



# Sense and Respond Logistics: Co-Evolution of an Adaptive Enterprise Capability



AFEI  
Adaptive Enterprise Seminar

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Project Lead

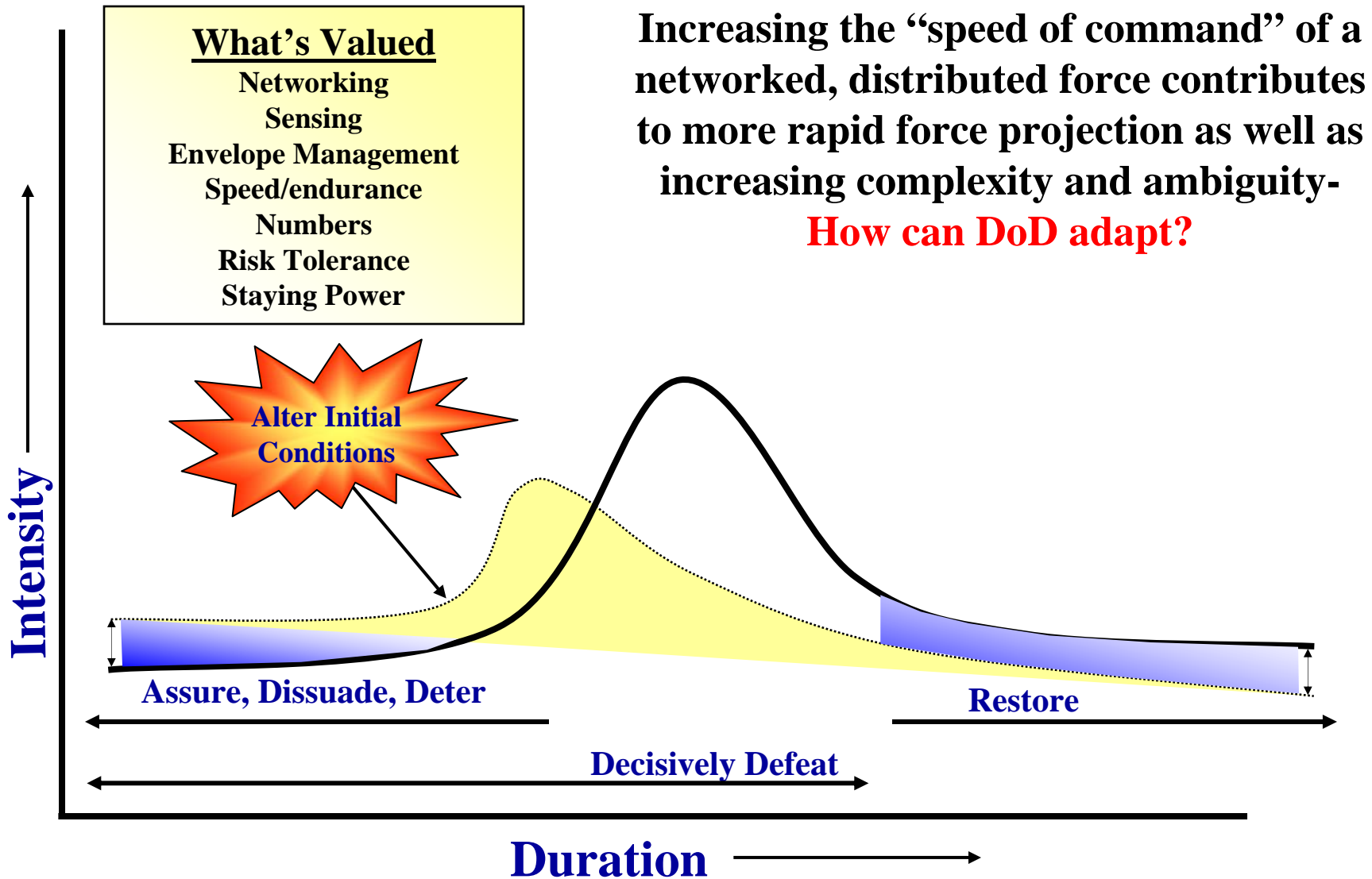
2 December 2003

# Agenda

- The New Strategic Reality
- The S&R Project
- Essence of “S&R Concept”
- Co-evolution: From Concept to Capability
- Moving Towards an Adaptive Enterprise

# Transforming Defense

*...deter forward ...or defeat with modest reinforcement*



# Transforming Defense

*...The new American Way of War*

## *The New Rules*

- Fight first for information superiority
- Speed of command
- Access to information-shared awareness
- Dispersed forces-noncontiguous operations
- Demassification
- Elimination of process lines  
(eg. organize, deploy, employ, sustain, ops, intel, logistics)
- Elimination of structural lines  
(eg. Joint ops at the small unit level)
- Dynamic self-synchronization
- Alter initial conditions
- Develop high rates of change
- Compression of levels of war

## NETWORK CENTRIC WARFARE

HIGH RATES OF  
CHANGE

CLOSELY COUPLED  
EVENTS

LOCK IN/OUT

SPEED OF COMMAND

SELF-  
SYNCHRONIZATION

# Strategic Implications for DoD

*...searching for new mechanisms of advantage*

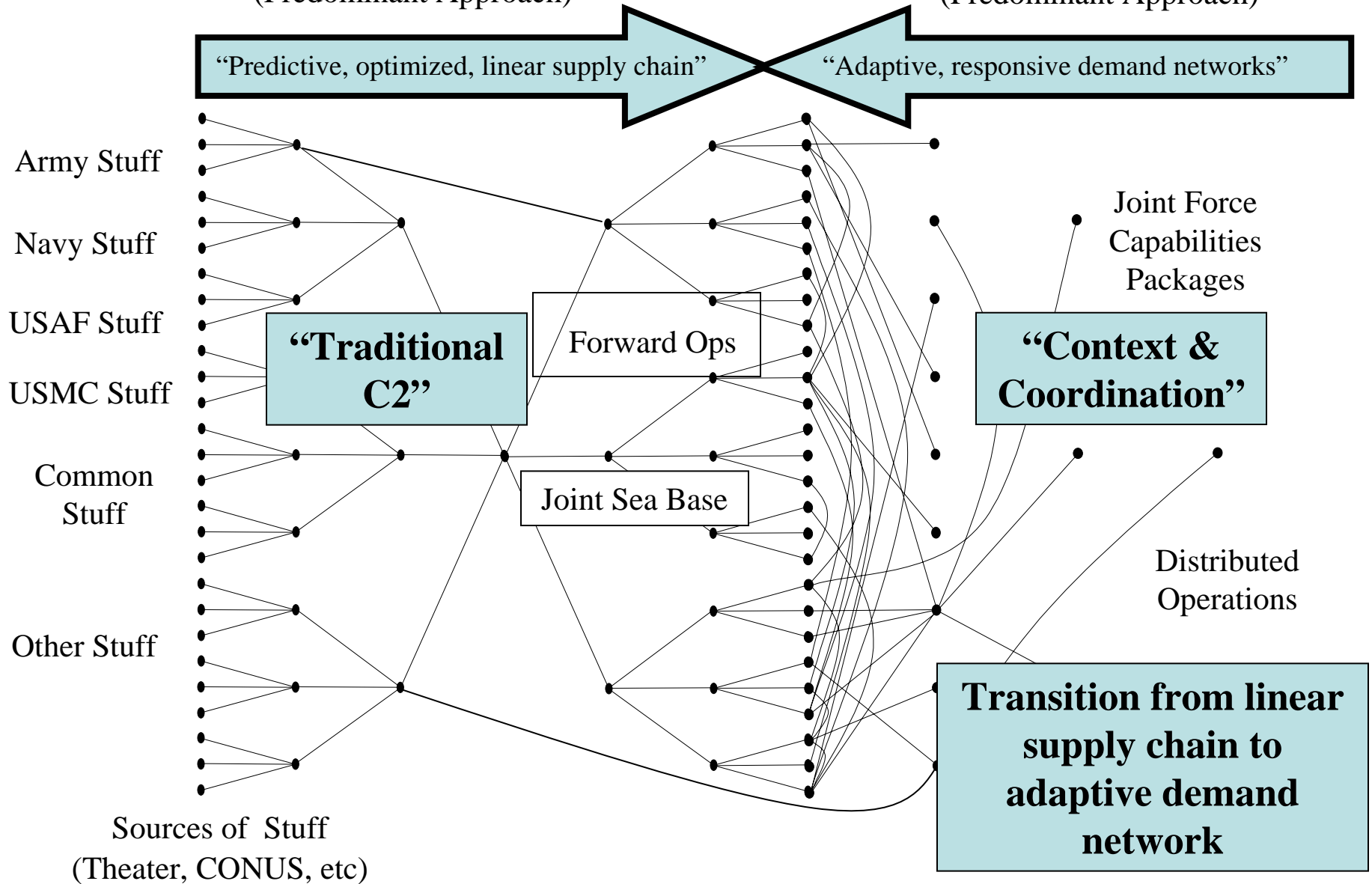
## **System design drivers:**

- Joint capability packages, configured on-the-fly
- Expeditionary
- Maneuver directly on objectives from operational and strategic distances w/o fixed ISBs or RSOI (force-to-objective maneuver—FTOM)
- Organize/Deploy/Employ/Sustain- a single, continuous process
- Non-contiguous battlespace, no secure rear areas
- Without pause
- Support system mechanisms transparent to operations
- End-to-end approach

