CRGP Collaboratory for Research on Global Projects

A Computational Framework for Experimentation with Edge Organizations

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Acknowledgements: OASD-NII/CCRP and Center for Edge Power

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"Power to the Edge" Track — June 15, 2005

Topics

- Computational Modeling of Organizations
- The Virtual Design Team (VDT) Model
- Modeling Edge Organizations
- The POW-ER Simulation Framework
- Proof of Concept Extensions
- Knowledge-Driven Simulation
- Discussion and Future Research

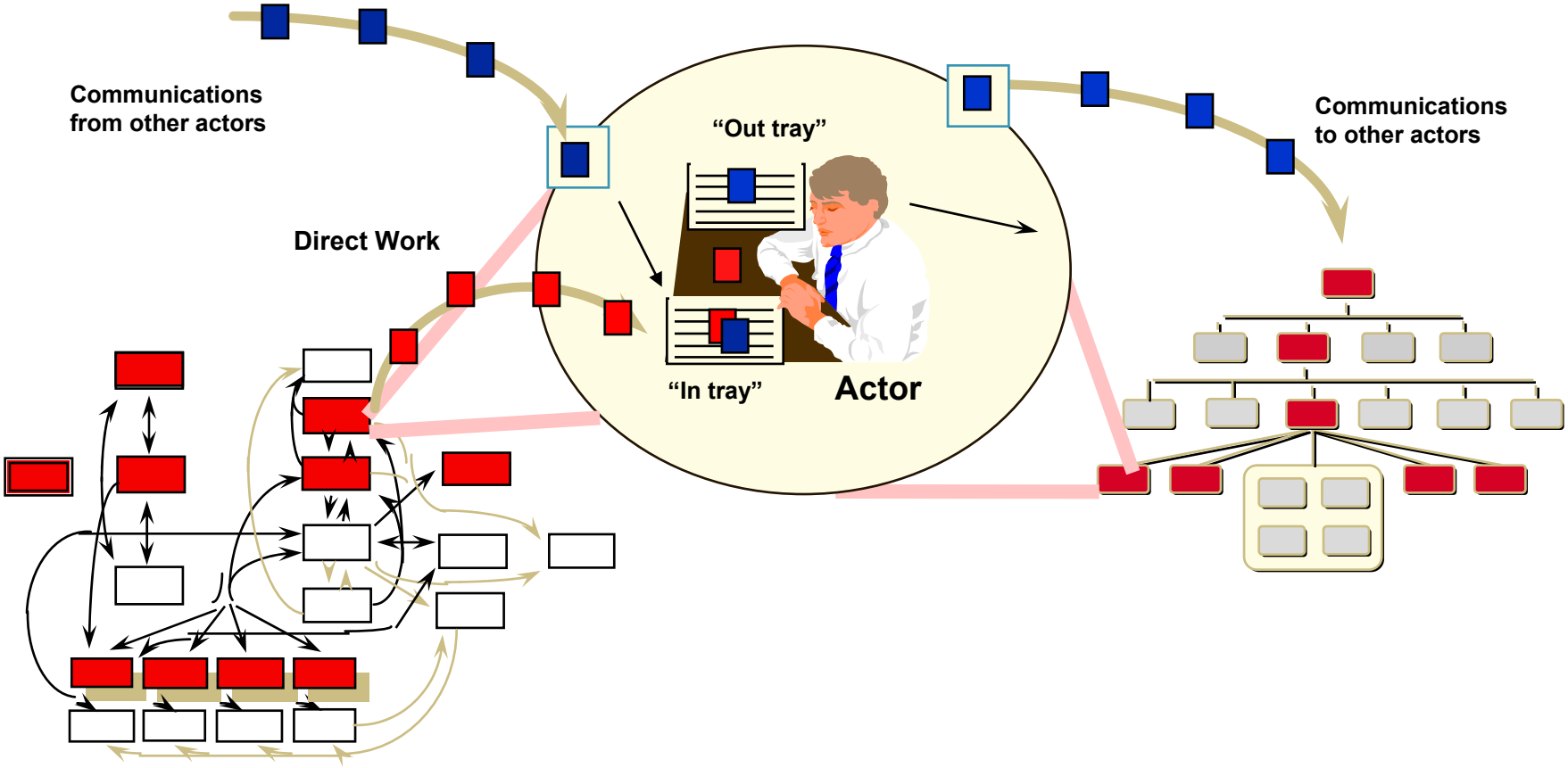
Computational Modeling of Organizations

- Field research methods can be time consuming and costly, and lack experimental control
- Computational modeling & simulation of existing or hypothetical organizations is an alternative
  - Agent-based modeling and simulation
    - Embodies mature, validated models of micro-behaviors
    - Develops predictive, multi-level social science theory
    - Predictions may be validated against empirical data
  - Analog of structural analysis tools—predicts outcomes
    - Supports desktop “what if” experimentation
    - Complements laboratory and analytical methods

