An Abstract Process and Metrics Model for Evaluating Unified Command and Control
A Scenario and Technology Agnostic Approach

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Agenda

- Purpose
- Goal of Presentation
- Brief Introduction to Abstract Model & Metrics
- Formal Process Definition
- Information Flow & Metrics Context During a Meme Attack
- Process Viscosity Example
- Latency Metrics Discussion
- Process Error Types & Non-Poisson Process Behavior
- Situational Awareness Discussion
- The Trouble with a Pure Service Oriented Architecture
- Using the Metrics for Capability Based Procurement
- Tools Needed to Implement the Underlying Abstract Model & Assessment Process
- Next Steps

Purpose

- **The purpose of this white paper is to define a domain neutral, process centric framework and the derivative metrics required to assess process re-engineering effectiveness and capabilities based procurement.**

- **The paper focuses on processes, process performance metrics, process formalisms, and in particular emphasizes process effectiveness gains through improved process adaptability and improved cognitive capabilities**

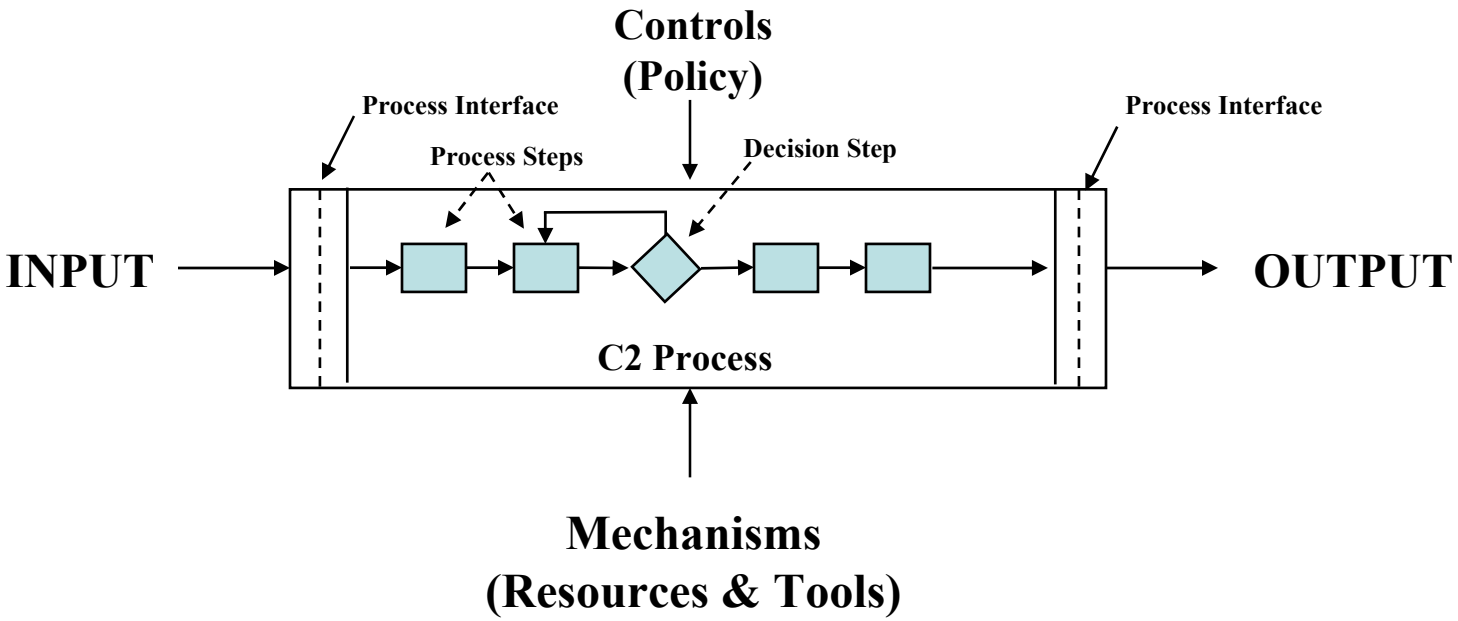
- **Unified Command & Control refers to several concepts:**
  - **Integrating National & Strategic Policy, Traditional C2, Multi-national and Interagency Policy and C2 structures**
  - **Policy management for Service Oriented Architecture, NCW Capability Access**
  - **Unified C2 Procurement Governance in Network Centric Warfare Environment**

Presentation Goal

CHANGING THE PARADIGM

Think in terms of processes to develop Capability Base Procurement Metrics

Do NCW mechanisms imply a change to existing process models?



The Abstract Model

- No Technology implied – resources can be carrier pigeons, message runners, computational agents, or chat software
- No pre-defined C2 processes assumed – OODA, etc.
- Metrics apply to any process
- Answers the question concerning whether or not NCW capabilities actually improve anything in a measurable manner
- Justifies procurement decisions based upon capability added

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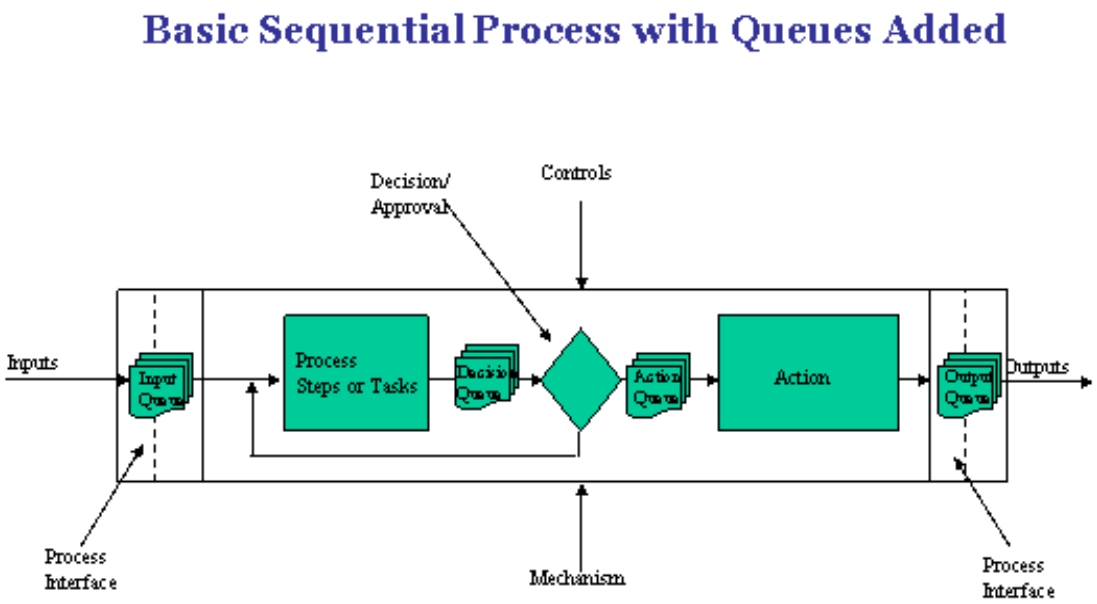
Process Metrics & Characteristics