# What's the Behavior Telling Us?

**Current Logistics Concepts**  
(Predominant Approach)

**Sense & Respond Logistics**  
(Predominant Approach)



# **The S&R Project**

# S&R Project Goals

- Catalyze transformation of a joint, adaptive logistics capability throughout DoD
  - **Develop a coherent, convergent DoD Logistics Transformation Strategy that reconciles and builds on S&RL, FLE, and PBL initiatives; link to experimentation**
- Develop a formal concept for S&R Logistics in the context of the Joint Operations Concept
- Incorporate a S&R logistics module into experimentation that allows DoD to gather operational data and evaluate the Sense and Respond concept; inform system design
  - **Create a **prototype information system** that supports logistics adaptation to changes in the operational environment**
  - **Use rapid prototyping and an experimentation campaign to capture learning and inform capability build**
  - **Allow opportunities for discovery and invention**
- Identify and document measures to evaluate potentially transformational logistics concepts
  - **Go beyond standard logistics flow measures to measures of survivability, agility, coherence, and speed/quality of effects**



# S&R Goals in Transformation Context

OFT Transformation  
Guidance and Strategy



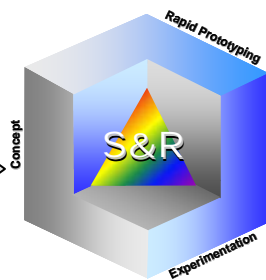
Range of  
Military  
Operations

Interim RANGE OF MILITARY OPERATIONS											
WAR	RODITW	RODITW									
	Threat of Force	Threat of Force									
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Military Logistics  
Transformation Concepts

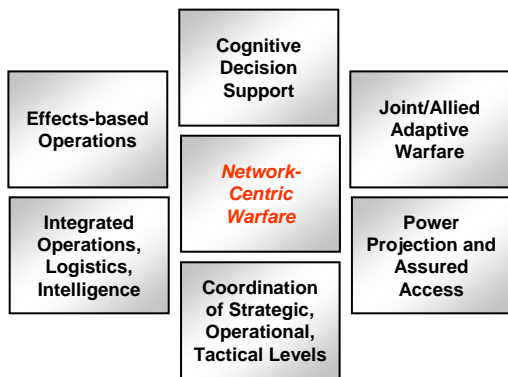
- Opportunistic Adaptation
- Real Time Management and Control
- Prediction and Anticipation
- Capabilities Packages and Modularity
- Short Term Inventory Optimization
- Seamless Logistics

Experiences  
and Lessons  
Learned

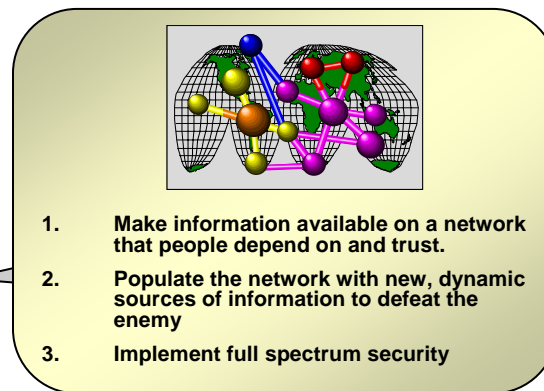


Sustaining  
Base and  
Commercial  
Technology

## Sense and Respond Logistics Goals



DoD Military Operations  
Transformational Concepts



NII Transformation Goals

# S&R Project Approach

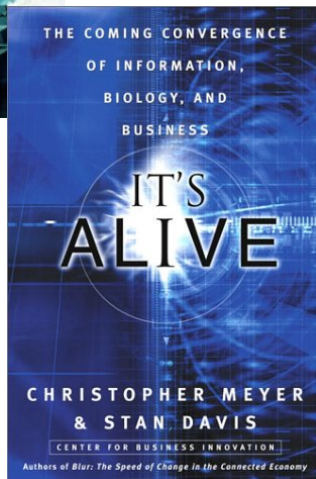
- Explore the behavioral aspects of networks and how they impact operational, organizational, process, and technology designs
- Operate networked teams synergistically across networked threads to achieve the desired outcome
  - Concept
  - Technical
  - Functional
  - Experimentation
- Leverage knowledge and technology from industry and academia
- Execute within operational context set by Joint Operations from the Sea Base
- Exploit full range of experimentation opportunities
  - Shift to capabilities-based system requires rapid prototyping and experimentation from the “point of effect” back
- Employ co-evolution strategy to influence change rapidly

# **The S&R Concept**

# S&R Concepts to Transform DoD



SWEDISH ARMED FORCES  
HEADQUARTERS



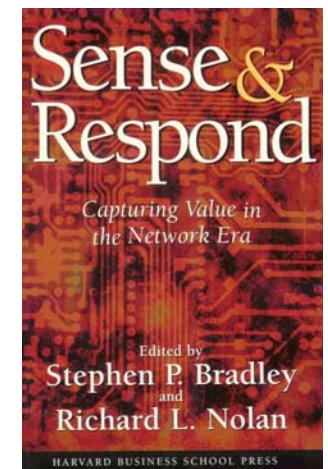
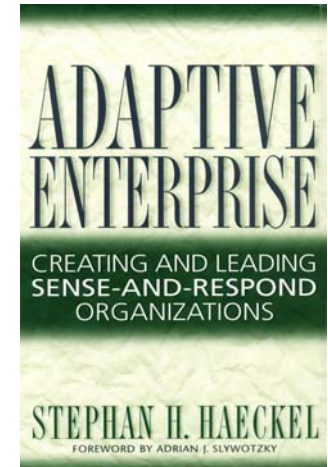
NATO Integrated Event-Driven  
Rapid Deployment Force

- The S&R business analog is an adaptive managerial framework originally developed by IBM

– **Key ideas:**

- Assume demand is ultimately unpredictable, so success depends on speed of pattern recognition and speed of response
- The best supply chain is no longer one that is highly optimized, but one that is highly flexible
- Organizes business units and subunits into “modular capabilities” that negotiate with one another over commitments
- Networks “self-synchronize” via a common environment and set of shared objectives; typically business financial and customer satisfaction measures
- Depends on sophisticated IT support to enable data sharing, “knowing earlier,” commitment tracking, and role reconfiguration

- **Business literature and practice reflect application of network centric theory and principles**



# Approaches to Logistics

## Mass-Based



- More is better
- Mountains of stuff measured in days of supply
- Uses massive inventory to hedge against uncertainty in demand and supply
- Mass begets mass and slows everything down

Prime Metric:  
Days of Supply

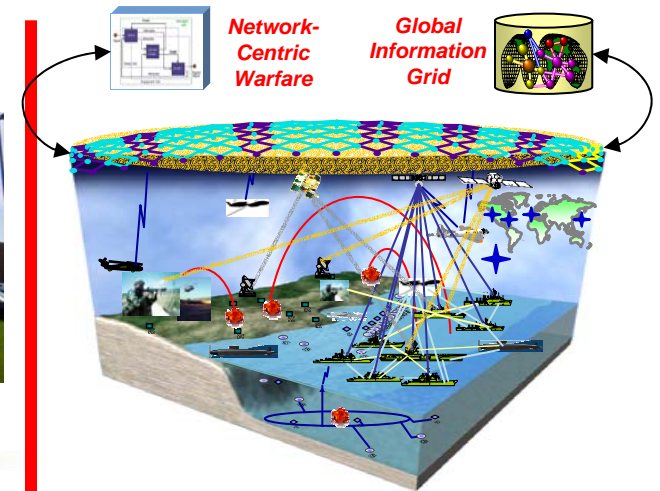
## Just-in-Time



- On-time is better
- Inventory is reduced to a minimum and kept moving
- Uses precise demand prediction and static optimization to purge uncertainty
- Works great, except when it doesn't

Prime Metric:  
Flow Time

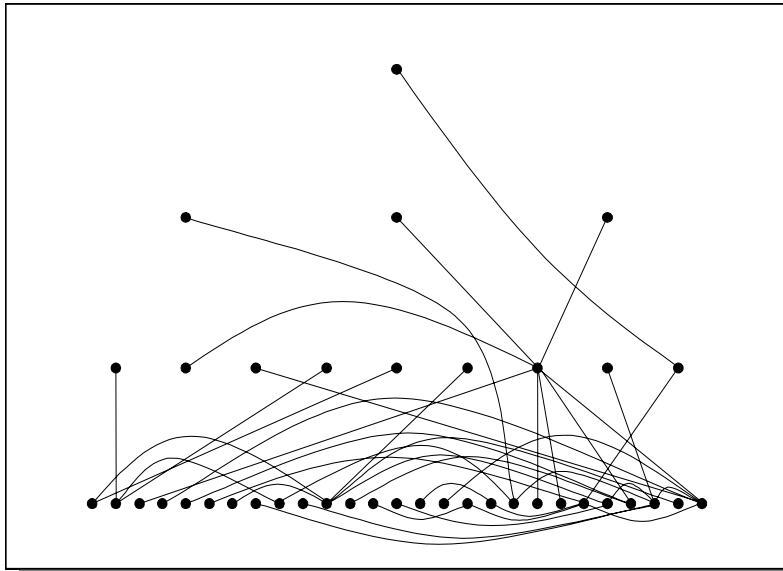
## Sense and Respond



- Adaptive is better
- Inventory is dynamically positioned throughout
- Uses transportation flexibility and robust IT to handle uncertainty
- Initial S&R models look promising
- Supports distributed, adaptive ops

