An Engineering Model
for
Enterprise Command and Control

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9th Command & Control Research & Technology Symposium
San Diego, CA June 15-17, 2004

Outline

ECHELON 4 CORPORATION

9th Command & Control Research & Technology Symposium
San Diego, CA June 15-17, 2004

Enterprise C2

ENTERPRISE COMMAND AND CONTROL


- *Enterprise*, n, an arbitrary unit of organization responsible for executing one or more policy constrained *value propositions* within a given context

- *Enterprise Command and Control (EC2)*, v, the interactive real-time act of measurement, situation assessment, planning, and plan execution required to guide an enterprise in achieving its value propositions all while immersed in an evolving context

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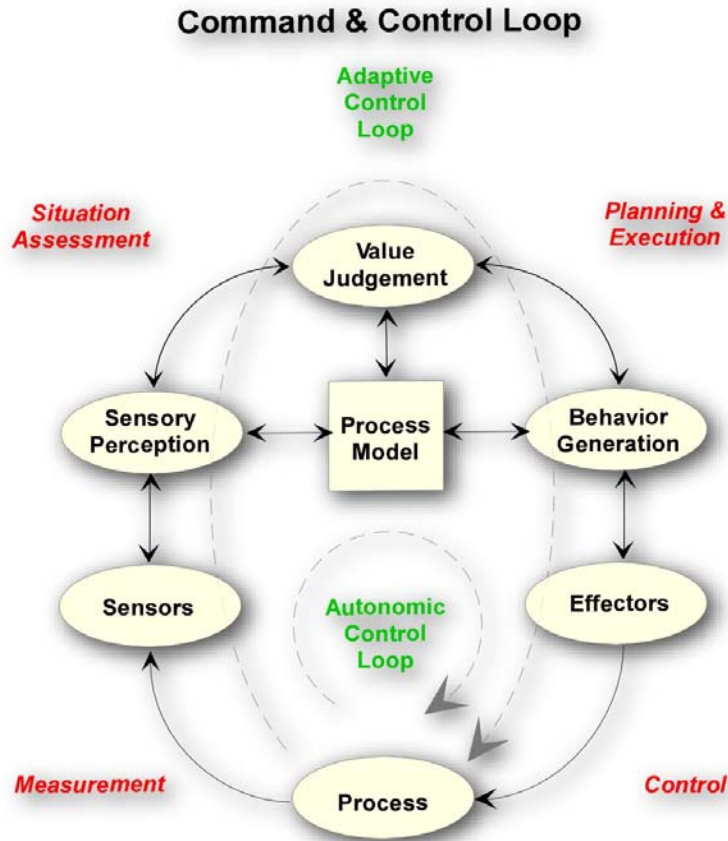San Diego, CA June 15-17, 2004
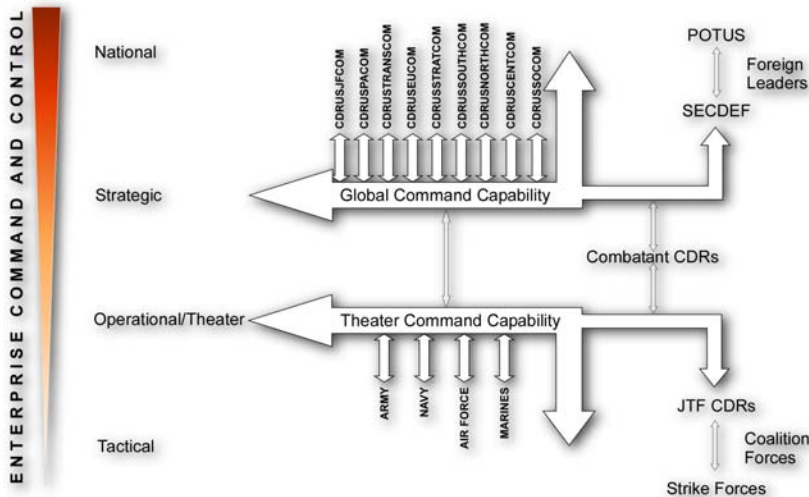
Evolution of Automation
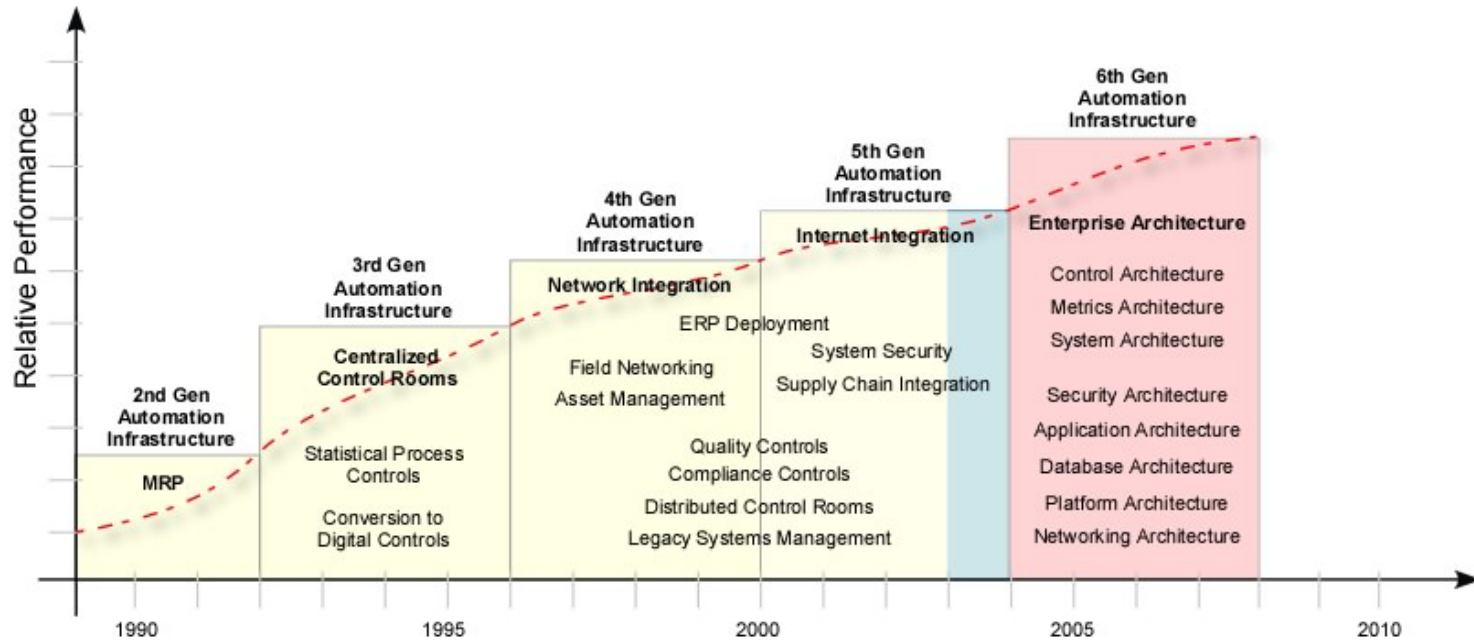
EC2 Issues