Process Metrics	*Process Input Characteristics*	*Process Output Characteristics*
• Analysis Latency	• Volume	• Volume
• Data Latency	• Frequency	• Frequency
• Decision Latency	• Completeness	• Understandability
• Action Distance	• Known Policy Map	• Memetic Content
• Node Viscosity	• Complexity	• COA Set
• Process Viscosity	• Inter-problem Relatedness	• Policy
• Span of Control	• Time Criticality	• Urgency
• Process Efficiency	• Urgency	• Complexity
• Simultaneity	• Command Execution Status	• Time Criticality
• Synchrony	• Negative Influence Memes	• Actionable Granularity
• Adaptability	• Single Version of Truth	• Inter-problem relatedness
• Responsiveness	• Actionable Granularity	• Memes
• Mechanism Realignment Latency		
• Controls Realignment Latency		
• Process Error Rate		

Process Model & Formal Definition



$P_i = <V_i, R_i>$

where

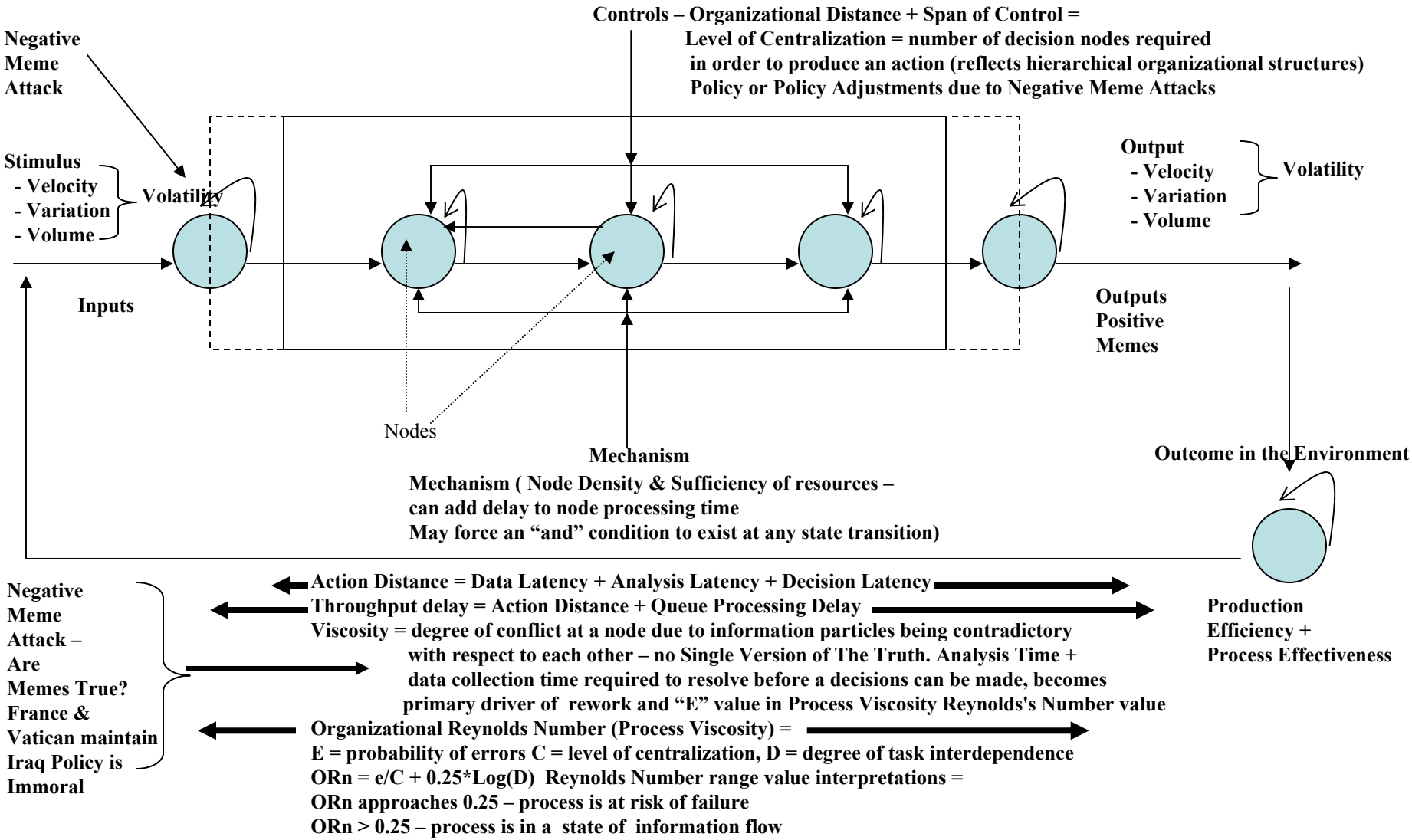
V_i is a set of variables (or nodes) whose assignments change over time, and

$R_i \subset V_i^+ \times t \rightarrow V_i^+$

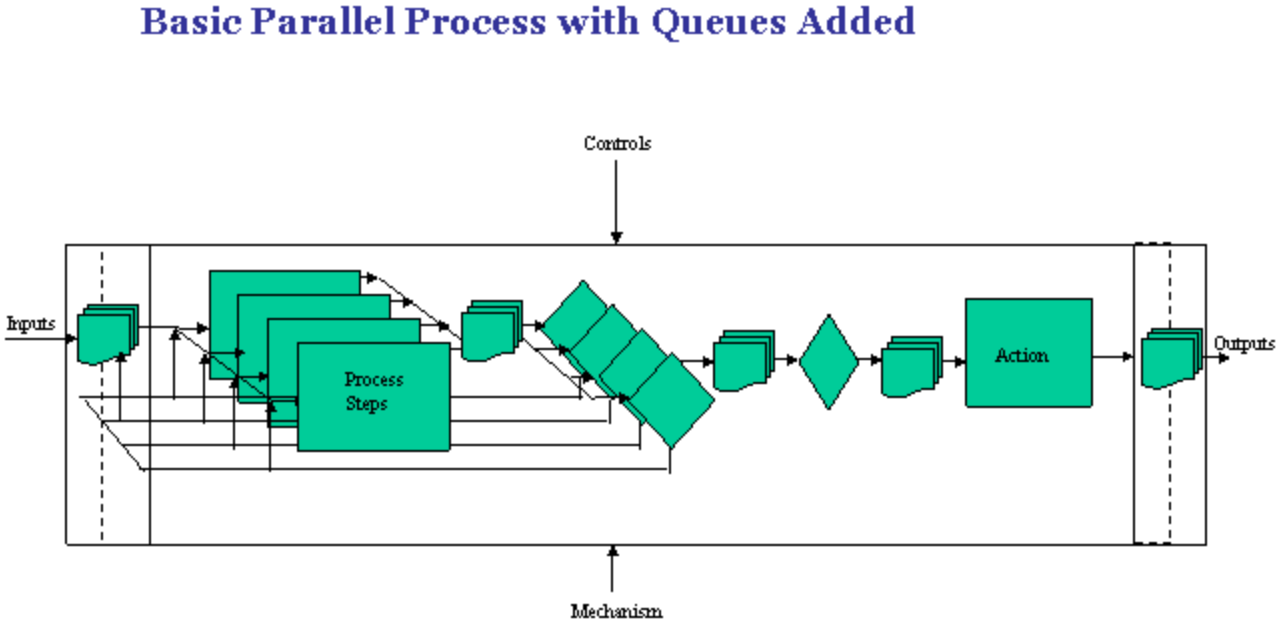
is a set of rules governing how those changes take place over time.