Prime Metric:  
Speed/Quality of Effects

# Sense and Respond Logistics Concept



## Network

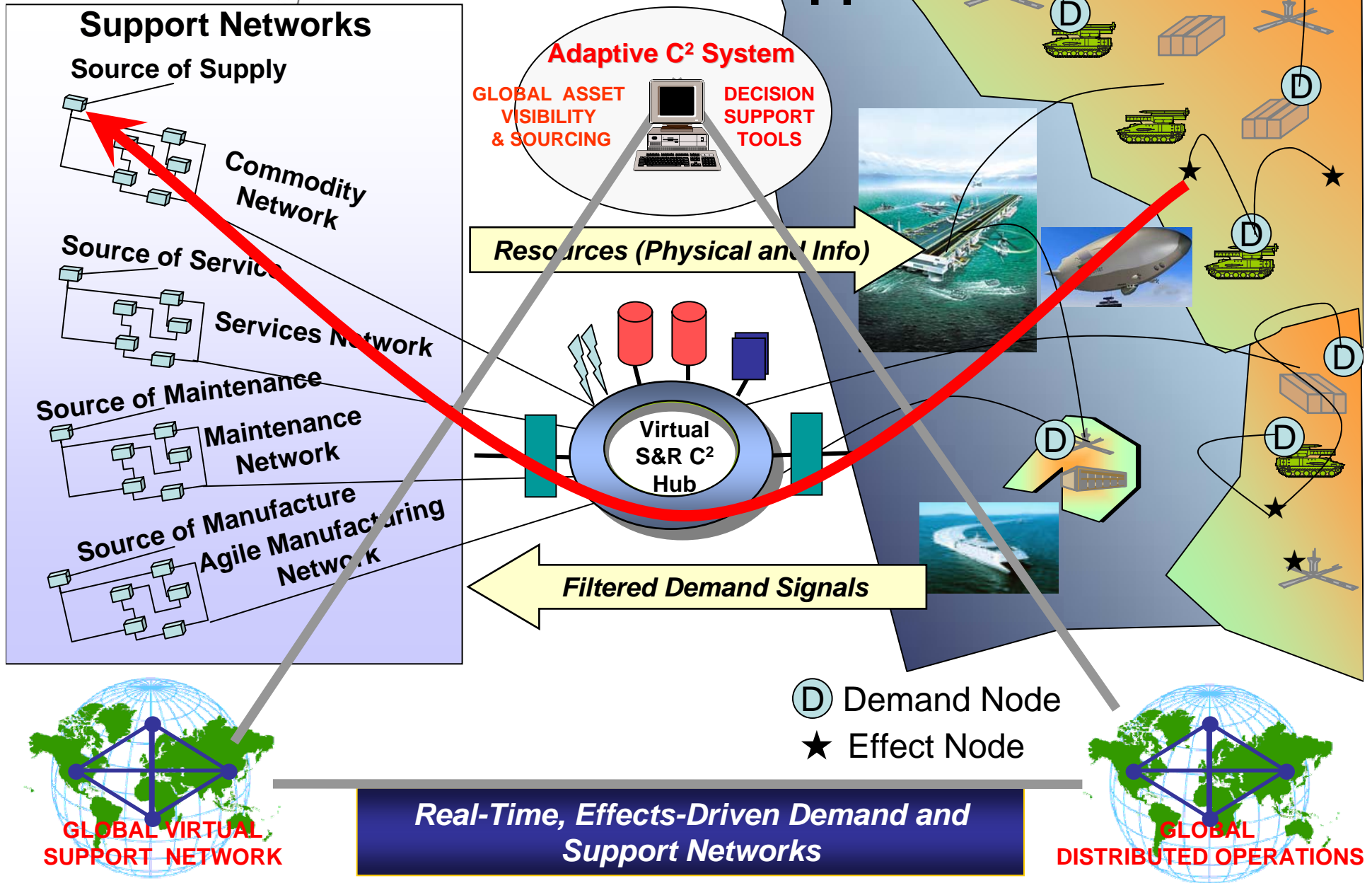
**Very robust, complex pattern,  
complex control, scale free**

**'business end' best connected,  
natural to reconfigure or change flow**

- Support network is dynamic
  - **Support doctrine anticipates event-driven, reconfigurable support nets**
  - **Emphasizes distribution flexibility and support network responds to need**
- Negotiation-based relationships
  - **All entities use commander's intent, planned effects, and detailed situation awareness to negotiate and synchronize**
  - **Roles and commitments of entities are dynamically defined within a specific context**
  - **All entities are described in terms of current capabilities, not as static forces**
- Networks are robust and difficult to analyze and attack
  - **More robust to node failure**
  - **Adapts to real-time demand signals**
- Supports distributed, adaptive operations
  - **Network adaptivity allows logistics decisions to be made continuously and anticipatorily**
  - **Emphasis on information and distribution allows a greater degree of operational flexibility and risk management**
  - **No pause—log does not constrain ops speed**
  - **Mechanisms are transparent to warfighters; but results are very apparent**

*S&RL is a source of operational advantage and a capability multiplier*

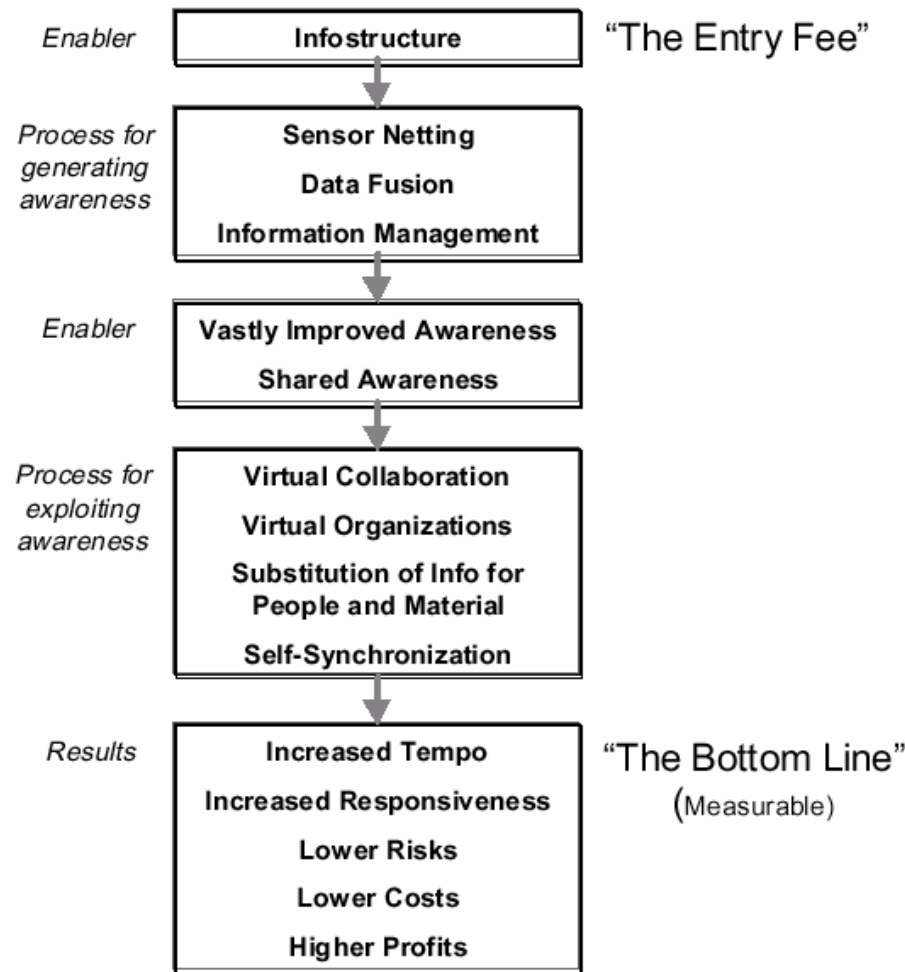
# End-to-End S&R Point-of-Effect to Source of Support