- Are we ready to automate (engineer) the upper levels of large-scale enterprise?
- Can we apply integrated computing, communications and control technologies to traditionally social management practices?
- Are enterprise system models sufficiently robust to represent enterprise behaviors?

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Cyclic Process of EC2

Command & Control Loop

Adaptive Control Loop

Situation Assessment

Planning & Execution

Value Judgement

Sensory Perception

Process Model

Behavior Generation

Sensors

Autonomic Control Loop

Effectors

Measurement

Process

Control

- Situation Assessment
  - Measurement
    - Sensor Management
    - Sensory Perception
  - Sensory Perception
    - Context Management
    - Pattern Recognition
- Planning & Execution
  - Behavior Generation
    - Policy & Asset Management
    - Plan Development
  - Control
    - Plan Execution
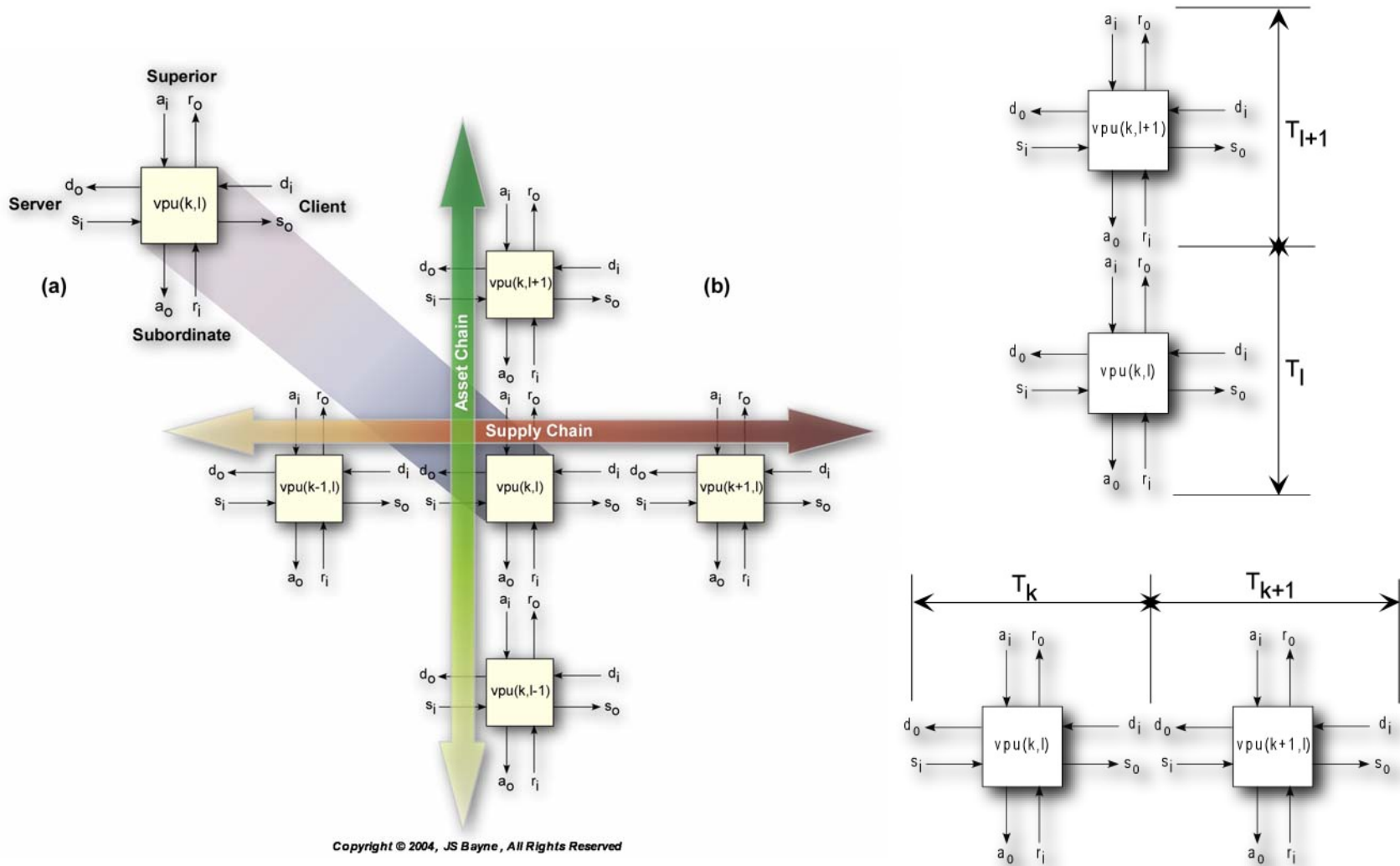   - Effector Management