$\boldsymbol{P} = \bigcup_i \{P_i\}$ is the set of all processes

Information Flow Metrics Context
Process Behavior During a Meme Attack

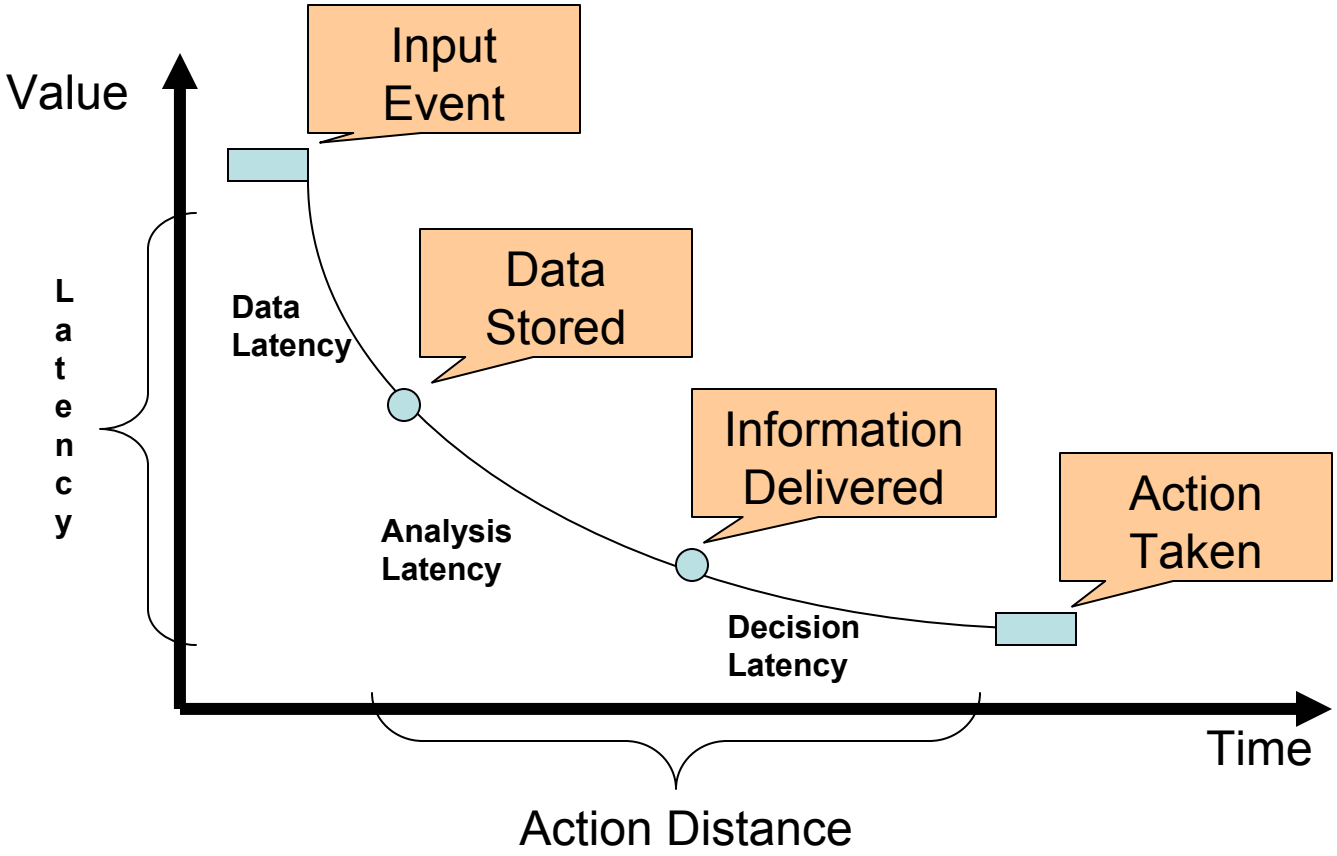


Organizational Reynolds Number Computation – A Process Viscosity Metric Example – Business Process Re-Organization Indicator

