TASP C2 Computational Modeling

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Autonomous Systems (AS)

- AS are increasingly sophisticated
  - Robots, UxVs, ICS, fraud, trading
  - Autonomous UxVs: Global Hawk, X-47B, Google
- Who's in charge?
  - No pilot/driver: CDR/manager? Engineer/mfgr?
  - Technology beyond authority
- AS *or* people?
  - Consistency, memory, processing, endurance
  - Adaptability, innovation, judgment, uncertainty
- AS *and* people?

TASP & C2

- Teams of Autonomous Systems & People
  - More than people using/controlling machines
  - People & machines are teammates
- Open C2 research questions
  - When should people work for robots/AS?
  - When should squadrons/orgs be integrated?
  - C2 (adr,poi,doi,…) = f(t,m,s,…)?
- Hard RQs
  - Negligible theory or experience
  - Expensive & risky to test systematically

- Model TASP C2 orgs
  - —Different levels of tech & integration
  - —Different missions & environs
  - —Vary C2 approaches – over mission & time
- Address open C2 RQs systematically
  - —Virtual C2 org prototypes
  - —1000s of experiments: quickly, cheaply, nonrisky
  - —Novel insight, understanding, theory, TTPs/SOPs
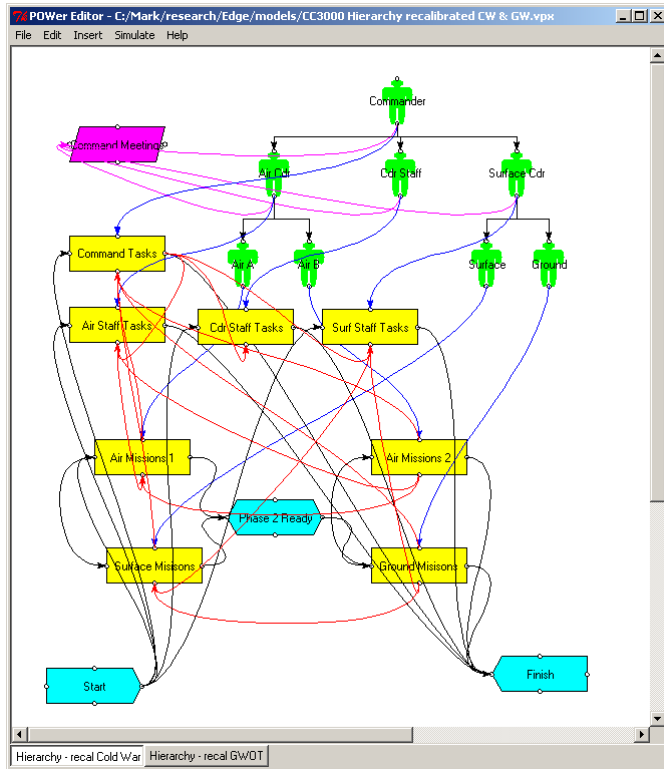- Where to find TASP C2 modeling environ?
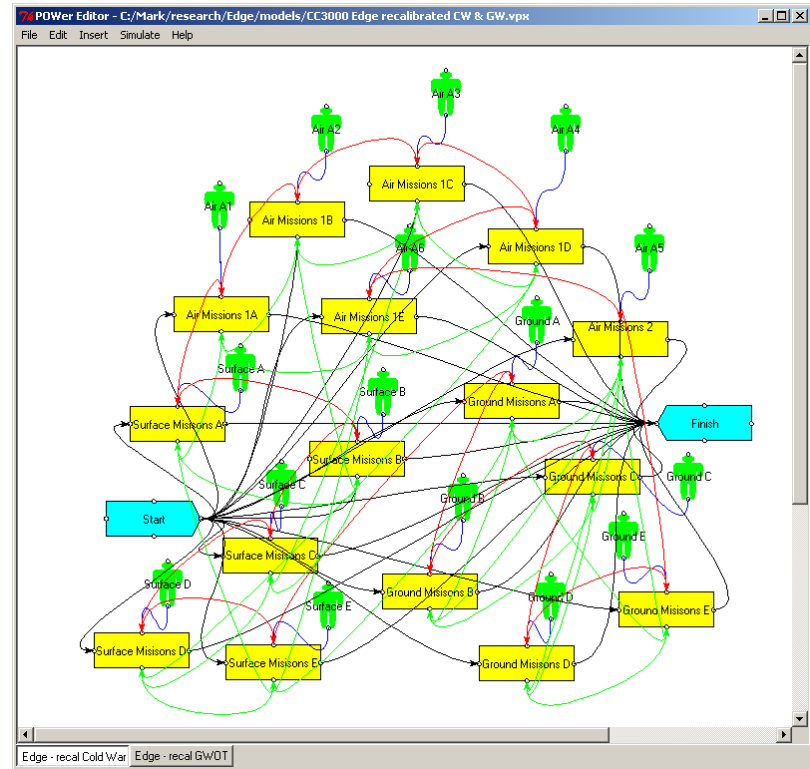
CENTER FOR
EDGE
POWER
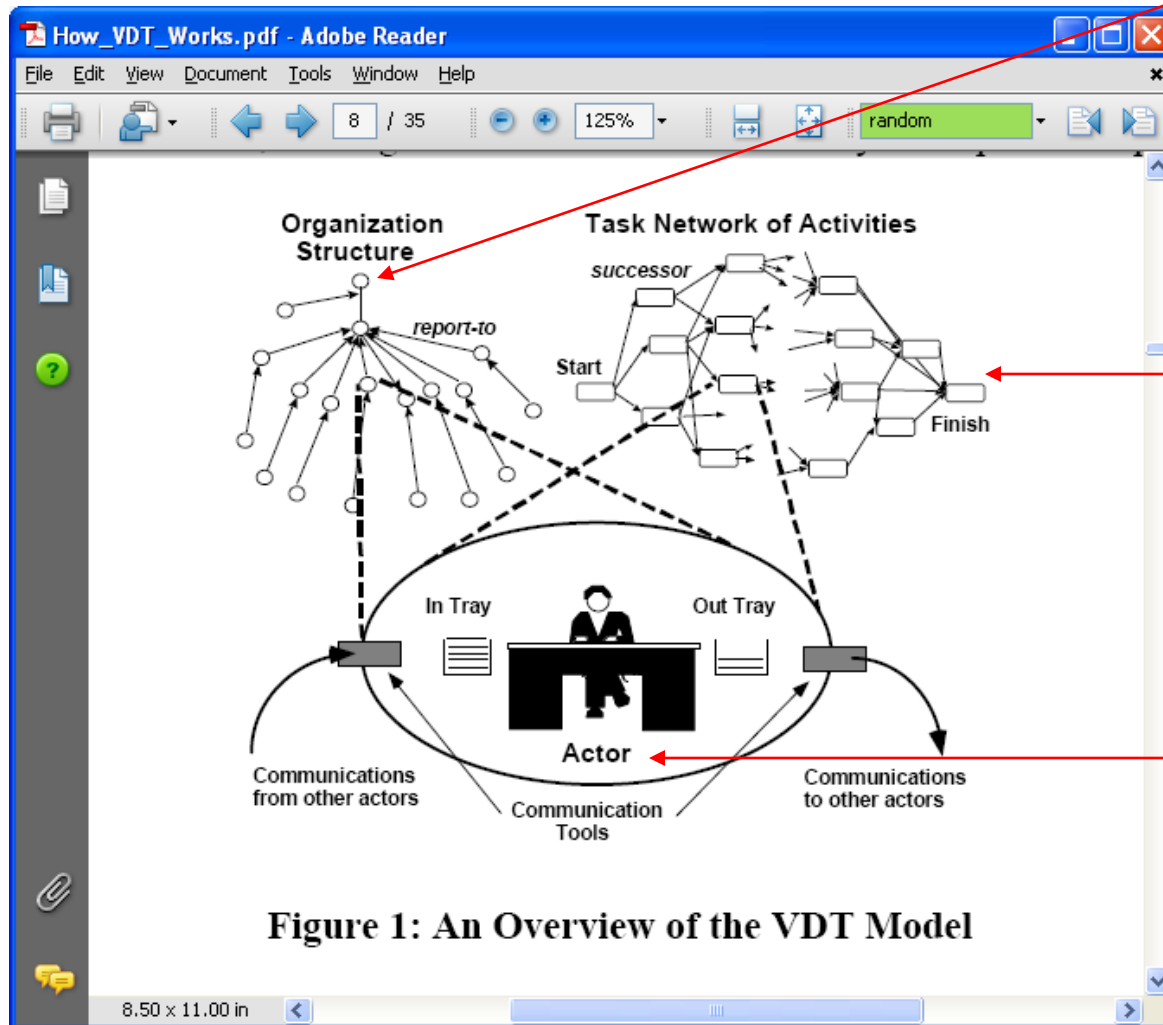
Org roles & relations;
Actor skills & experience;
Staff levels & structure