# **Concept-Technology Pairing**

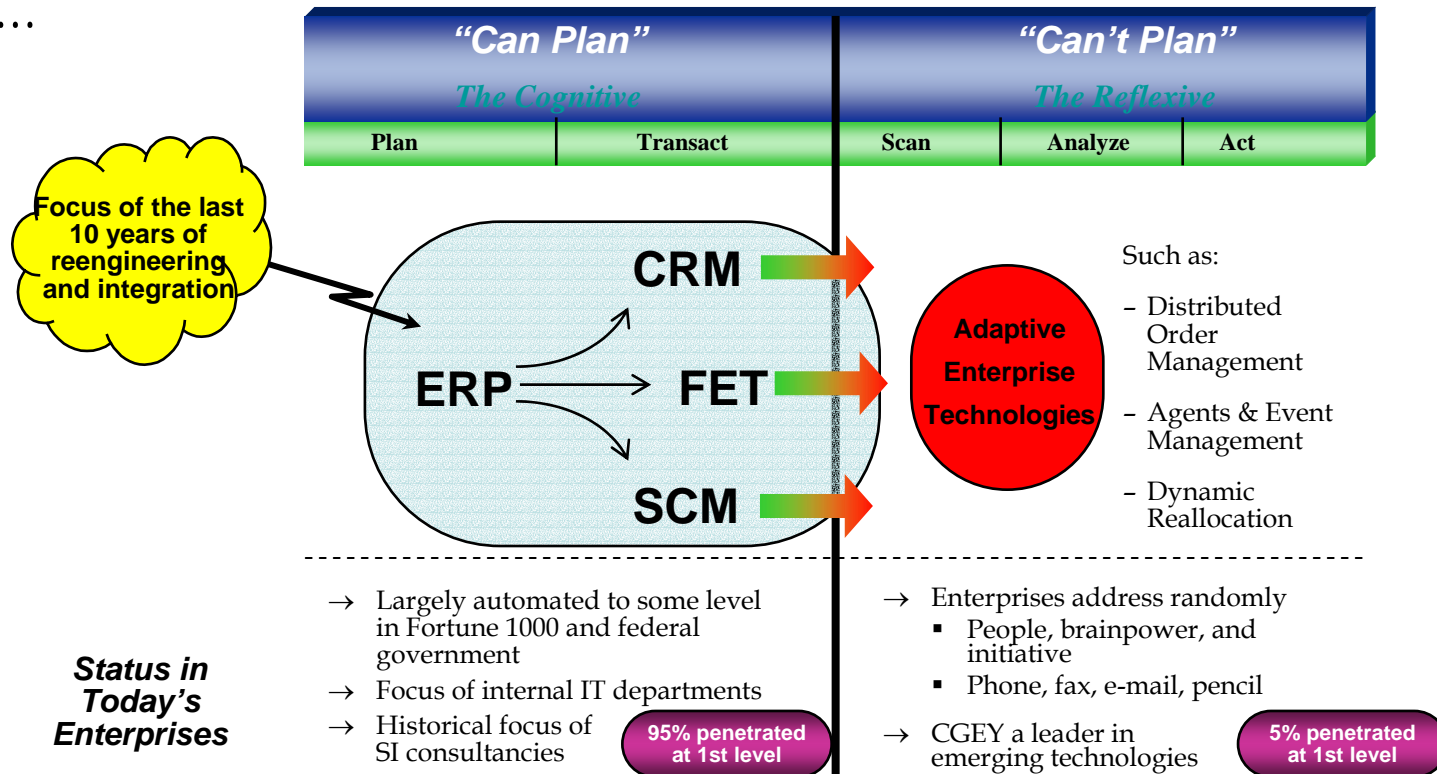


# The Event Driven Enterprise



# Strategic Context – *from data to action*

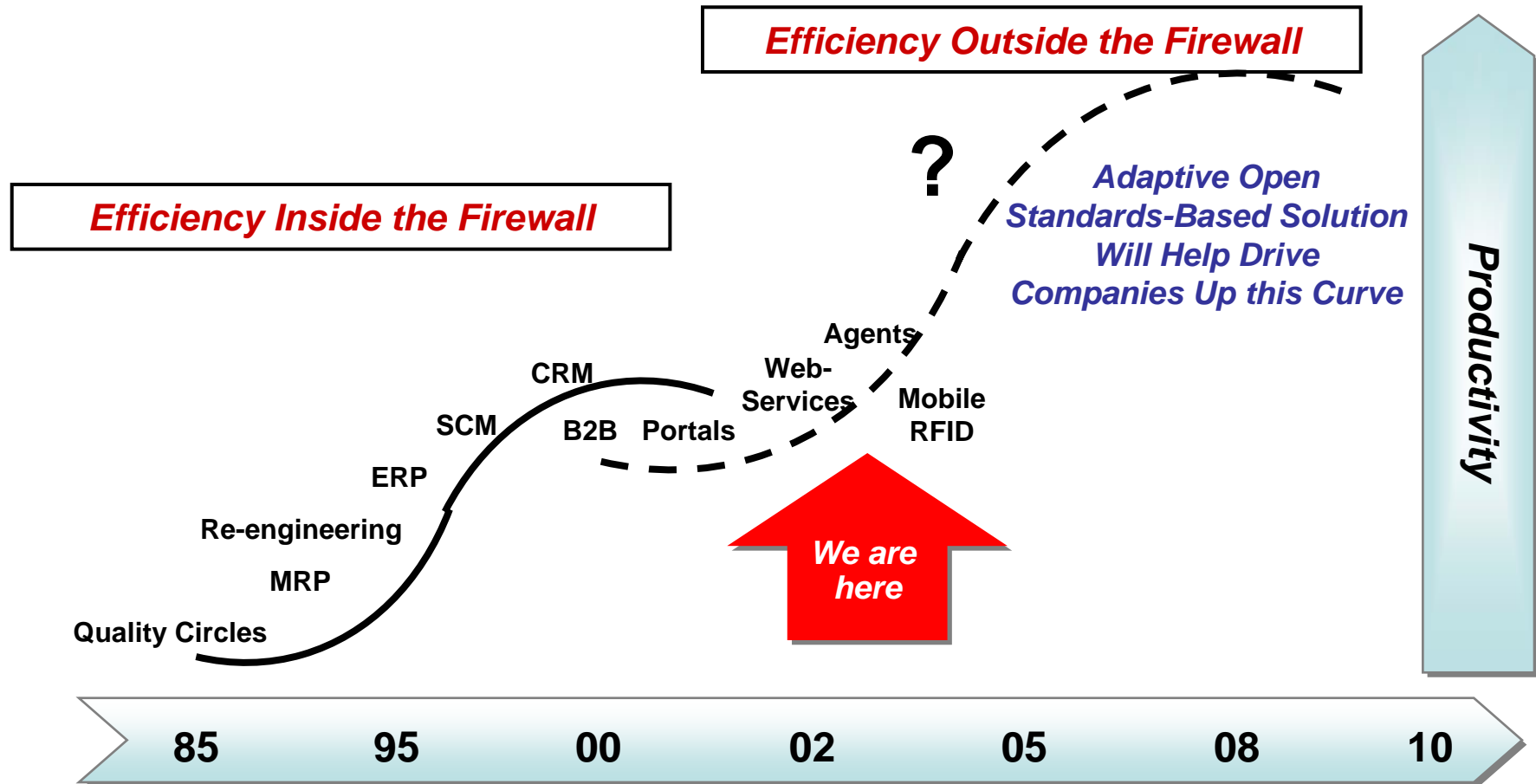
The technology marketplace is shifting from the “information age” to the “execution age” ...



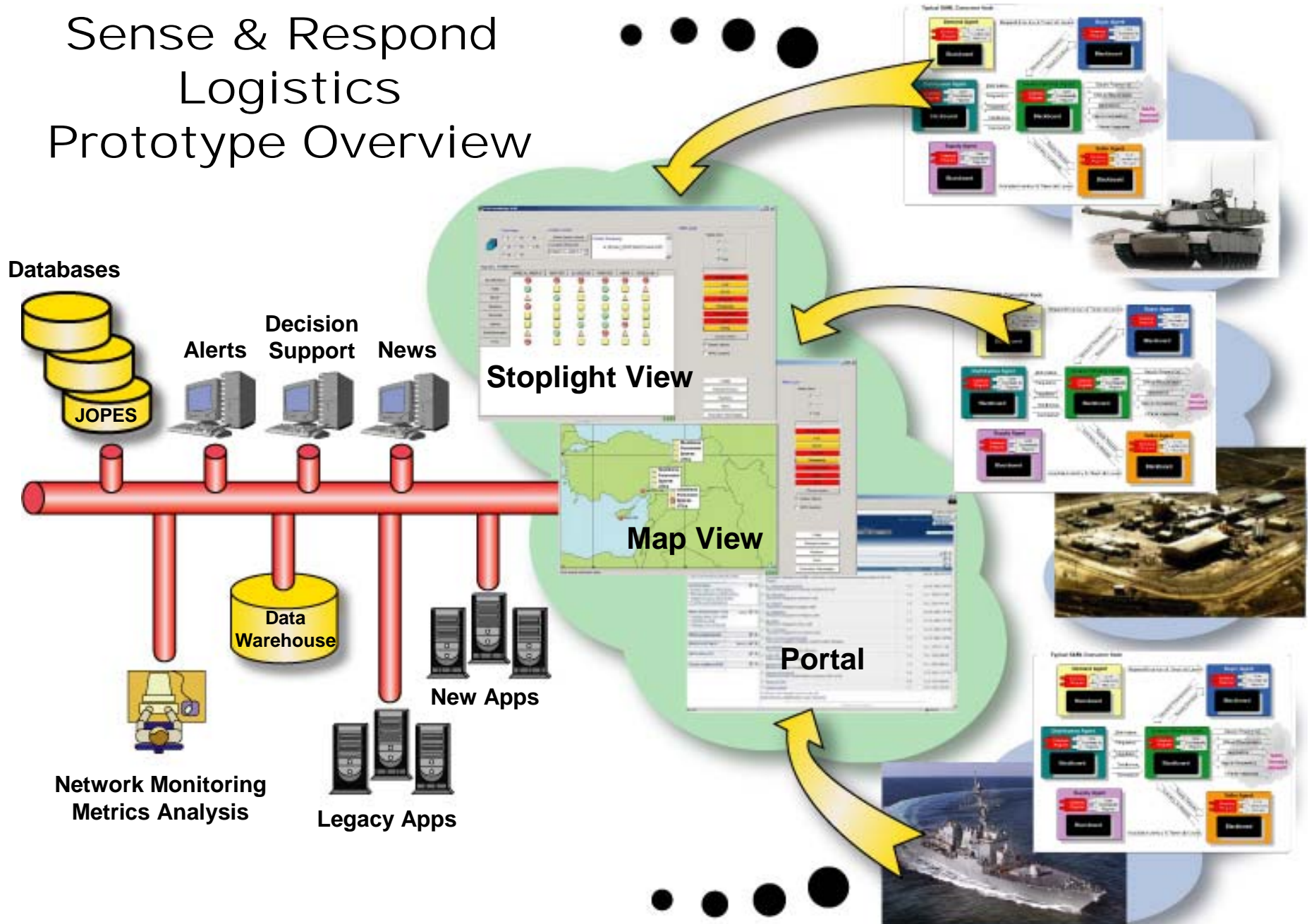
...the future is in balancing centralized planning/optimization with distributed decision-making and execution.

