An Engineering Model for Enterprise Command and Control

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Outline

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2. C2 Automation Evolution
3. EC2 Process
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5. EC2 Objective: Value Production
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9. Plans of Record (POR)
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12. EC2 “Bridge”
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Enterprise C2

- **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.


**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

- **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 ($r_i$)
Value Production Model
EC2 Context Model

EC2 Environment Actors

Global Strategic Context
Global Strategic Planning Context
Local Operational Context $P_n$
Local Tactical Context $P_{n}^T$
Local Operational Context $P_{n}^O$

Supervisor
Planner
Regulator
Operator
Auditor
Director

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EC2 Plans of Record (POR)

```c
struct 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_est_time_to_complete */
}

struct 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;
    plan_critical_path;
    plan_manager;
    plan_init(); /* plan resourcing */
    plan_proc(); /* plan process (task list) */
    plan_error(); /* plan error handler */
    plan_end(); /* plan clean up on end */
    plan_status(); /* plan current status */
    plan_est_time_to_complete */
}
```
Collaborative EC2
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

E5 Supervisory Workstation

E4 Analysis & Planning Workstation

E3 Operations Workstation

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Asset Chain Collaboration

Superior-Subordinate Command Chain

(a) superior
   portCapable?
   haveAssets
   dispatchPOR
   accept

(b) superior
   portCapable?
   needAssets
   allocateAssets
   capable
   dispatchPOR
   accept

(c) superior
   needAssets
   allocateAssets
   capacity
   dispatchPOR
   accept
   accept
Supply Chain Collaboration

Peer-Peer Command Chain

- Peer A Domain
- Peer B Domain

(a) proposal
qualifiedAccept
commit

terms

(b) proposal
counterProposal
qualifiedAccept
commit
adjustTerms

(c) request
canDo
proposal
qualifiedAccept
adjustTerms
commit
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