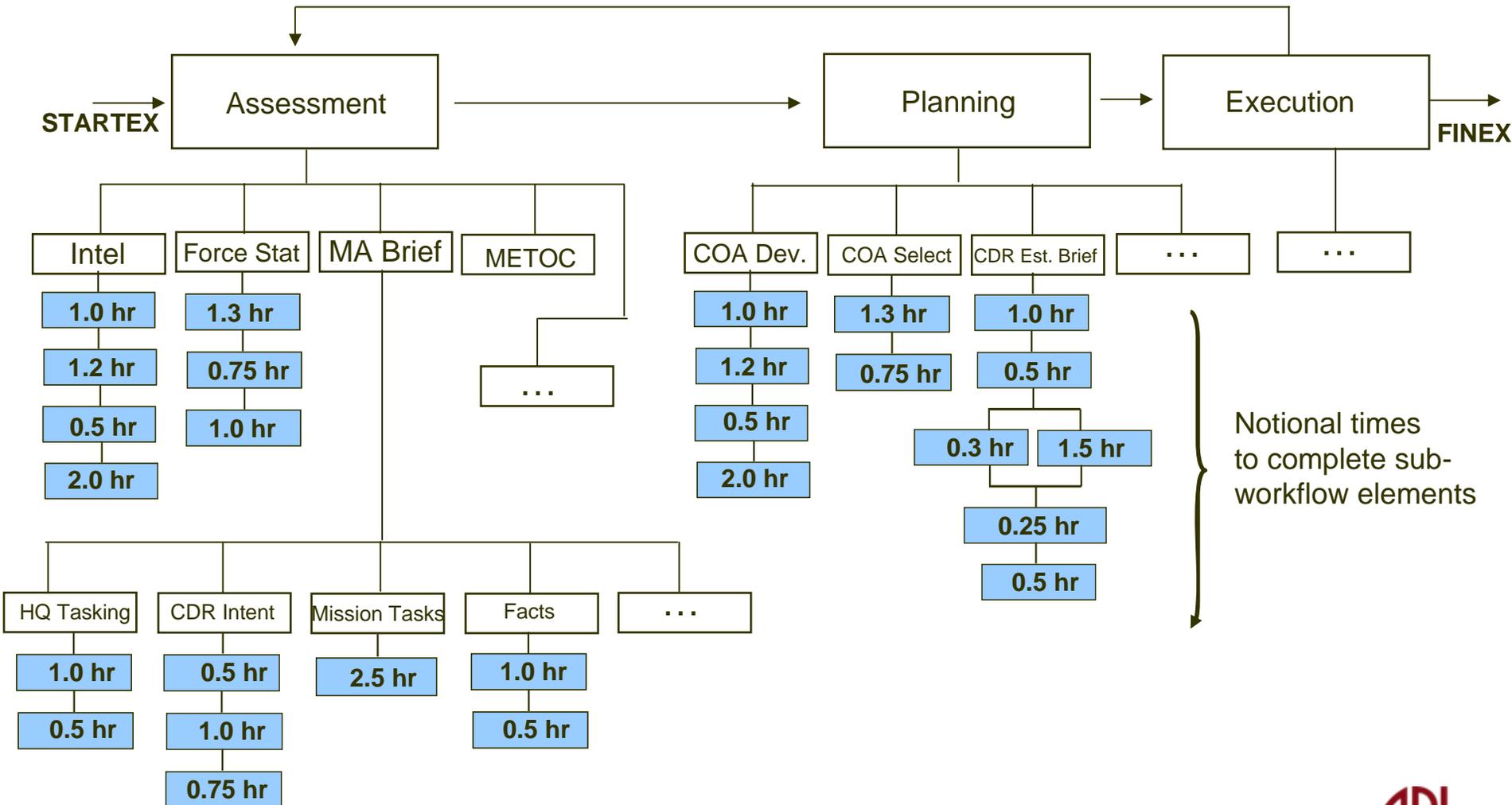


Mission-specific Workflow Evaluation

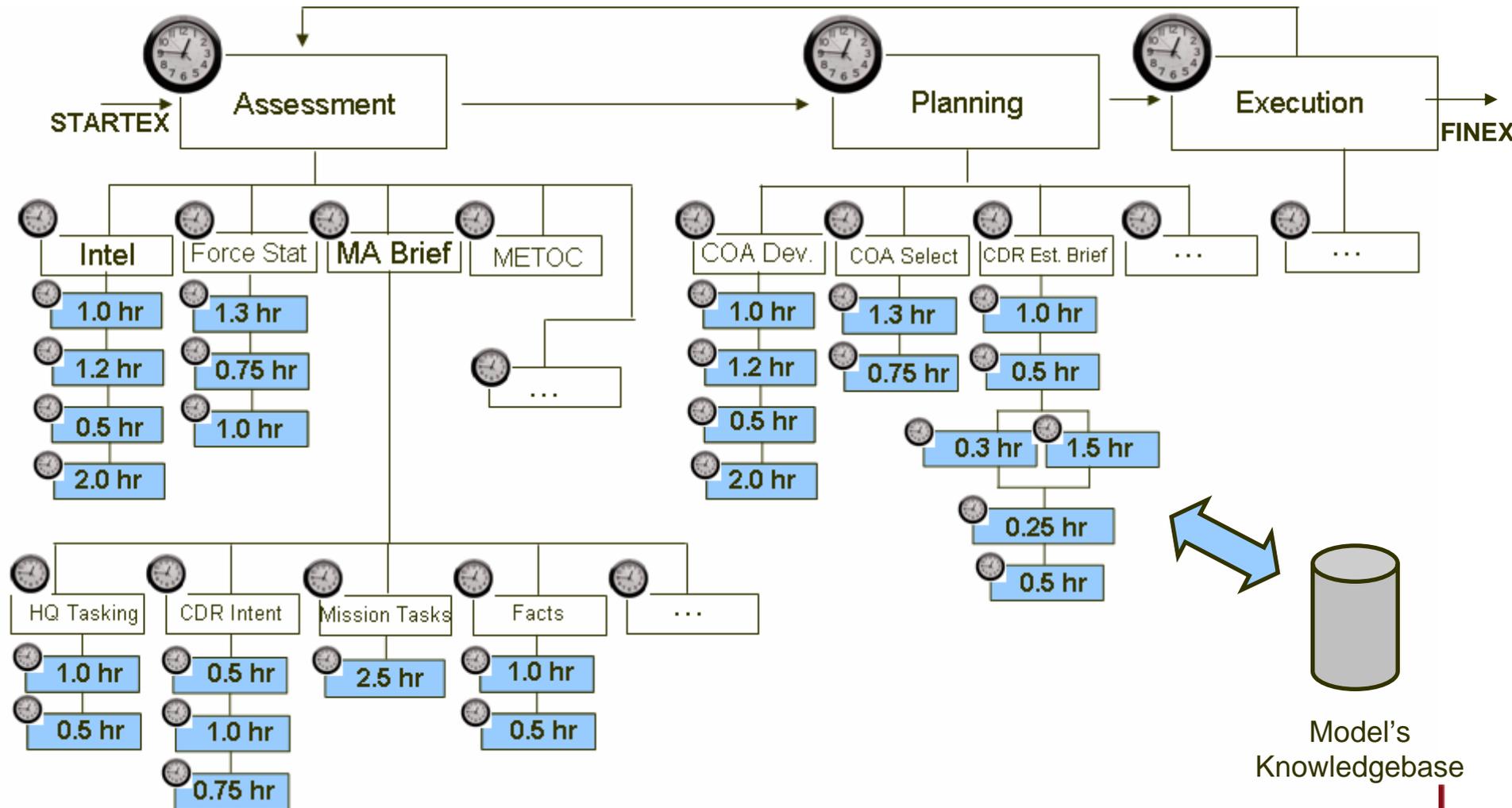
APL

The Johns Hopkins University
APPLIED PHYSICS LABORATORY

Create & Characterize a Workflow Pattern based on the Global Strike Process Decomposition