Key EC2 Characteristics
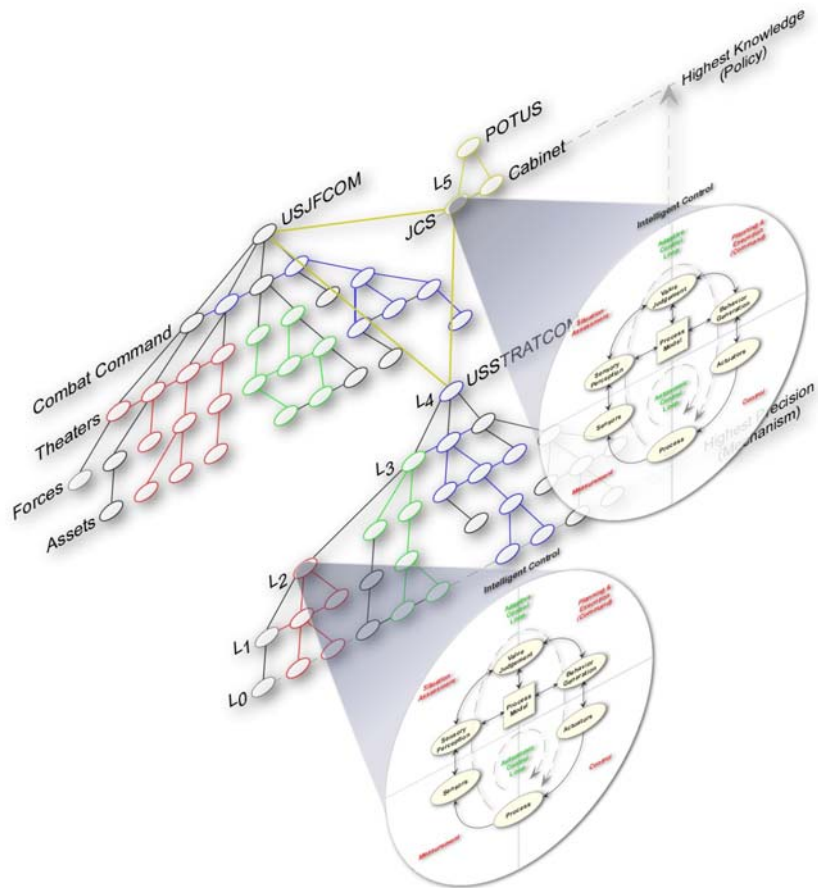
- Strategic, Operational, Tactical
- Distributed (Decentralized)
- Always On Everywhere (24x7)
- Real-time (Timely)
- Mesosynchronous
- Federated (Allied Agents)
- Collaborative (P2P)
- Accountable (Causal)
- Dynamically Stable (Regulated)
- Evolutionary
- Scalable
- Available
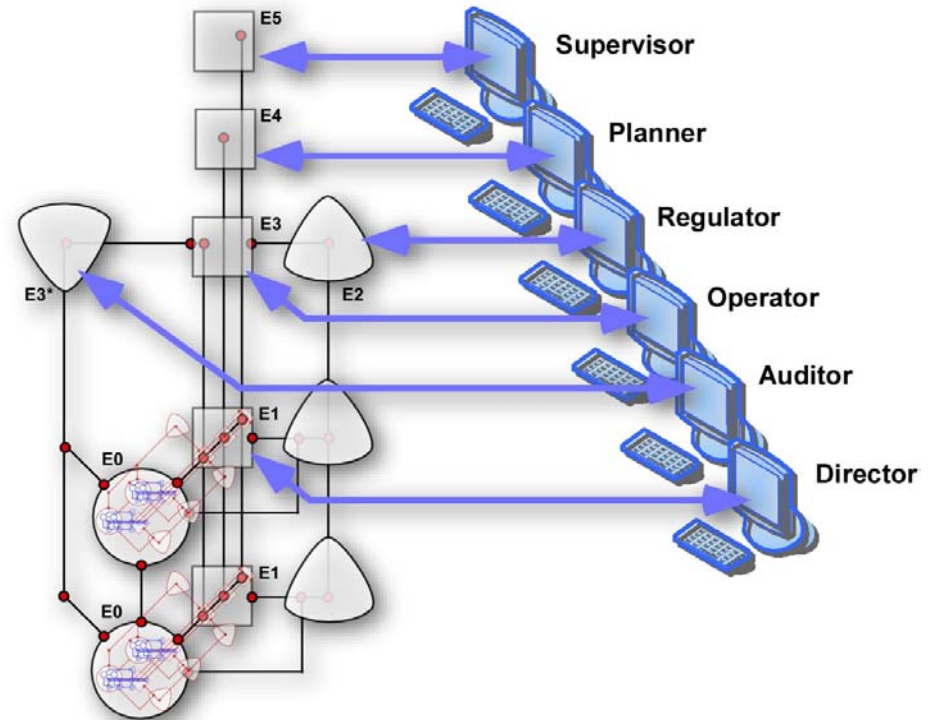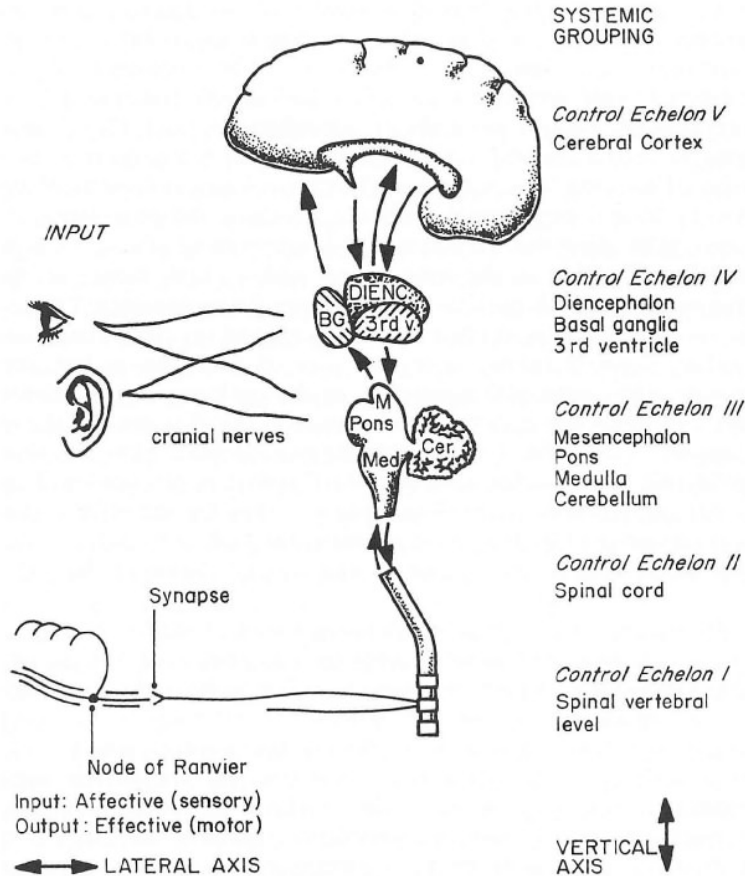- Secure