# Strategic Context – *the new technology “S” curve*

*The new technology S curve will enable the optimization of the ecosystem*



# Sense & Respond Logistics Prototype Overview



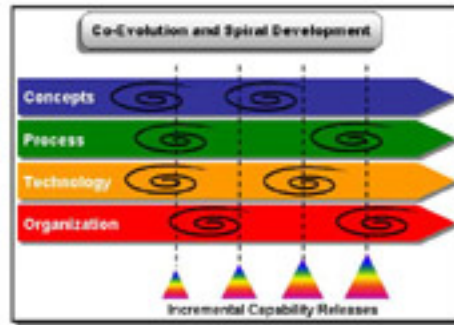
# **A Co-Evolutionary Approach**

# Co-Evolutionary Process

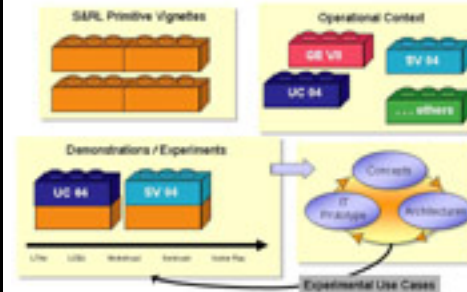
## Strategy and Concept



## Co-Evolution and Spiral Development

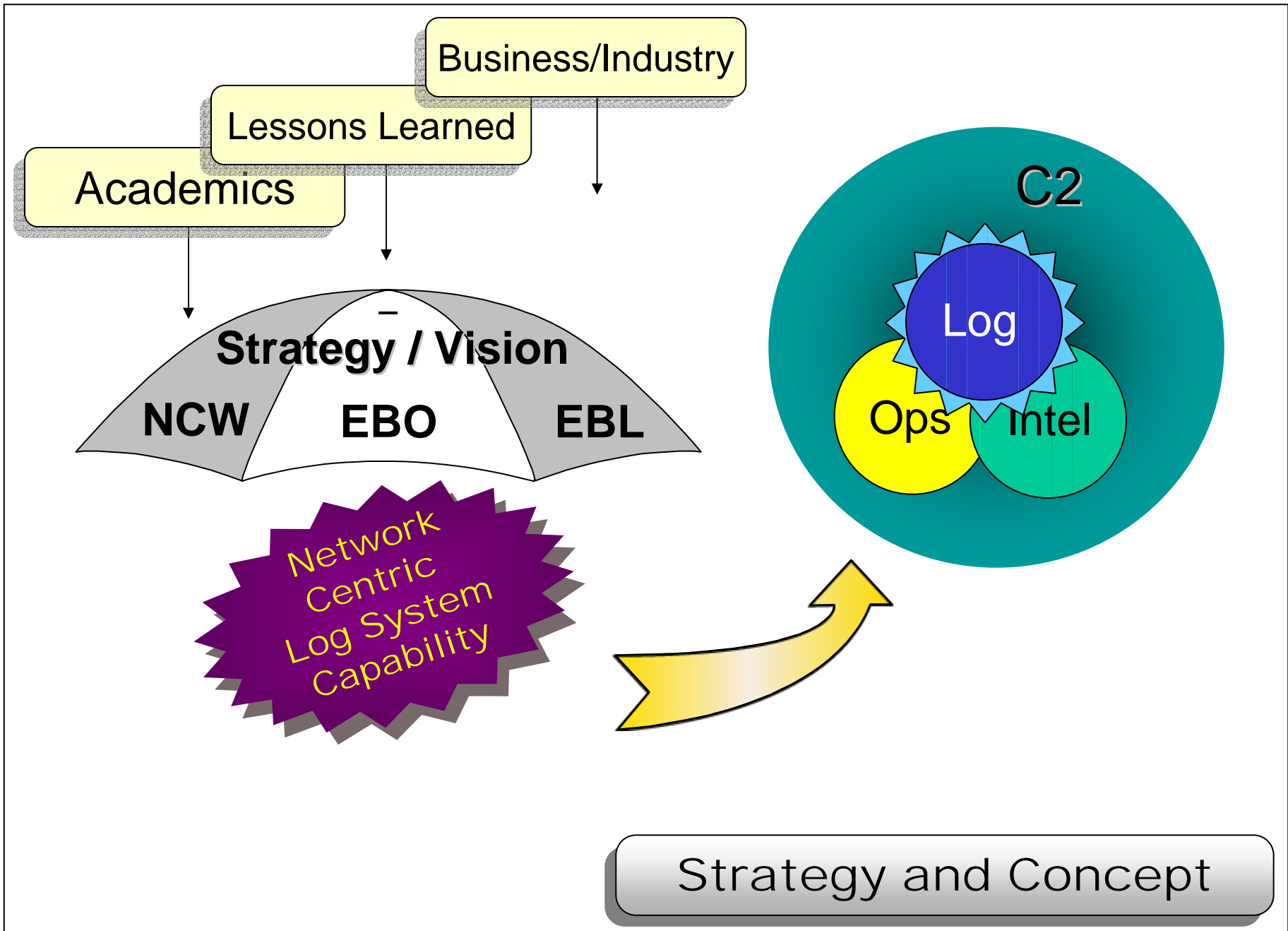


## S&R Experimentation Framework



## Implications Across DoD and Beyond





Co-Evolution and Spiral Development

Concepts

Process

Technology

Organization

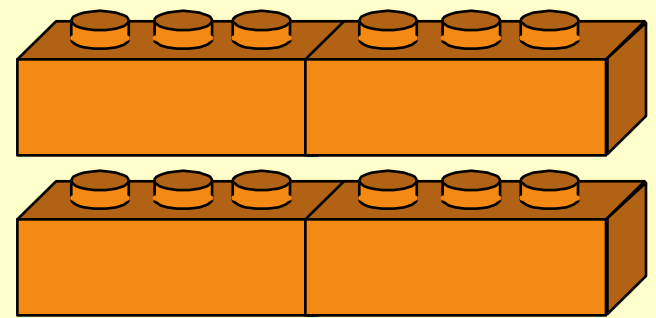


Incremental Capability Releases

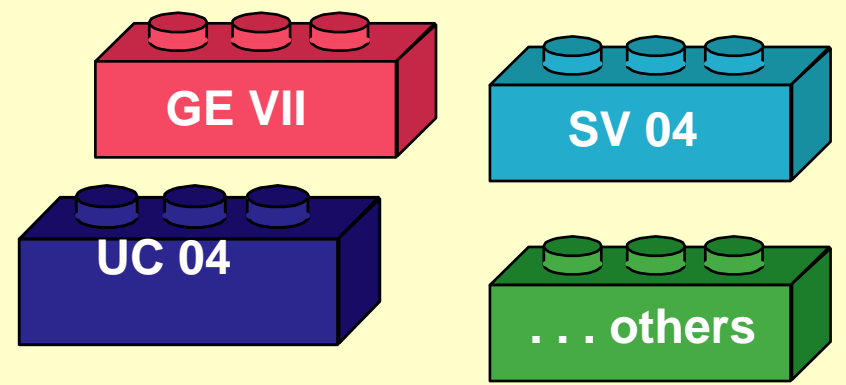


# S&R Experimental Framework

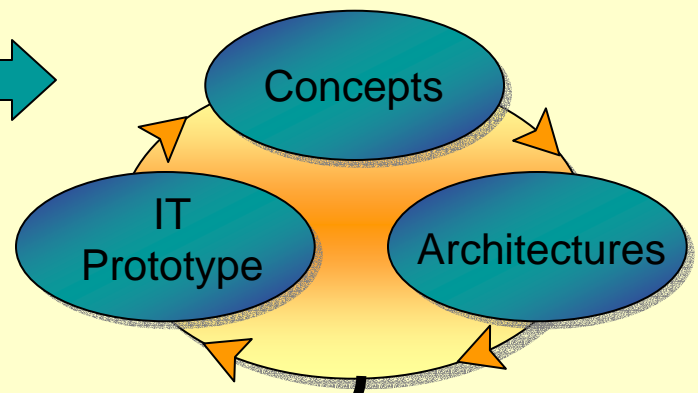
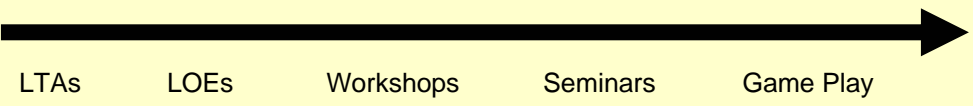
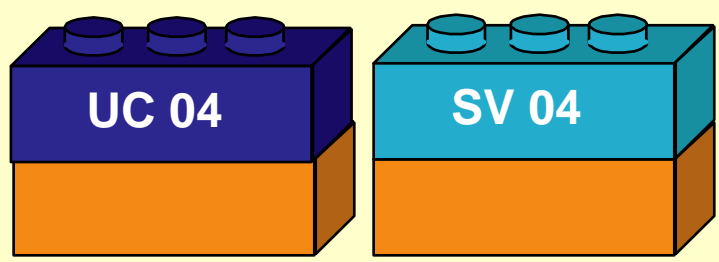
## S&RL Primitive Vignettes