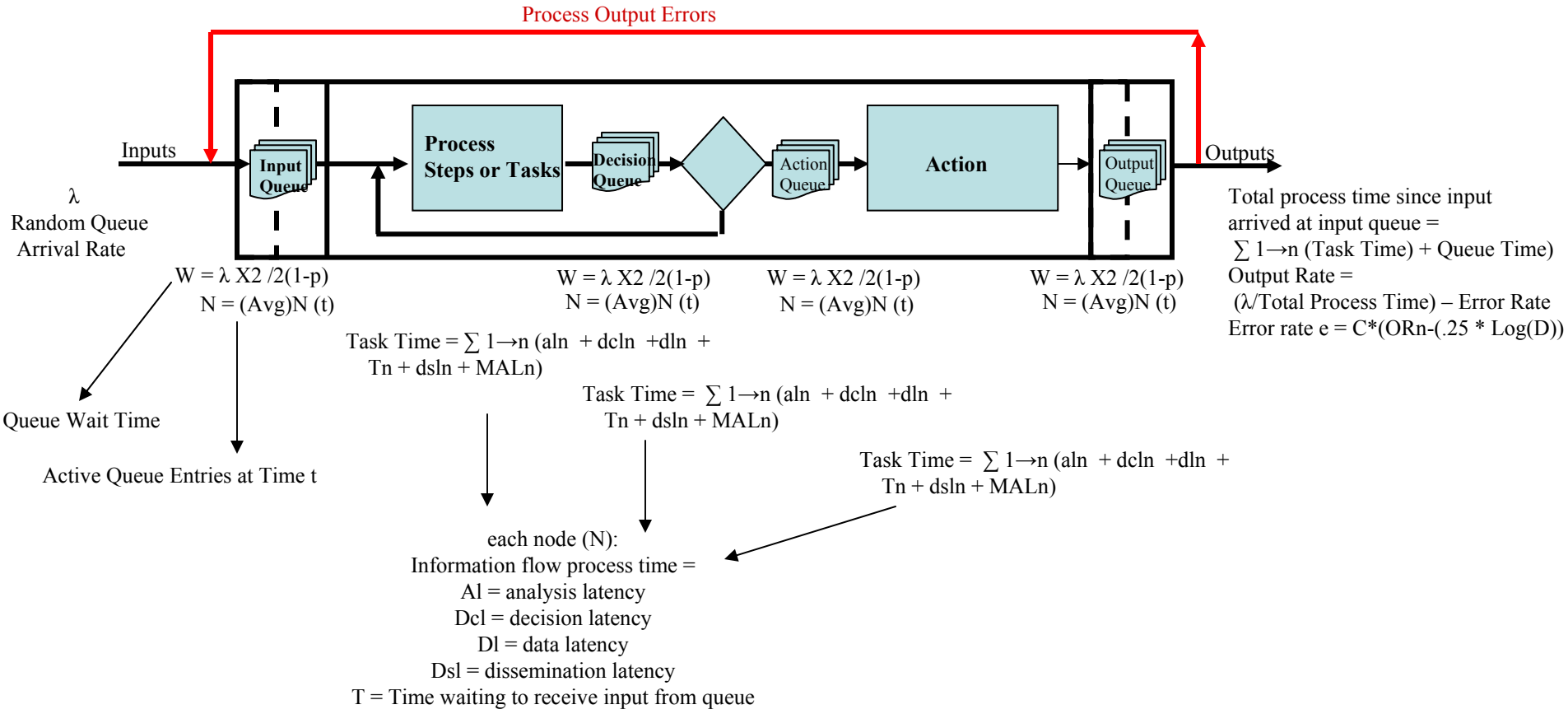


All approvals mandatory and concurrent
The Organizational Reynolds Number = ORn = e/C + 0.25*Log(D)
E = Routine tasks typically have a 0.05 probability of error,
and highly innovative tasks have an 0.15 error probability
D = 4 Rework Lines = dependency ratio (rework links per task)
C = Centralization factor (low=1.2, medium=1, high=0.8)
ORn = .05/1 + 0.25*(Log(4)) = .05 + (.25*(.6026)) = .05 + (.1505) = .2005
or
ORn = .15/1 + 0.25*(Log(4)) = .15 + (.25*(.6026)) = .15 + (.1505) = .3005
If the ORn Is greater than .25, information flow will be turbulent

Latency Model



Non-Poisson Model Validations

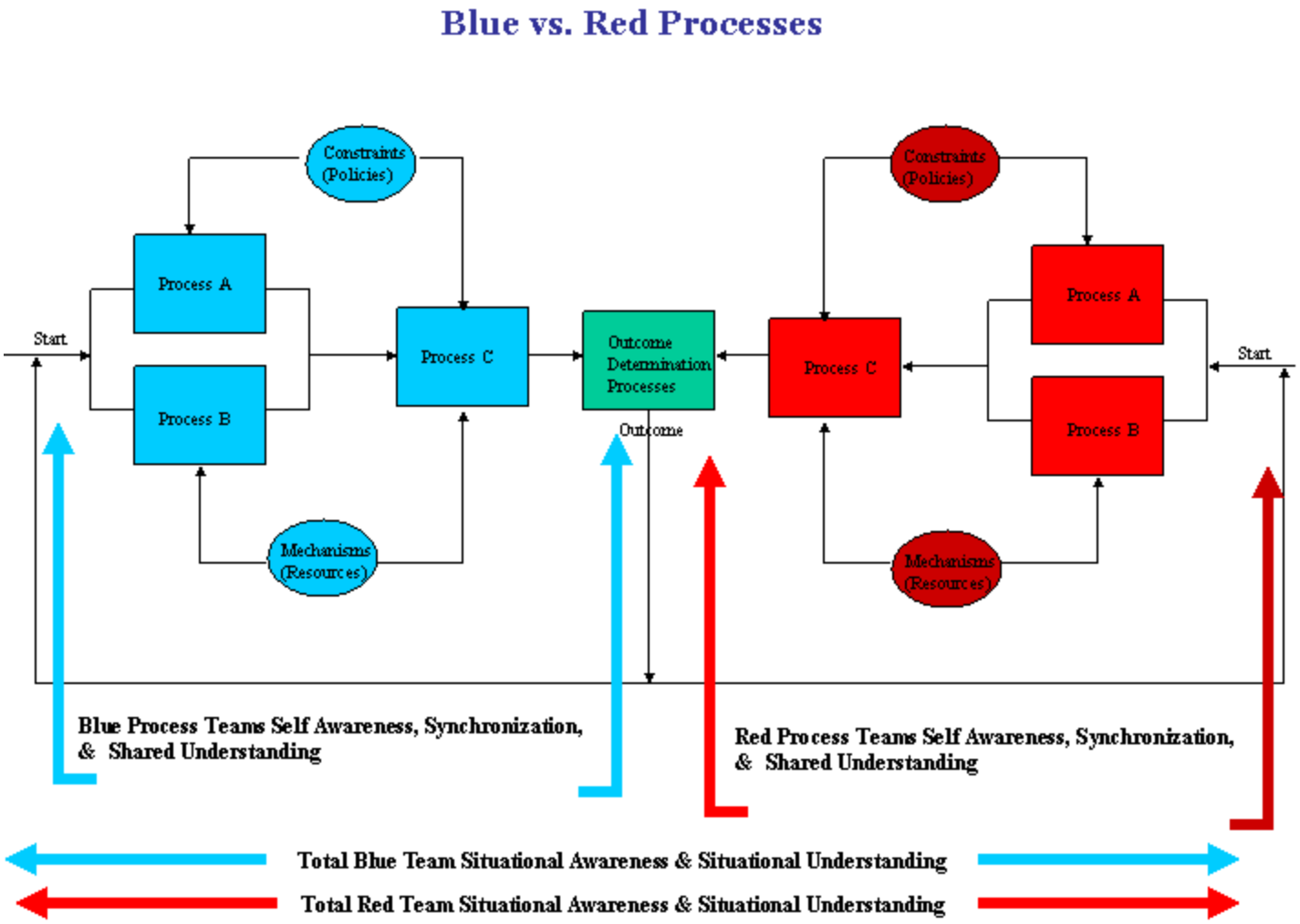


Expectations – given a non-Poisson rate, random volume, with changing input types and characteristics, process models should exhibit random latency scores, longer queue times, more internal rework, more intra-process communication and higher Organizational Reynolds Numbers. These randomizations should produce good output until the ORn is exceeded by volume problems, velocity problems, mechanism availability problems, and unforeseen time critical or urgency problems. We would expect to incur larger output error rates in terms of poor decisions, poorly understood intent and COAs, increased rework, and communications, but we should particularly anticipate that an increasing percentage of time critical and urgent inputs will go un-serviced at the various queues.