Key Objective – Value Production
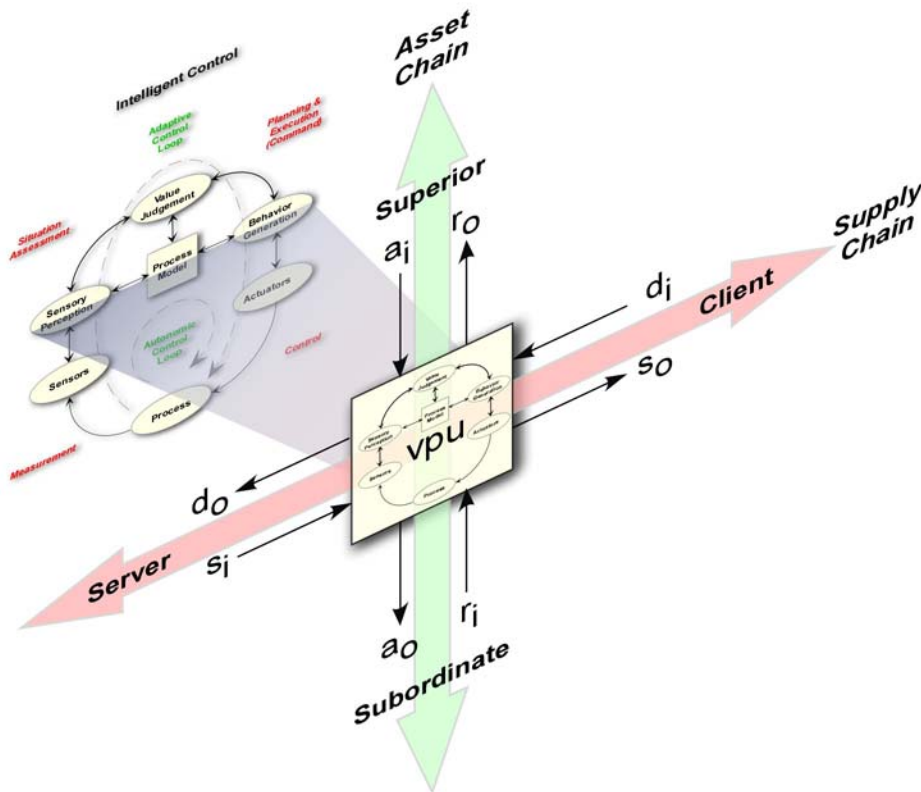
- **Supply Value Chain**
  - Clients
    - Demand In (d_i)
    - Supply Out (s_o)
  - Servers
    - Demand Out (d_o)
    - Supply In (s_i)
- **Asset Value Chain**
  - Superiors
    - Assets In (a_i)
    - Returns Out (r_o)
  - Subordinates
    - Assets Out (a_o)
    - Returns In (r_i)