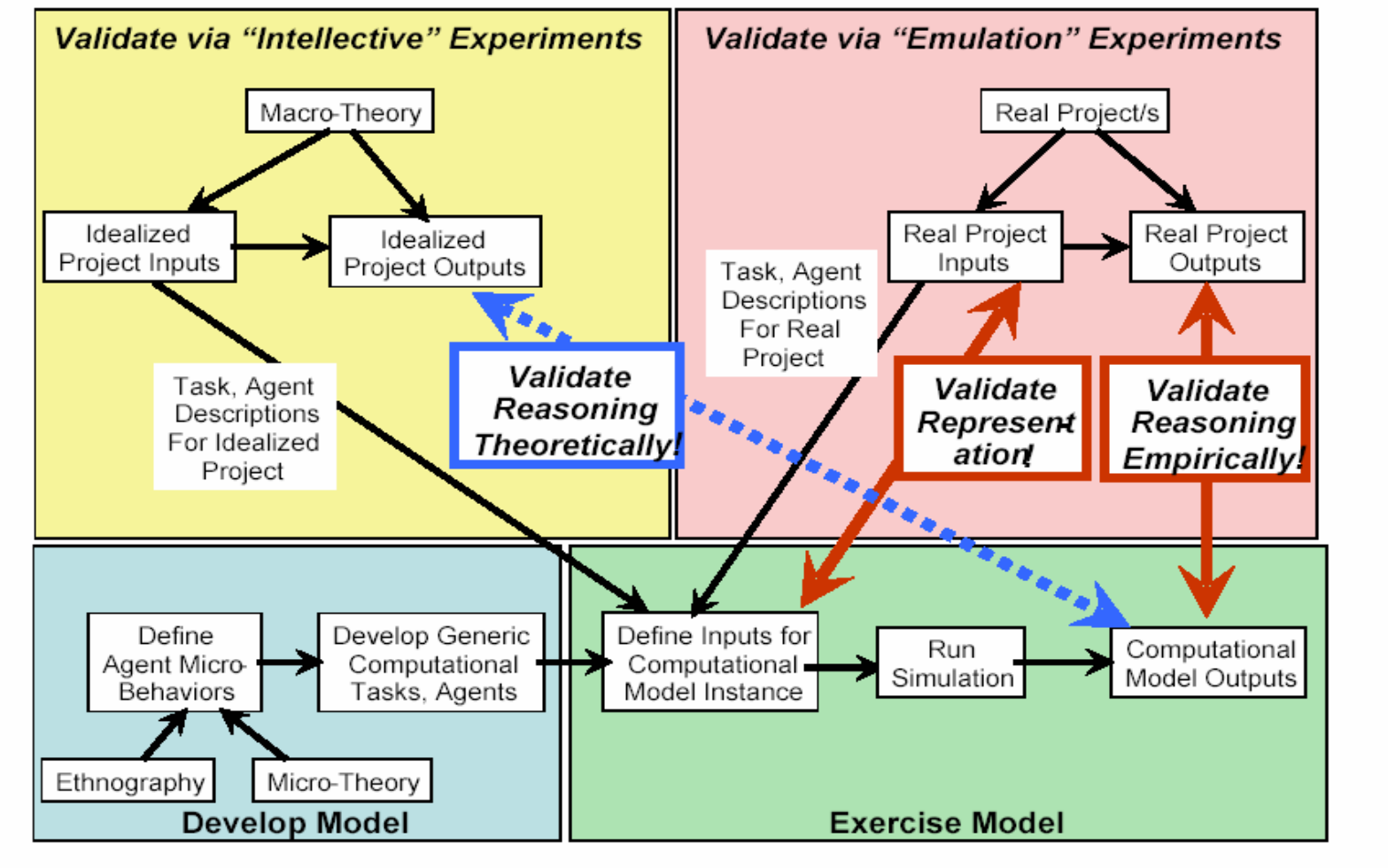
The Virtual Design Team (VDT) Model

- Ongoing research project at Stanford University
  - VDT ➔ Commercial *SimVision*® software product
- Models traditional project-oriented organizations
  - Construction
  - Aerospace
  - Consumer product development
  - Healthcare
- Models pre-planned projects
  - Fixed organizational structure and task plan
- Validated through fieldwork in multiple domains.