## Operational Context



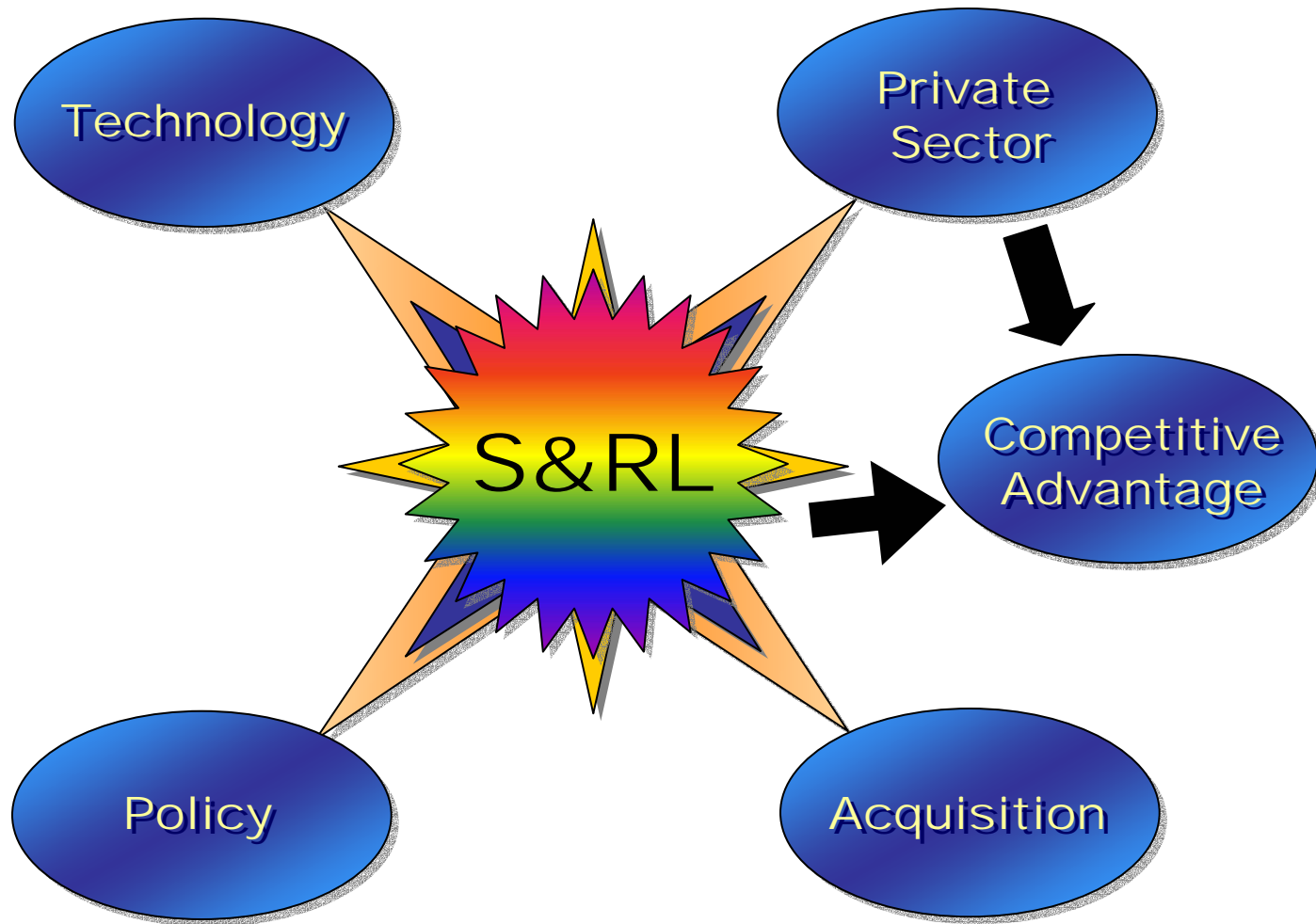
## Demonstrations / Experiments



Experimental Use Cases



Implications across DoD and Beyond



# Critical Role: Prototyping and Experimentation

- DoD lacks dynamic info simulation models, info-based prototypes, and experimentation designs that translate NCW theory and principles into operationally usable concepts and tools
- Knowledge and understanding of network science not a core competency within DoD
- Leadership not aware of or underestimates value of commercial world analogs and implementations to DoD's transformation efforts
- Commercial analogs must be *adapted not adopted* to DoD operational applications
- First adopters in the commercial sector are mostly non-Defense
- Capabilities transformation accelerator- drives cultural then structural change

*Shift to capabilities-based system requires rapid prototyping and experimentation from the “point of effect” back*

# **Moving Towards an Adaptive Enterprise**

# Project Chronology

- 2002 Efforts
  - Study the problem space: OPS/LOG area
  - Initial research into demand networks
  - Hook operational partners and build the project carpool
  - Work the conceptual ideas into high level policy, concept development, and experimentation guidance
  - Establish outreach program
- 2003 Efforts
  - Structure the team for co-evolutionary development
  - Formalize relationship with partners
  - Establish “champions”
  - Operationalize S&R concept
  - Launch prototype build and experimentation
  - Link with other related efforts
  - Influence convergent DoD strategy
  - Develop pathway for coalition partners
  - Continue outreach program

# Catalyzing the Change

- Synchronize the support chain to the “kill” chain
  - **Concept driven capabilities development**
  - **Organizational alignment; cross-enterprise approach**
  - **Information architecture and technology**
  - **Prototyping and experimentation**
- Broaden the industrial base
  - **Role of public-private partnerships**
  - **New business models**
- Focus S&T and R&D
- Strengthen the academic base
  - **Cross-disciplinary curricula and research projects**
  - **Cognitive sciences**
  - **Complexity science**
  - **Operations research**
  - **Distributed systems engineering**

**Questions?**

**Back Up Slides**



# Logistics: Pre- and Post-Transformation

1. Linear
2. Chains
3. Use-based
4. Service Stovepipes
5. Functional Stovepipes
6. Title Ten-Driven
7. Pre-planned
8. Poor Ops Log ISR integration
9. Reactive
10. Parametric Analysis-based
11. Hierarchical
12. Monolithic
13. Poor scalability
14. Not flexible
15. Consumption-based
16. Mass
17. Attrition
18. Service perspective
19. Efficiency
20. Highly Optimized
21. Brittle, rigid supply chains

1. Non-linear
2. Networked
3. Effects-Based
4. Cross-Service Mutual Support
5. Cross-Enterprise
6. Joint Logistics
7. Dynamic Continuous planning and execution
8. Net Warrior Ethos
9. Anticipatory
10. Collaborative
11. Networked
12. Distributed, modular
13. Dynamically Scaleable
14. Flexible
15. Adaptive, Cognitive
16. Speed of effect
17. Effects based
18. Joint Coherence
19. Effectiveness
20. Effective
21. Robust, flexible demand networks

# Required S&RL Capabilities: The Ability to...

- Provide adaptive logistics between battlespace entities and the support network
- Operate within a network-centric enterprise framework for logistics (and Ops, ISR, & C<sup>2</sup>)
- Provide logistics support for effects-based, distributed, collaborative operations
- Support rapid decisive operations via flexible projection, basing, and sustainment
- Provide end-to-end visibility for logistics resources (including process capacities)
- Provide adaptive logistics support for the full range of military operations
- Dynamically tailor modular logistics support to effects, capabilities, missions, and tasks
- Provide adaptive support networks to rapidly respond to events and operational needs
- Predict and anticipate logistics support requirements and alternative solutions
- Provide operational Commanders with support options based on adaptive logistics
- Fully integrate logistics processes with Operations, ISR, and C<sup>2</sup>
- Integrate strategic, operational, and tactical support capabilities
- Situationally adapt communications, processing, and information resources
- Assure the operation, integrity, and security of the network infrastructure
- Use objectives and planned effects to support decision making and risk management
- Integrate CONUS, OCONUS, host nation, indigenous, and ally logistic resources
- Support decision-making with cognitive decision support tools