Create an Executable Model of the Workflow Pattern



GOC-CE: Portal-based Visualization of the Global Strike TSP Workflow

TSP Knowledge Wall site pulls status information maintained in other TSP workspaces

The Knowledge Wall provides the CDR a quick view of GS TSP process status

The screenshot shows the 'Global Lightning 06 - TSP Knowledge Wall' interface. It is divided into three main sections: Assessment, Planning, and a Workspace Hierarchy diagram.

Assessment Tasks:

Title	Complete
Higher HQ Tasking	Yes
Intel Update	Yes
METOC Update	Yes
Proposed Mission Statement	Yes
Proposed Commander's Intent	Yes
Specified, Implied, and Essential Tasks	No
Restrains, Constraints, Considerations	No
Assumptions/Facts	No
Initial CCIRs	No
Recommendations	No

COA Development Tasks:

Title	Completed
Higher HQ Tasking	Yes
Mission Statement	Yes
Commander's Intent	No
Intel Update	No
METOC Update	No
Battlespace Evaluation	No
COA's	No
GCC Inputs	No
Recommendations	No

CDR Estimate Tasks:

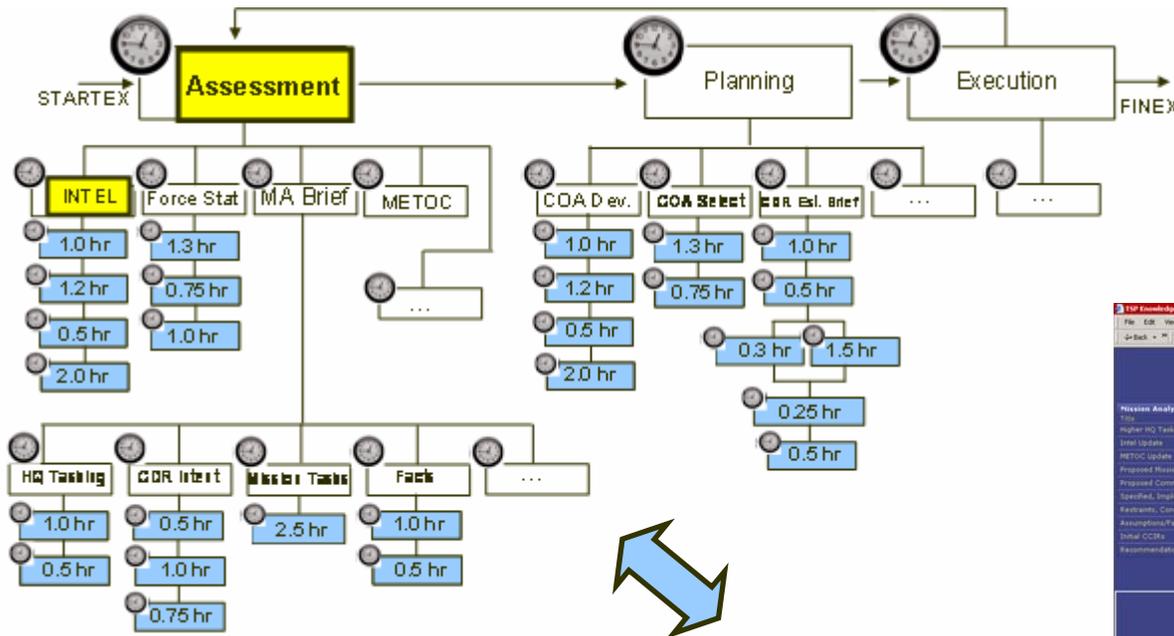
Title	Complete
Higher HQ Tasking	Yes
Mission Statement	Yes
Commander's Intent	No
Battle Space Evaluation Updates	No
COA Summary	No
Collateral Damage Estimates	No
Potential Enemy Response	No
Risk Assessment	No
GCC Inputs	No
COA Comparison	No
Recommendations	No