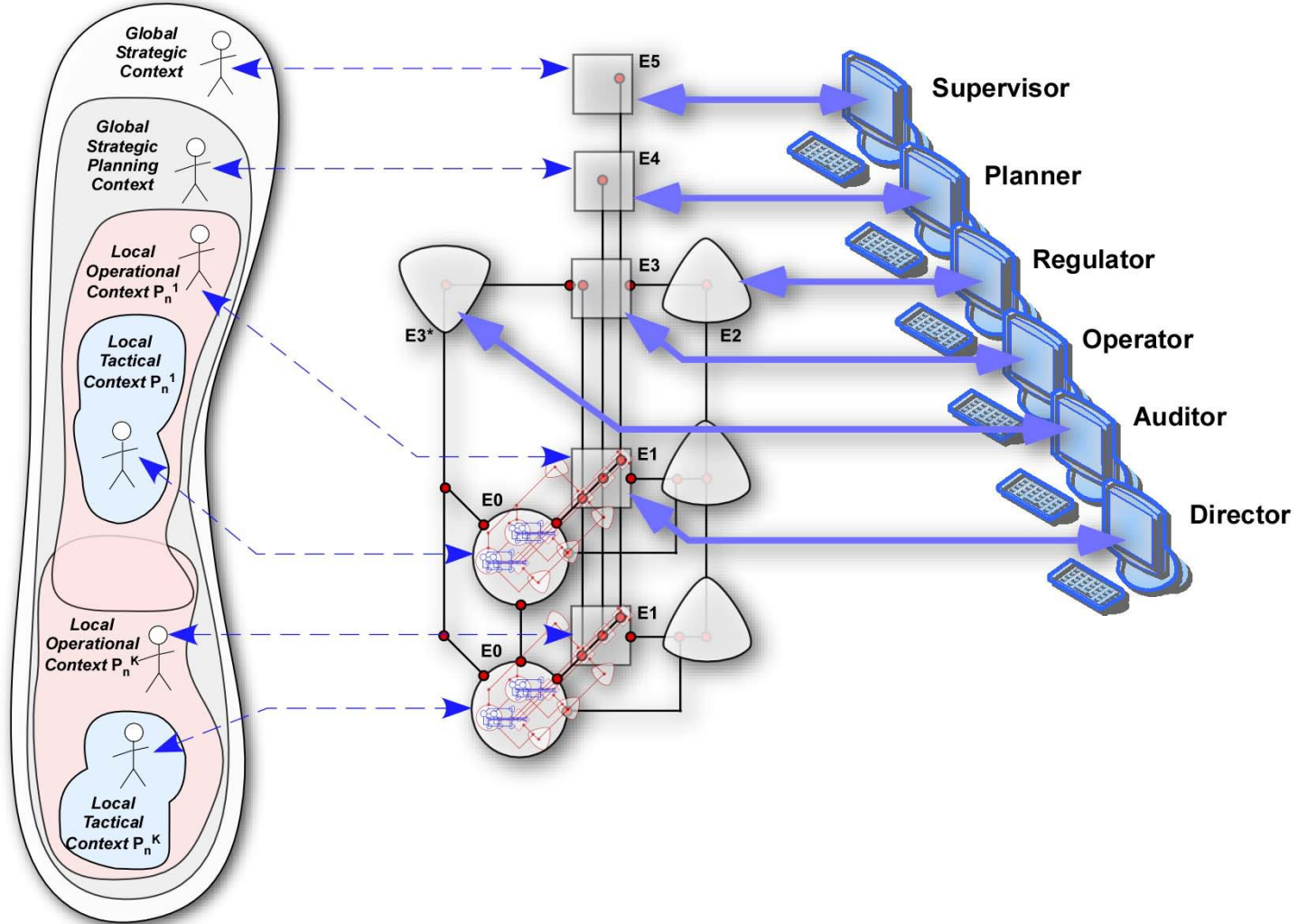Copyright © 2004, JS Bayne, All Rights Reserved

EC2 Actor Model

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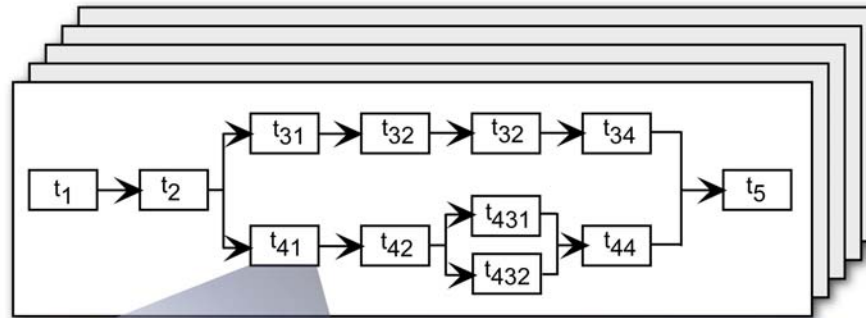
EC2 Environment Actors

EC2 Plans of Record (POR)

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```
task {
        task_id;
        task_time;
        task_resources;
        task_policies;
        task_risk {
                task_risk_time;
                task_risk_resources;
                }
        task_predecessors;
        task_successors;
        task_start_time;
        task_completion_time;
        task_penalty_function;
        task_critical_path;
        task_manager;