Co-Evolution and Spiral Development

Concepts

Process

Technology

Organization

Co-Evolution and Spiral Development

Concepts

Process

Technology

Organization

Rapid, Incremental Sense & Respond Logistics Events

Network  
Centric  
Log System  
Capability

Assessment  
& Feedback

Future

Experimentation

Analysis

Simulation

Demonstrations

Wargames

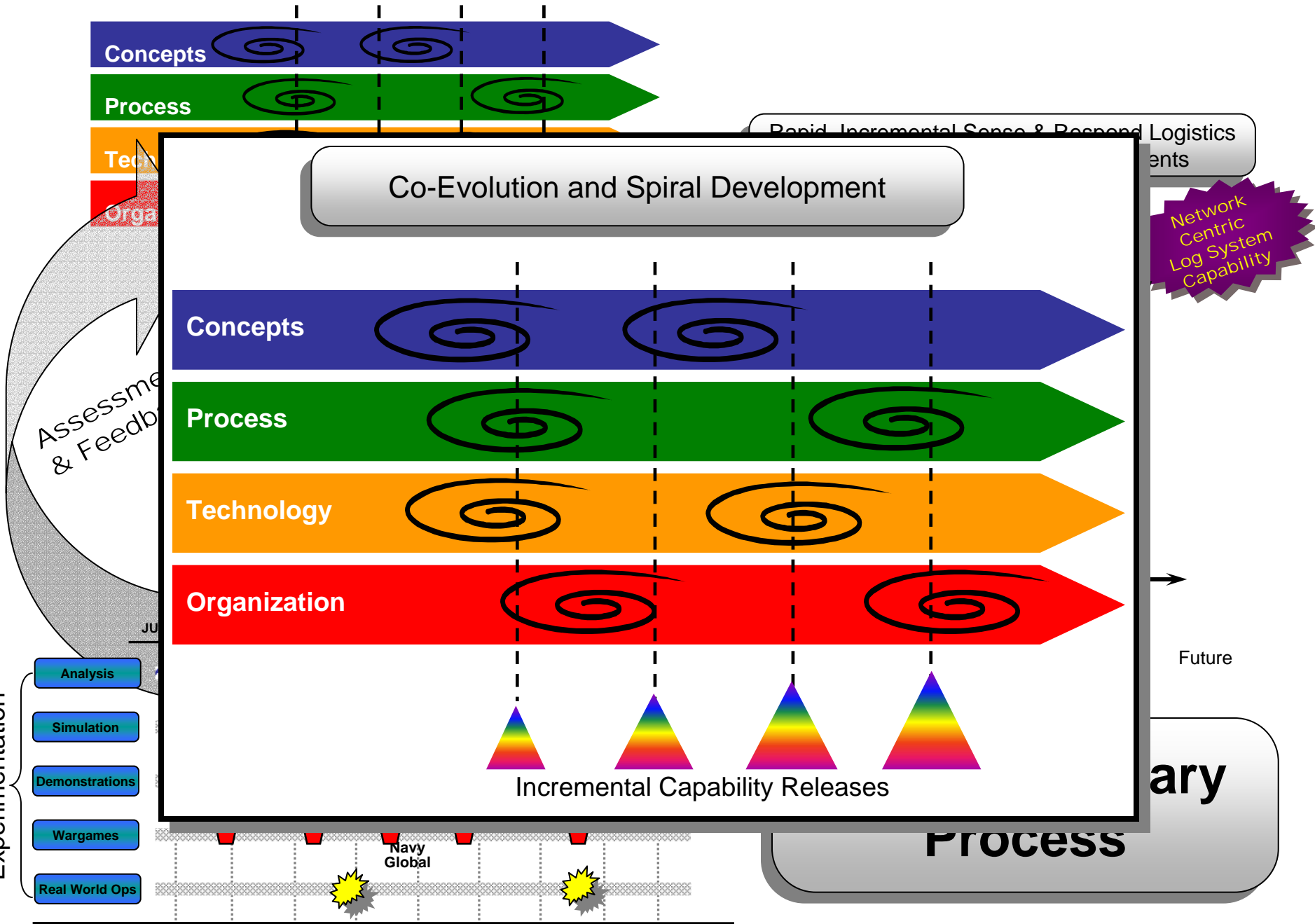
Real World Ops

Incremental Capability Releases

Navy  
Global

Process

ary



Co-Evolution and Spiral Development

Concepts

Proc

Tech

Orga

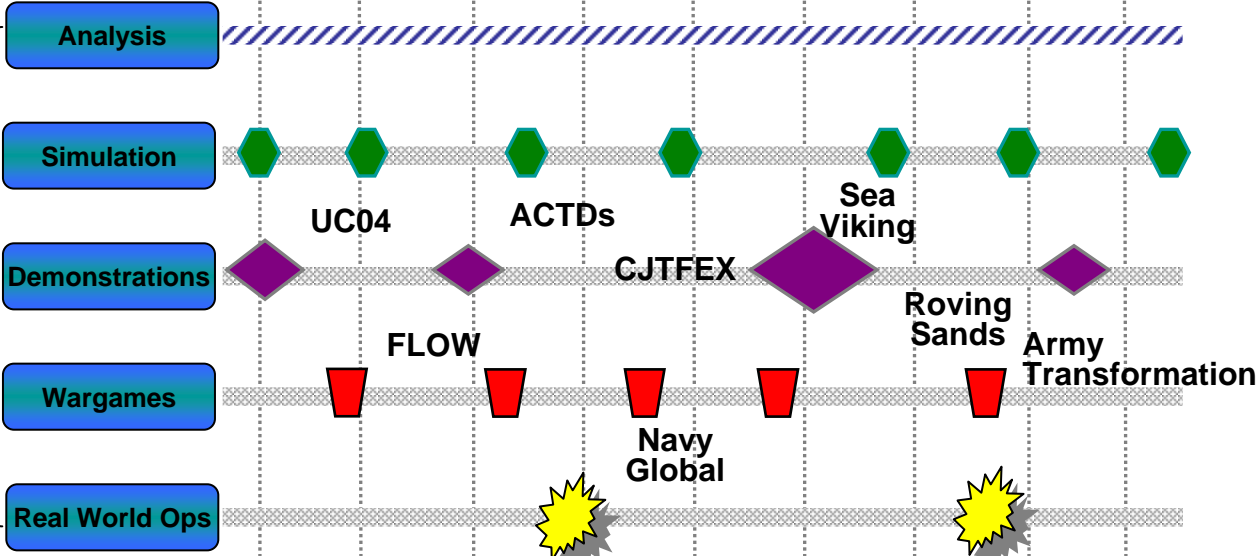
Planned and Event-Driven  
Experimentation and Operational Evaluation

Logistics  
ents

Network  
Centric  
Log System  
Capability

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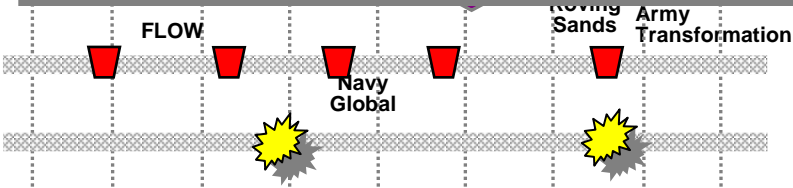
Experimentation



Assessment  
& Feedback

Experimentation

- Analysis
- Simulation
- Demonstrations
- Wargames
- Real World Ops



Future

Process

ary

Co-Evolution and Spiral Development

Concepts

Proc

Tech

Orga

Rapid, Incremental Sense & Respond Logistics  
Operational Capability Enhancements