For this non-Poisson instance of the model: the input characteristics should be:

time criticality = random, Truth content = random, urgency = random, process controls = random, mechanism availability = random (this will by definition increase queue service times to the breaking point)

What is Situational Awareness?



Time Sequence

Time 0 – Red Conceptualizes a Surprise Attack Against Blue

Time 1 – Red Completes Detailed Planning & Course of Action

Time 2 – Red Assembles Resources and Positions for Attack

Time 3 – Red Attacks- Blue not prepared Suffers Resource Damages

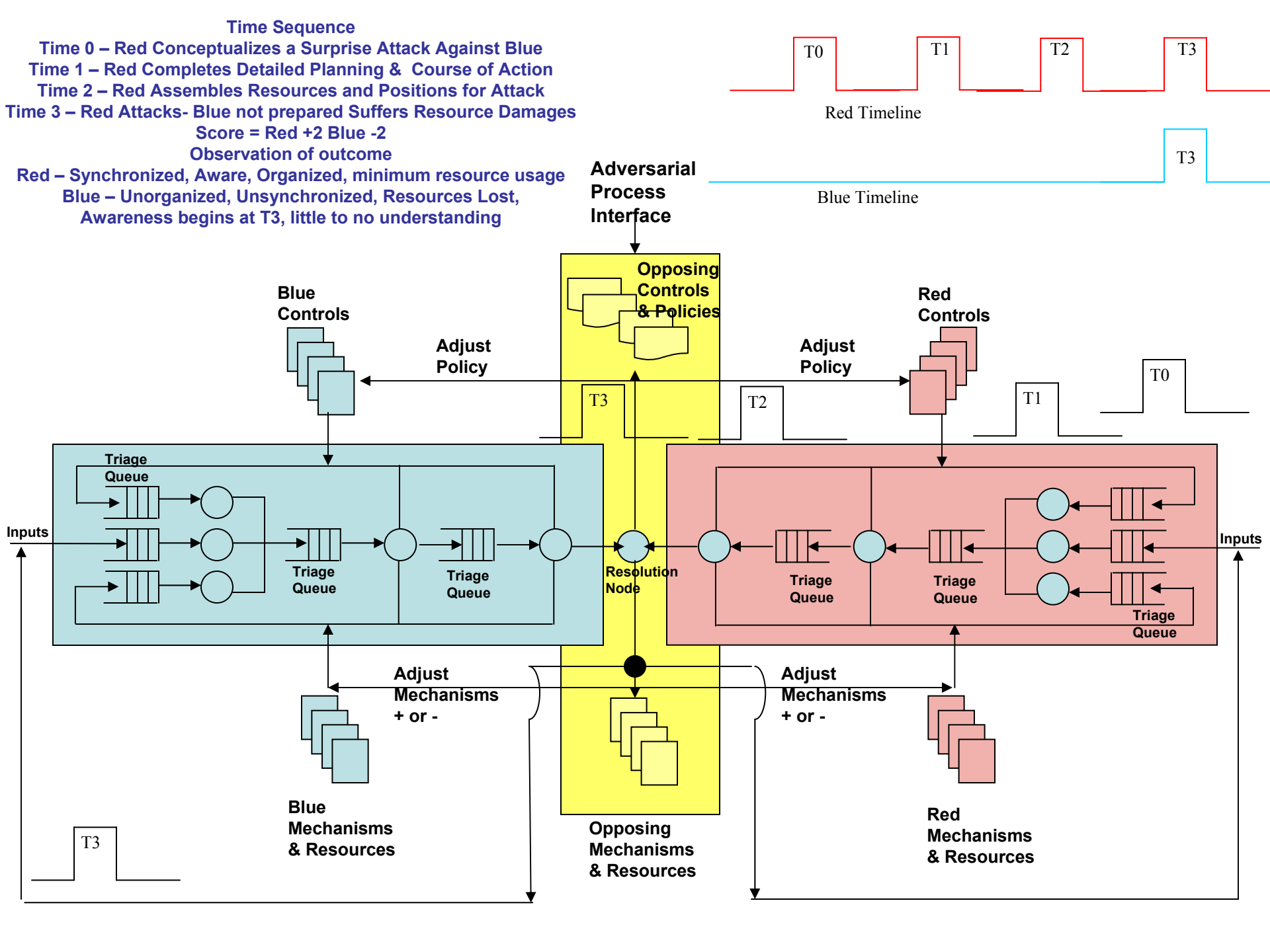
Score = Red +2 Blue -2

Observation of outcome

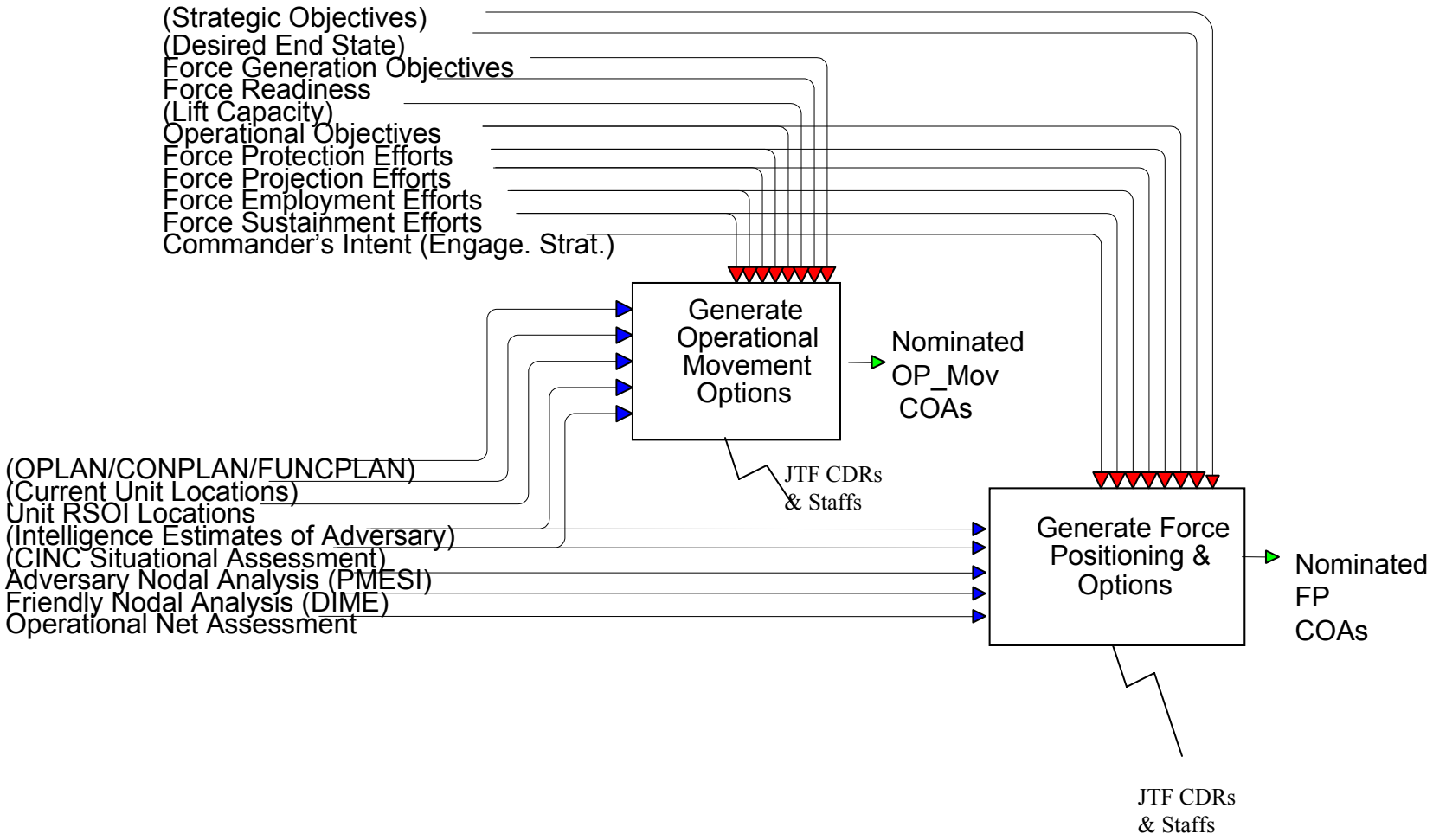
Red – Synchronized, Aware, Organized, minimum resource usage

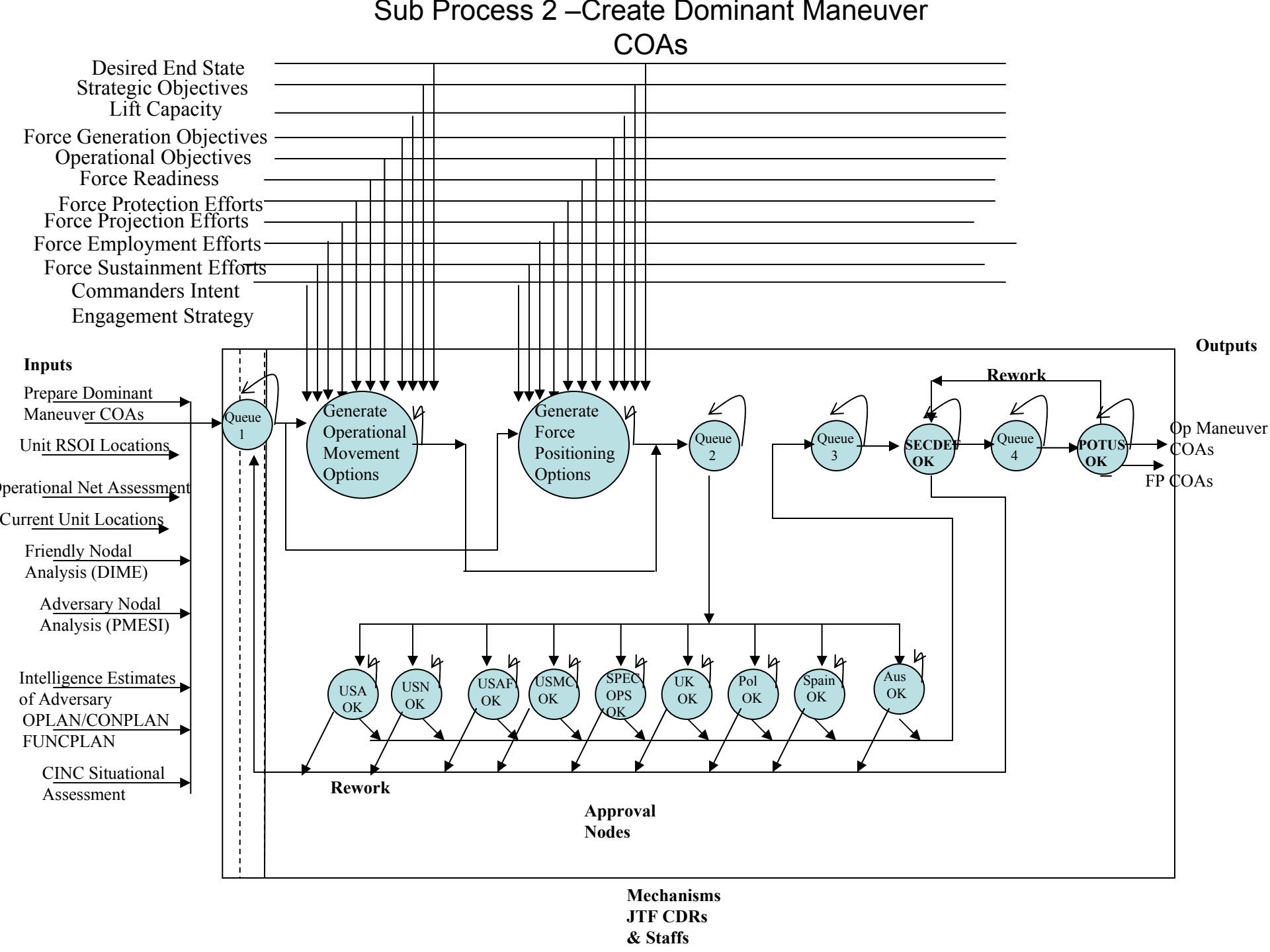
Blue – Unorganized, Unsynchronized, Resources Lost,