        task_init();      /* task resourcing */
        task_proc();      /* task process (step list) */
        task_error();     /* task error handler */
        task_end();       /* task clean up on end */
        task_status();    /* task current status */
        task_etc();       /* task est time to complete */
}
```
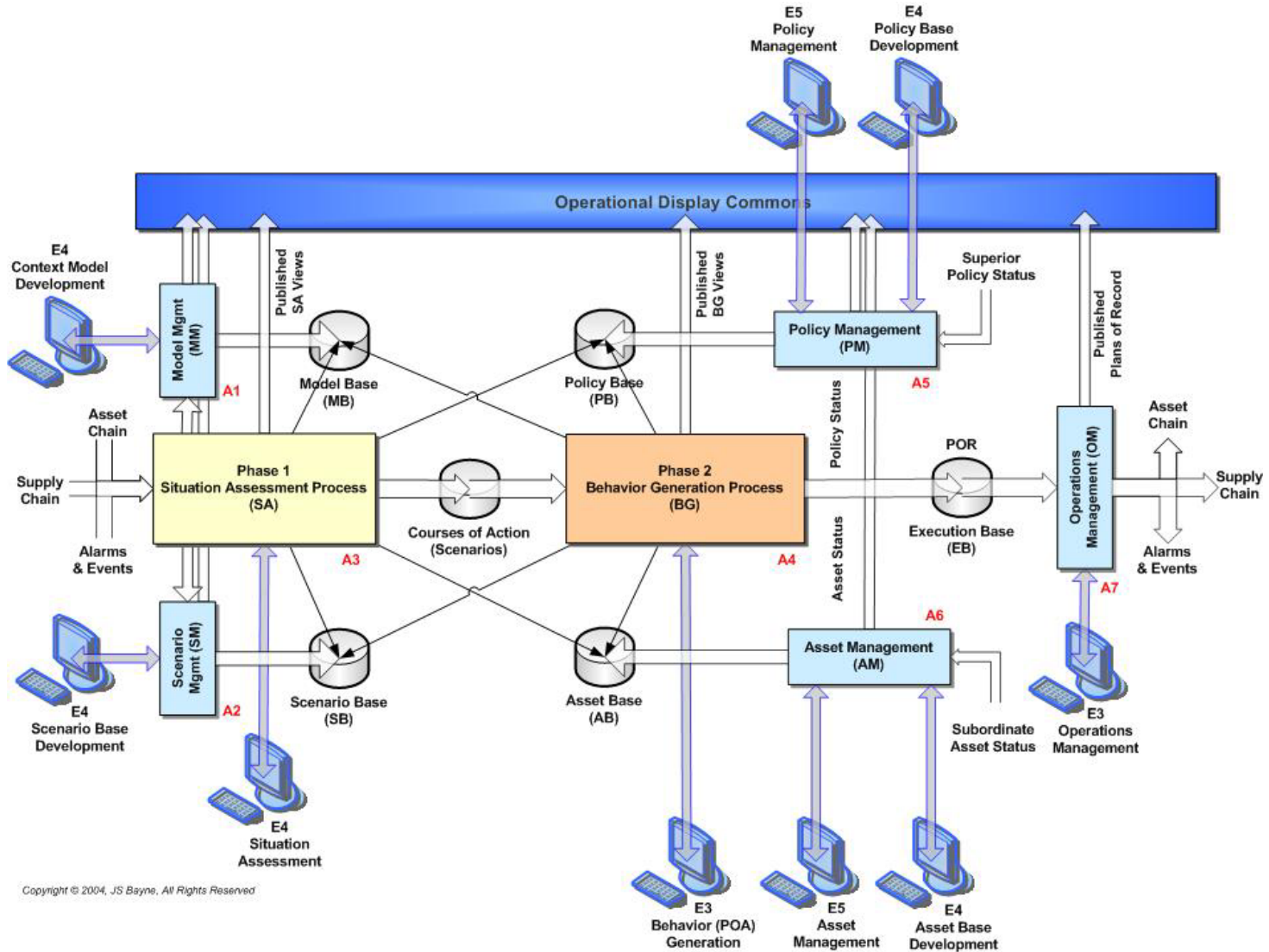
```
plan {
        plan_id;
        plan_time;
        plan_resources;
        plan_policies;
        plan_risk {
                plan_risk_time;
                plan_risk_resources;
                }
        plan_predecessors;
        plan_successors;
        plan_start_time;
        plan_completion_time;
        plan_penalty_function;
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```
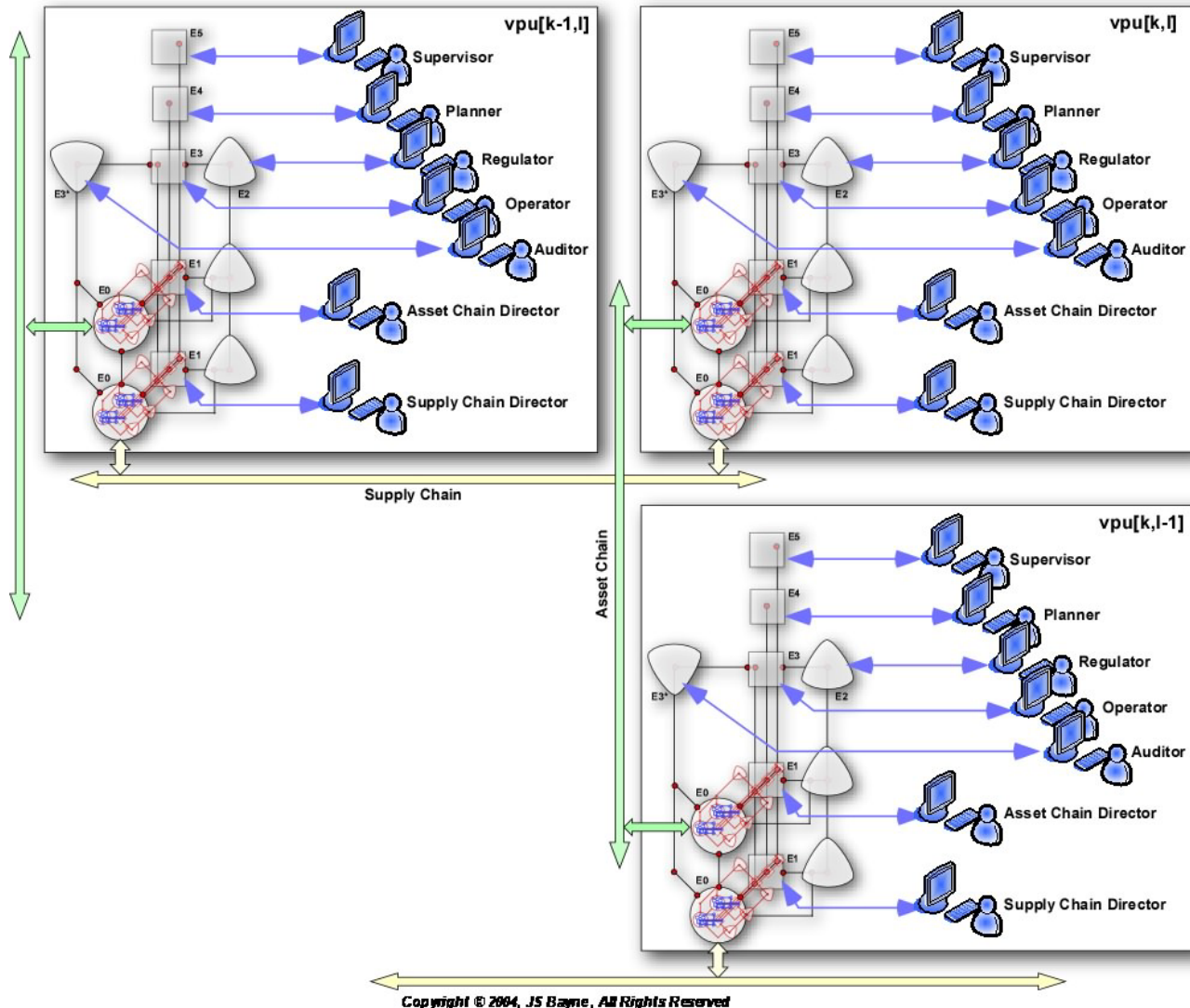
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EC2 Application