Logistics  
ents

Network  
Centric  
Log System  
Capability

Network  
Centric  
Log System  
Capability

Assessment  
& Feedback

Logistics Capability

S&R  
Vision /  
Concept

Capability Increments

Future

Present

Future

ary

Process

Experimentation

Analysis

Simulation

Demonstrations

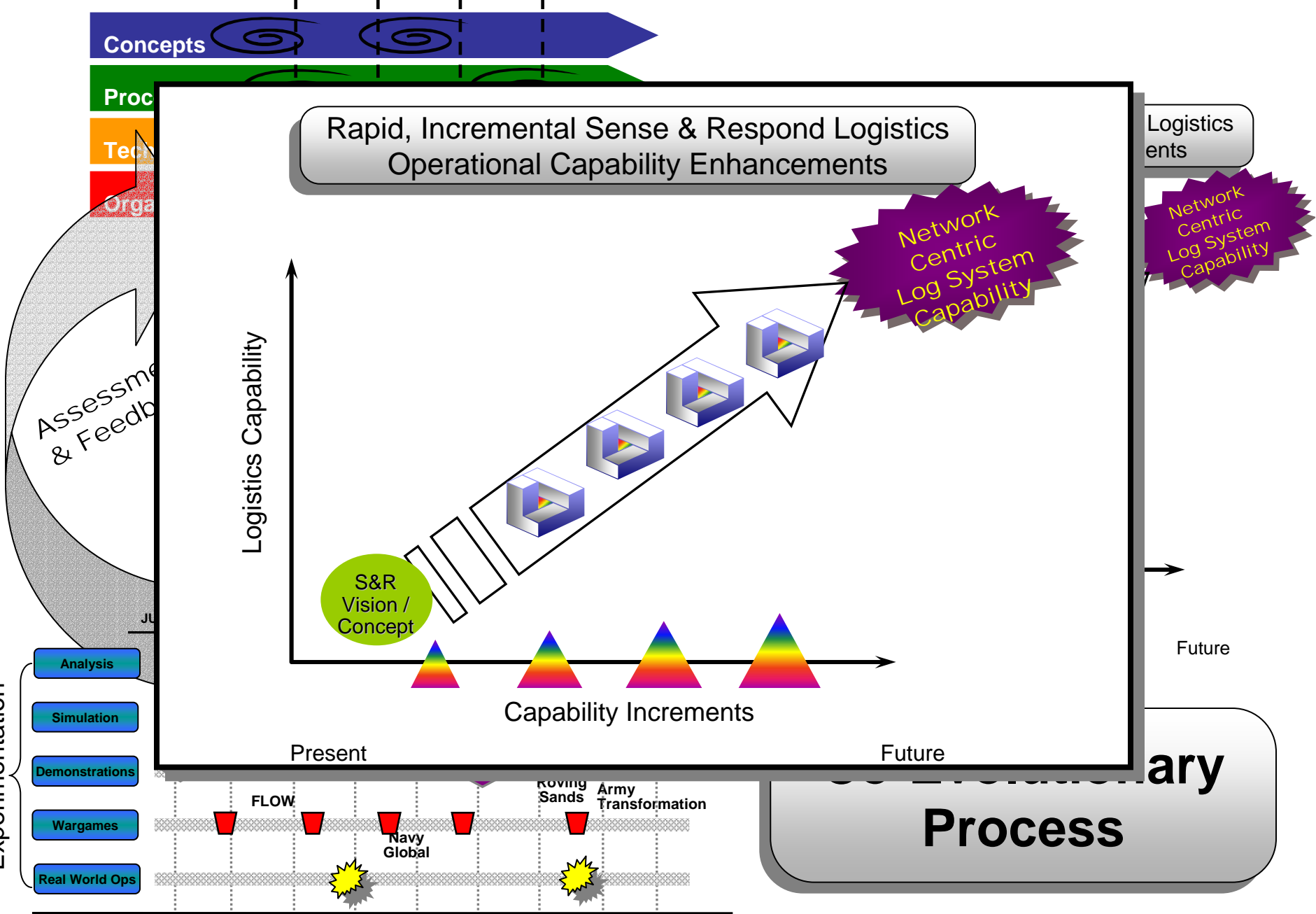
Wargames

Real World Ops

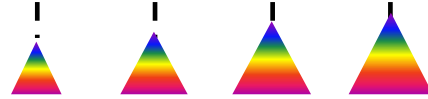
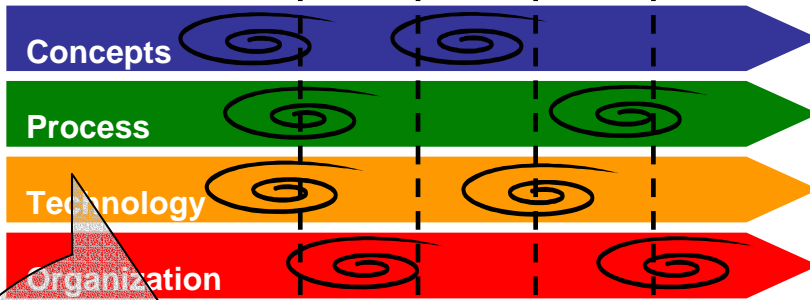
FLOW

Navy  
Global

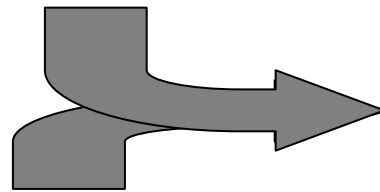
oving  
Sands  
Army  
Transformation



Co-Evolution and Spiral Development

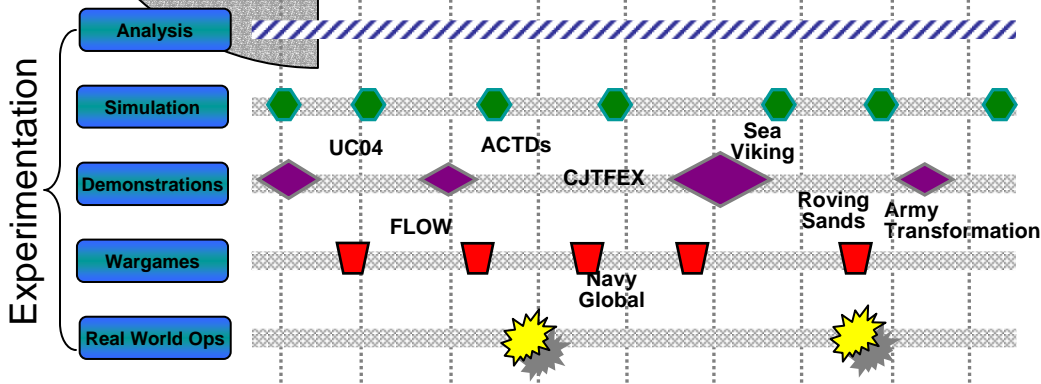


Incremental Capability Releases

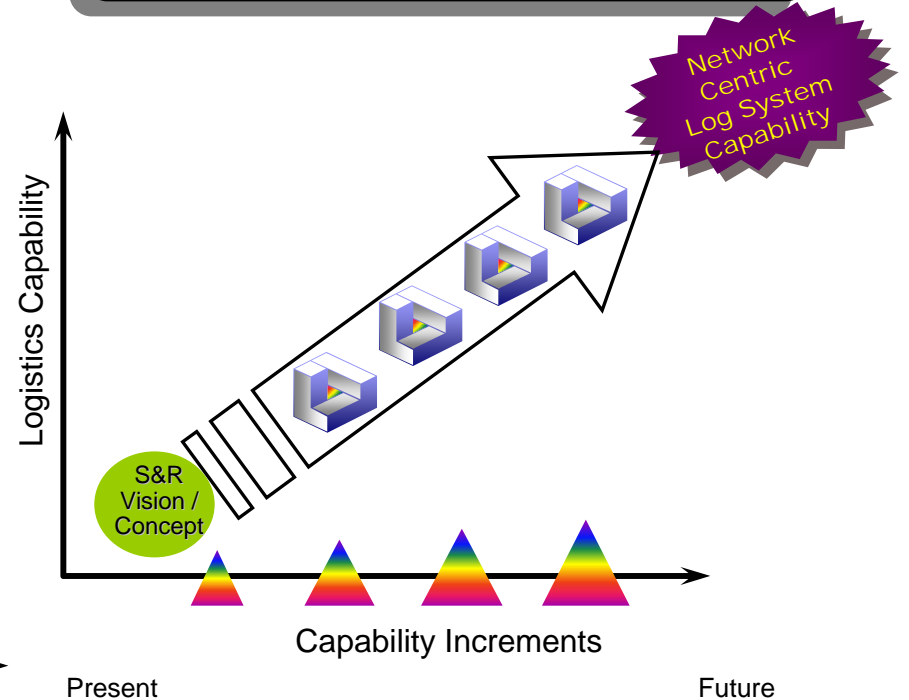


Planned and Event-Driven Experimentation and Operational Evaluation

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Rapid, Incremental Sense & Respond Logistics Operational Capability Enhancements

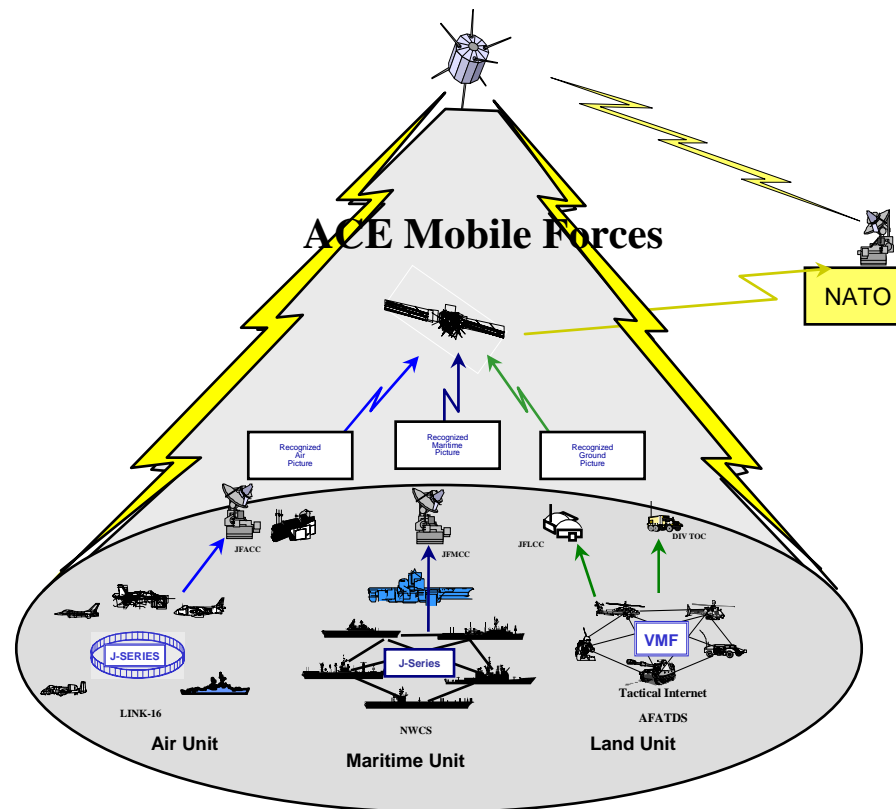


**Co-Evolutionary Process**

# Event Driven Enterprise at Work...

## *NATO Rapid Reaction Headquarters*

### Integrated Event-Driven Rapid Deployment Force



Adapted from Royal Netherlands Army ISIS  
Event Driven Army initiative