Workspace Hierarchy Diagram:

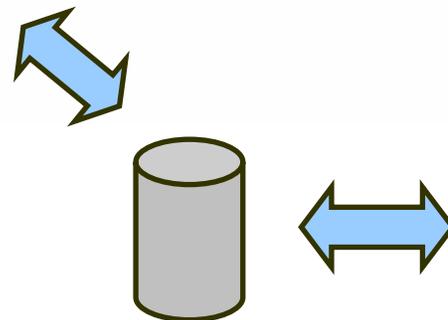
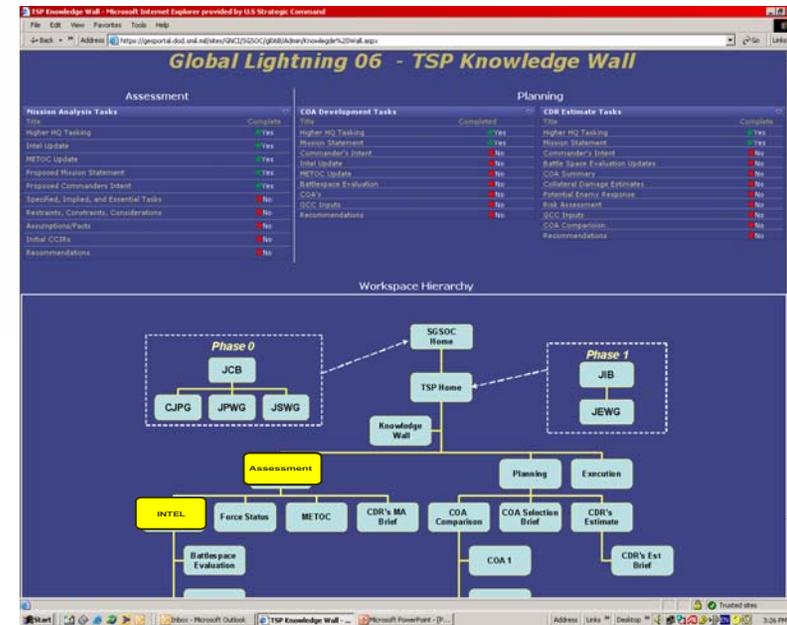
```

    graph TD
      TSPHome[TSP Home] --- SGSOCHome[SGSOC Home]
      TSPHome --- KnowledgeWall[Knowledge Wall]
      KnowledgeWall --- Assessment[Assessment]
      KnowledgeWall --- Planning[Planning]
      KnowledgeWall --- Execution[Execution]
      
      subgraph Phase0 [Phase 0]
        JCB[JCB] --- CJPG[CJPG]
        JCB --- JPWG[JPWG]
        JCB --- JSWG[JSWG]
      end
      
      subgraph Phase1 [Phase 1]
        JIB[JIB] --- JEWG[JEWG]
      end
      
      TSPHome -.-> Phase0
      TSPHome -.-> Phase1
      
      Assessment --- Intel[Intel]
      Assessment --- ForceStatus[Force Status]
      Assessment --- METOC[METOC]
      Assessment --- CDRMA[CDR's MA Brief]
      
      Intel --- Battlespace[Battlespace Evaluation]
      
      Planning --- COAC[COA Comparison]
      Planning --- COASB[COA Selection Brief]
      
      COAC --- COA1[COA 1]
      
      Execution --- CDRE[CDR's Estimate]
      CDRE --- CDREB[CDR's Est Brief]
  
```

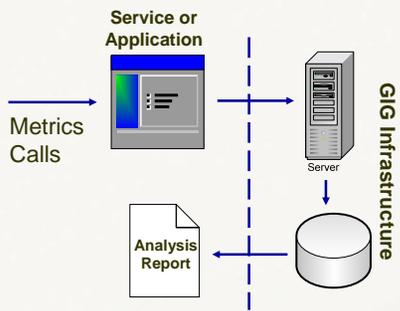
Evaluate Execution of Mission-specific Workflow Pattern