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Collaborative EC2

vpu[k-1,l]

vpu[k,l]

vpu[k,l-1]

Supply Chain

Asset Chain

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EC2 "Bridge"

| C2 Level Commentary | C2 Level Alarms & Events |

| Command Inputs | Command Courses of Action | Command Plans of Action | Control Inputs | Control Plans of Record | Status of Executing Plans of Record |

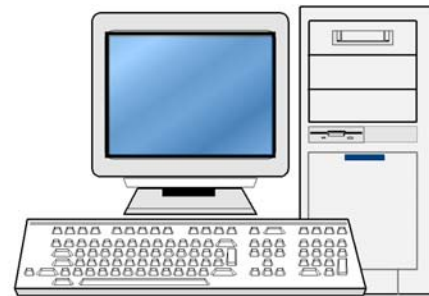| Command Policies | Situation Assessment | Behavior Generation | Control Policies |
| Command Assets | | | Control Assets |

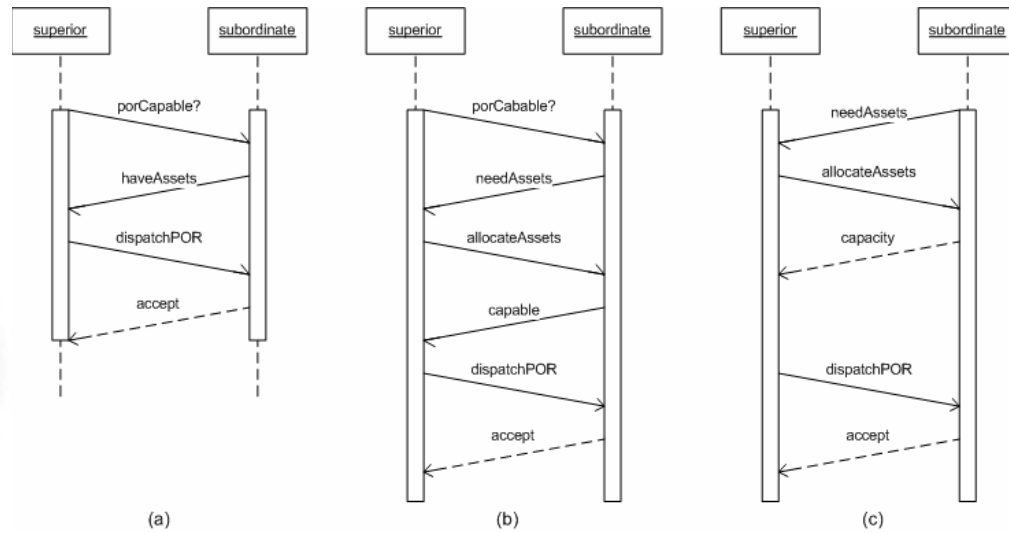Copyright © 2004, JS Bayne, All Rights Reserved