Work tasks & relations;
Coord, rework & delay;
Task effort & difficulty

Work tasks & comms
prioritized & processed
serially by each actor

Figure 1: An Overview of the VDT Model

Adapted from Stanford VDT Group (2004) and Rolands & Associates (2010)

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JTF: Machine Bureaucracy

JTF: Edge

Adapted from Gateau et al. (2007)

Degree	Automobile	UAV
0	No autonomy; continuous human control	Manned aircraft; continuous human control of flight and sensor operation (F/A-18, SH-60)
1	Safety features (ABS, ESS, ACC)	Remote manual control of flight and sensor operation (Scan Eagle)
2	Limited autonomous driving (lane control)	Preprogrammed flight; remote manual control of sensor operation (Fire Scout)
3	Autopilot (lane & road changes)	Preprogrammed flight and sensor operation (Triton or Global Hawk)
4	Full autonomy; human driver not required	Autonomous decisions and flight and sensor operation (Future capability)

Dim 2: Interdependence

Type	Organization	UAV
Pooled	Minimal interaction; coordination via rules & standards	Aircraft performing surveillance missions in different geographic areas
Sequential	Outputs from one organization unit are inputs to another; coordination via plans & schedules	Surveillance from one aircraft provides targeting information for another
Reciprocal	Two or more units perform a common task; coordination via feedback & mutual adjustment	Two aircraft defend one another if either is attacked
Integrated	Two or more different organizations perform a common task reflecting reciprocal interdependence.	Manned and unmanned aircraft fly together and defend one another.

Scenario Matrix

Interdependence /Degree	Pooled	Sequential	Reciprocal	Integrated
Degree 0	D0P	D0S	D0R	D0I
Degree 1	D1P	D1S	D1R	D1I
Degree 2	D2P	D2S	D2R	D2I
Degree 3	D3P	D3S	D3R	D3I
Degree 4	D4P	D4S	D4R	D4I

Modeling Difficulty

Interdependence /Degree	Pooled	Sequential	Reciprocal	Integrated
Degree 0	D0P	D0S	D0R	D0I
Degree 1	D1P	D1S	D1R	D1I
Degree 2	D2P	D2S	D2R	D2I
Degree 3	D3P	D3S	D3R	D3I
Degree 4	D4P	D4S	D4R	D4I

- CTF organization
  - 1 task network: 20 variations
  - 1 organization network: 20 variations
  - 1 mission-environment: 20 scenarios
- Basic POWer model
  - Represents CTF organization
  - D0P & D1P baselines for validation
- Extensions
  - POWer models for other scenarios
  - Simulate, analyze & refine

Thank You

- Questions welcome

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http://faculty.nps.edu/menissen/Welcome.htm