Visualize Model's Execution Status Via the GOG-CE



Model's Knowledgebase



Automated Data Collection, Analysis, & Reporting

APL

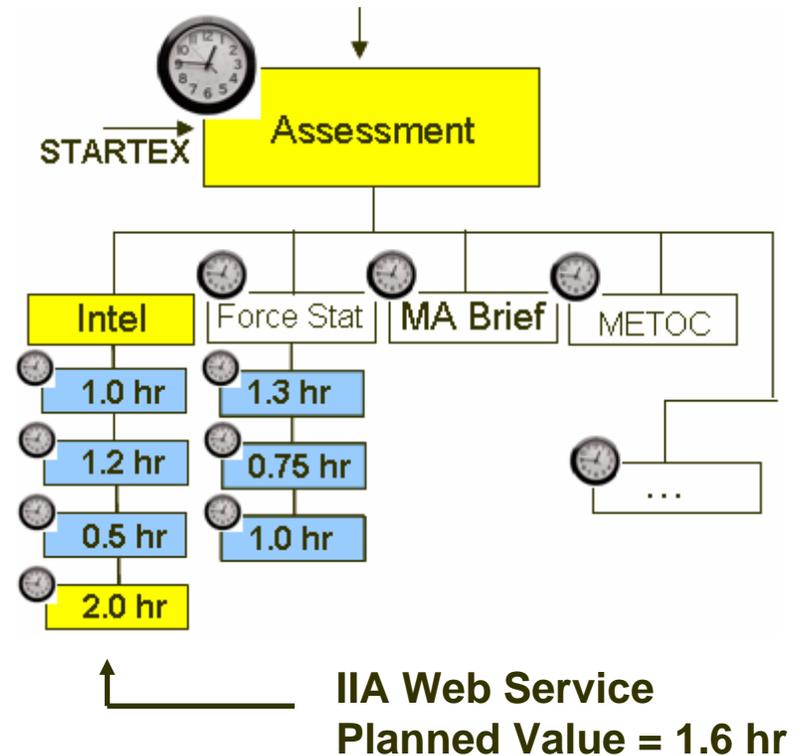
The Johns Hopkins University
APPLIED PHYSICS LABORATORY

Automated Data Collection, Analysis & Reporting

- **Developed a set of “analysis services (AS)” that facilitate automated data collection and detailed analysis of “core” and “vendor-developed” services and applications**
- **The AS are bound to those services/applications at run time via dynamic run-time binding**
- **Execution of the AS is controlled via runtime configuration settings**
- **Gathered metrics and analytic results are intended to be managed within the GIG infrastructure for each service/application to be analyzed**
- **The AS are used to identify and analyze service/application performance, e.g. time spent per class/method, CPU, IO, and memory utilization, etc.**
- **The AS are discovered via a Universal Description, Discovery and Integration (UDDI) registry**

Example Value-Add Use Case

- During the TSP mission assessment phase, the workflow model identifies a temporal overflow exception associated with INTEL image acquisition (IIA)
- The web service software responsible for that task exceeded its planned execution time budget by 25%



- The question to be answered: is there a problem with the software or did some external factor contribute to/cause that problem?

Example Value-Add Use Case (cont.)

- A probe from an envisioned NCES diagnostic software service was used to analyze the IAA web service
- That analysis showed
 - The web service software was not at fault
 - The performance issue was due to a failure of the software to establish a secure socket connection to the network, i.e. a network problem
 - The software error messages should be augmented for better diagnostic clarity

Value of Model-driven Workflow Evaluation Approach

- Employs a disciplined, system engineering process
- Quantifies workflow shortfalls
- Identifies areas for capability improvements
- Provides focus for future capabilities development and helps shape acquisition decisions