E5 Supervisory Workstation   E4 Analysis & Planning Workstation   E3 Operations Workstation
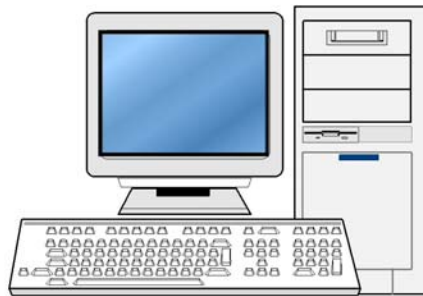
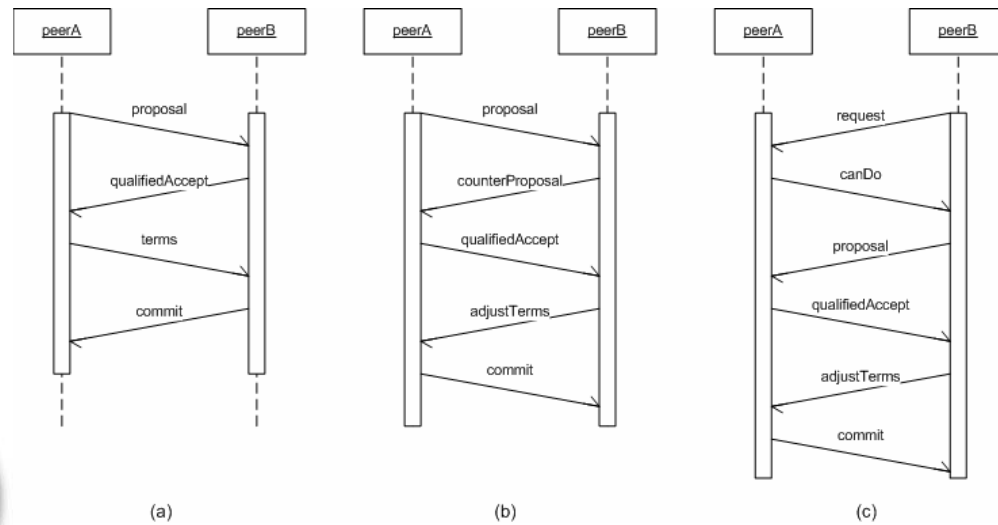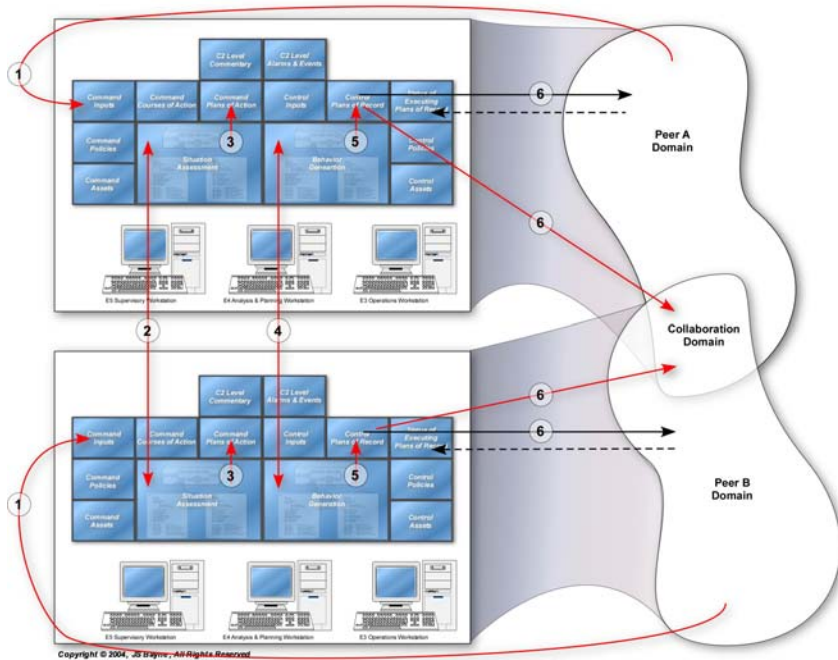9th Command & Control Research & Technology Symposium
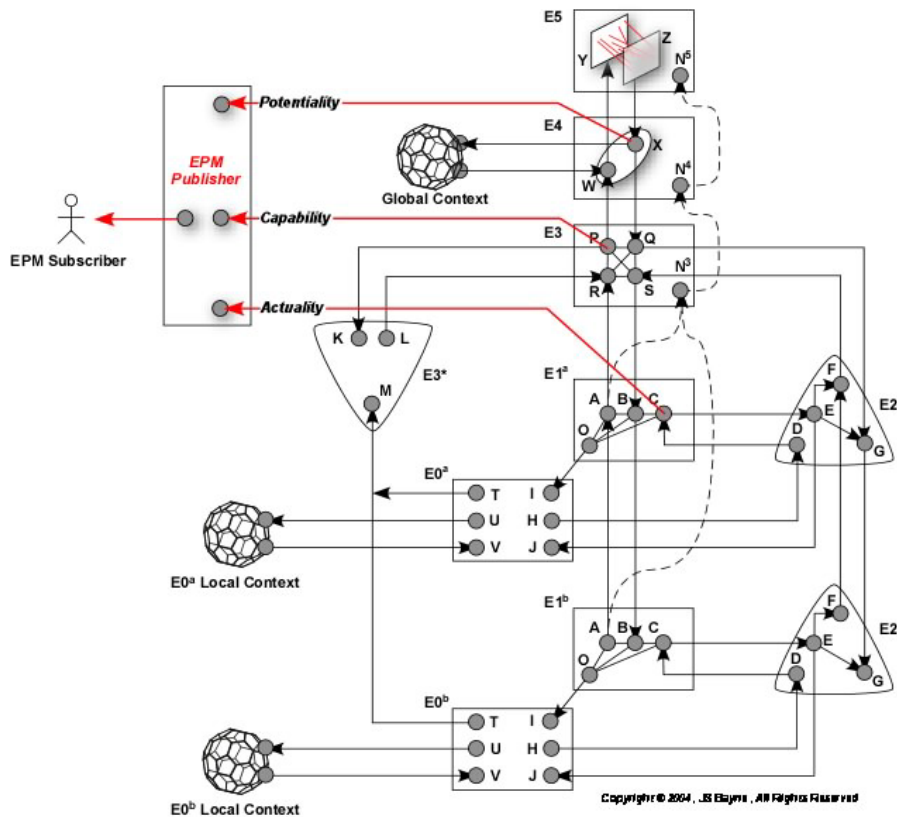San Diego, CA June 15-17, 2004

Asset Chain Collaboration
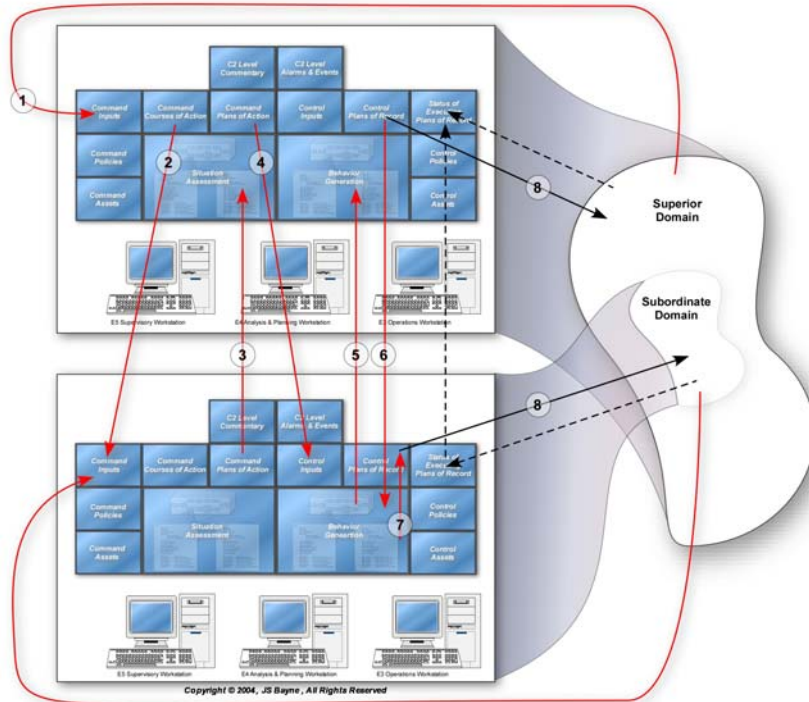
Supply Chain Collaboration

Enterprise Performance

- Potential
  - *What a process is potentially capable of doing*
- Capability
  - *What a process is "resourced" to do*
- Actuality
  - *What a process is actually doing*
- Latency
  - *Ratio of Capability to Potential*
- Productivity
  - *Ratio of Actuality to Capability*
- Performance
  - *Ratio of Actuality to Potential*

Q&A

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