Awareness begins at T3, little to no understanding

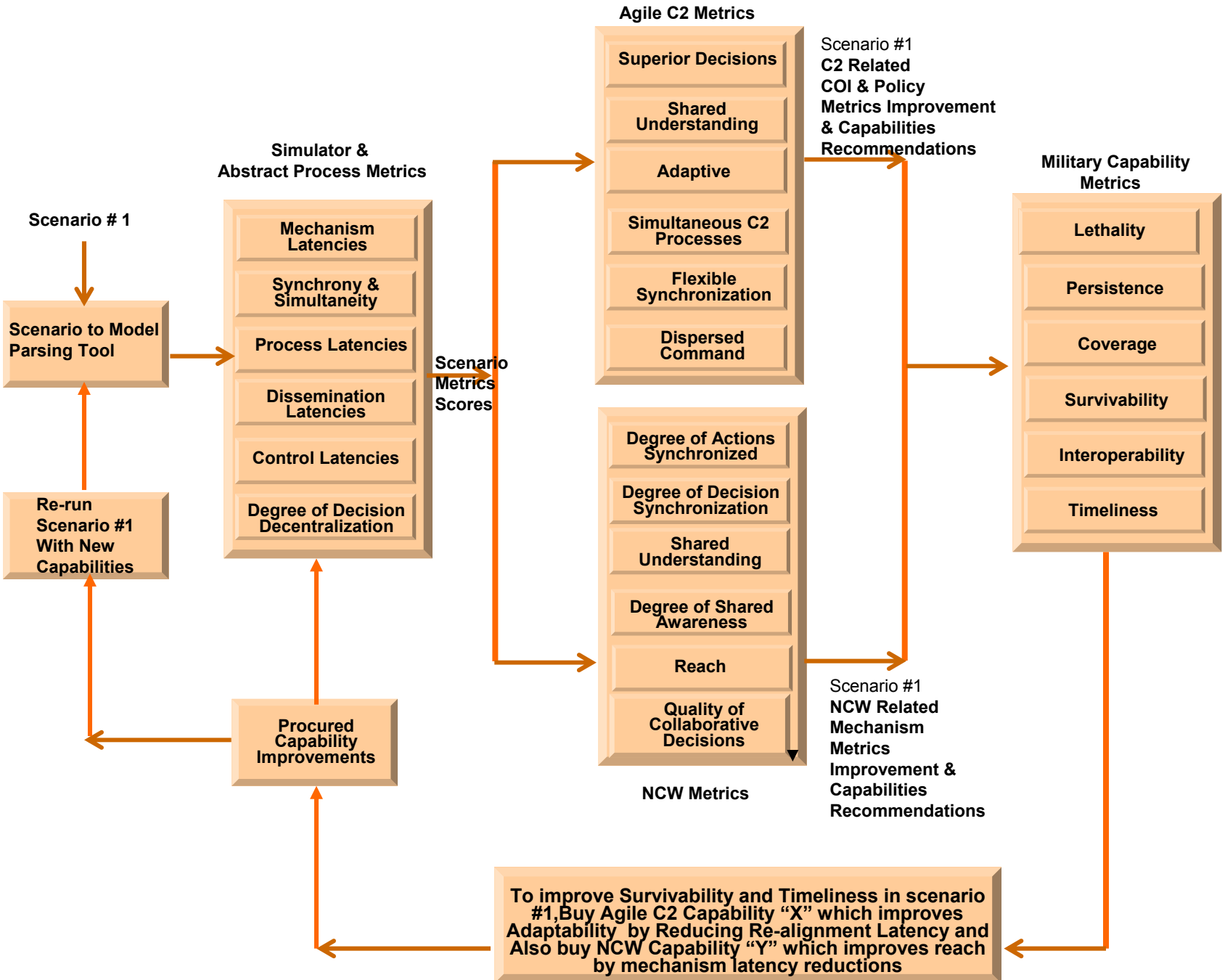


Sub Process to Generate Dominant Maneuver Operational Movement and Force Positioning COA Options

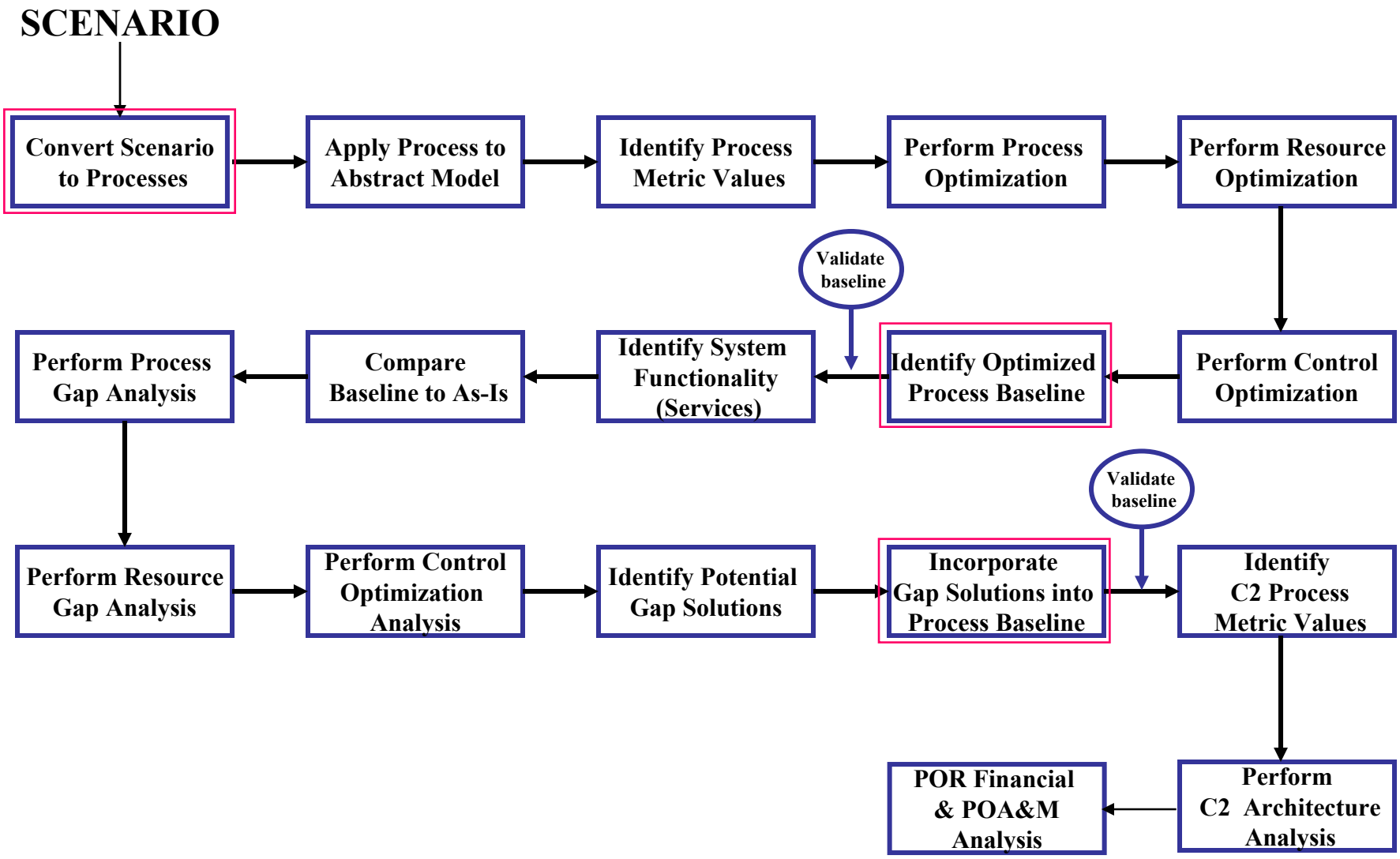



Sub Process 2 –Create Dominant Maneuver COAs
Desired End State
Strategic Objectives
Lift Capacity
Force Generation Objectives
Operational Objectives
Force Readiness
Force Protection Efforts
Force Projection Efforts
Force Employment Efforts
Force Sustainment Efforts
Commanders Intent
Engagement Strategy
Inputs
Prepare Dominant Maneuver COAs
Unit RSOI Locations
Operational Net Assessment
Current Unit Locations
Friendly Nodal Analysis (DIME)
Adversary Nodal Analysis (PMESI)
Intelligence Estimates of Adversary OPLAN/CONPLAN FUNCPLAN
CINC Situational Assessment
Queue 1
Generate Operational Movement Options
Generate Force Positioning Options
Queue 2
Queue 3
SECDEF OK
Queue 4
POTUS OK
Rework
Outputs
Op Maneuver COAs
FP COAs
USA OK
USN OK
USAF OK
USMC OK
SPEC OPS OK
UK OK
Pol OK
Spain OK
Aus OK
Rework
Approval Nodes
Mechanisms
JTF CDRs
& Staffs

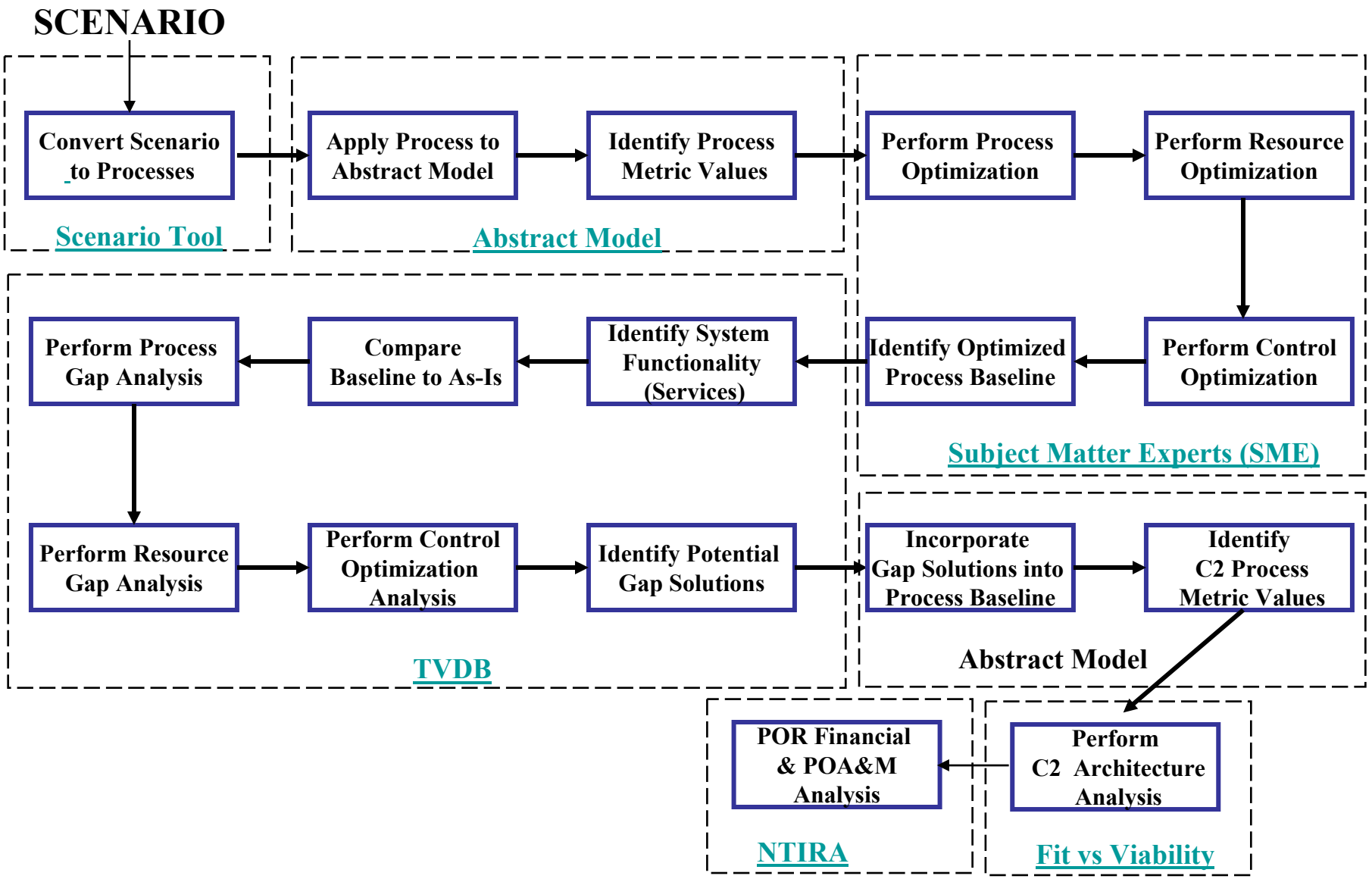
Capability Based Procurement Justification Process Metrics Flow



Assessment Process Steps



Where Do The Tools Fit In???



Next Steps

- **Process Theoretic**
  - **Evaluate Baldwin Effect Impact on Mechanism Re-Alignment Latency**
  - **Pursue the Potential Impact of Gaian Guilds on Process Re-Design**
  - **Can Agent Based Mechanisms Reduce Joint, Inter-Agency, and Multinational Process Complexity?**
- **Build tools**
  - **Scenario Parser**
  - **XBML Language to C2XML to Policy Language Parsers**
  - **Abstract Model Simulator with Automated Abstract Metrics to Agile C2 & NCW Metrics Mapping**
  - **Dr. Raymond Paul's Policy Framework Tool Set**
- **Validate Equations**
- **Validate Meme Policy Response Capability of Abstract Model Simulator**
- **Model Memes Using Genetic Algorithms for Improved Policy Adaptation & Automated Creation of Multiple Policy Courses of Action**