VDT Model - Actor Information Processing



Validation of VDT



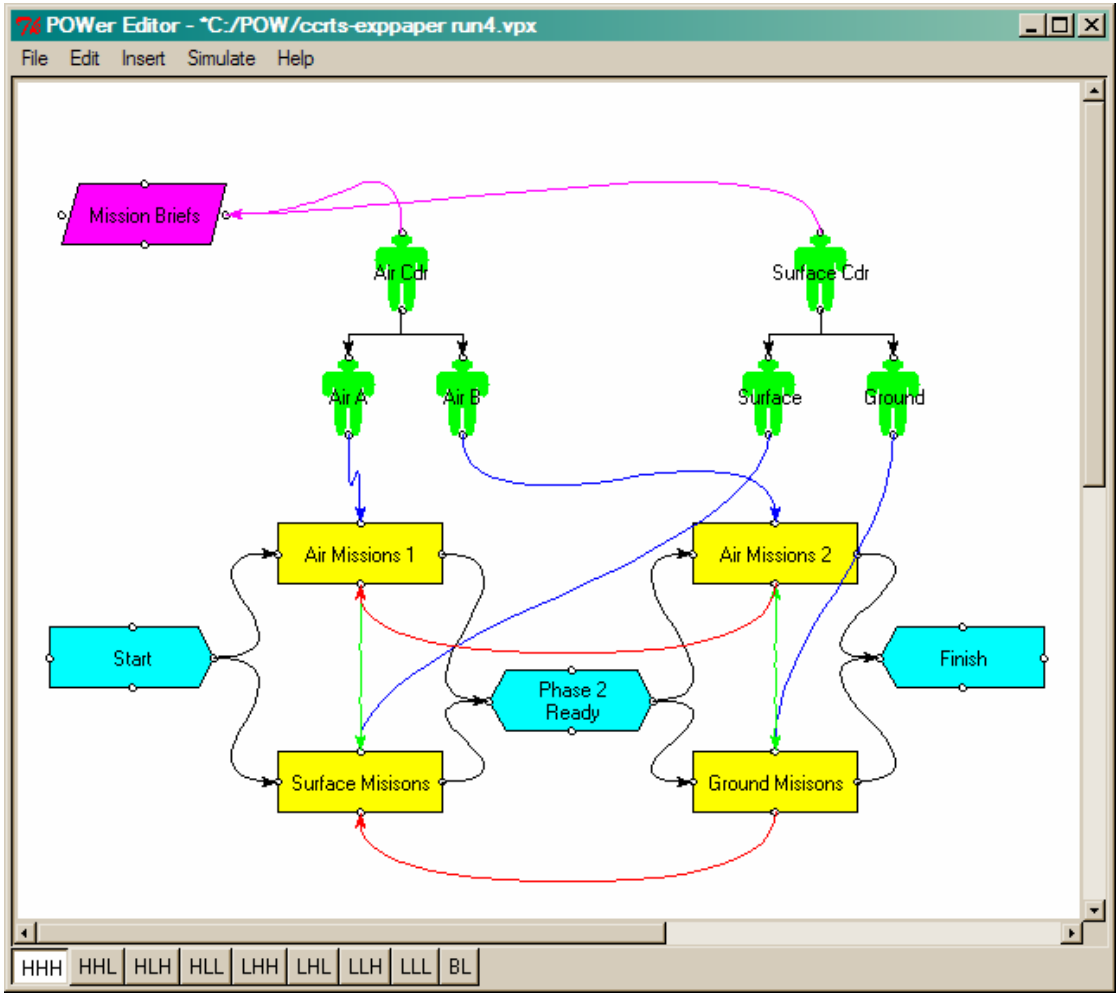
Modeling Edge Organizations

- Characteristics of Edge organizations
  - Rapid adaptation to changes in field environment
  - Dynamic task assignment and reporting hierarchies
  - Leadership may derive from competence and circumstances, not just position
- Features lacking in traditional project models
  - Task sequencing may be determined by situation
  - Demand-driven dynamic allocation of resources
  - Advanced communication and information systems

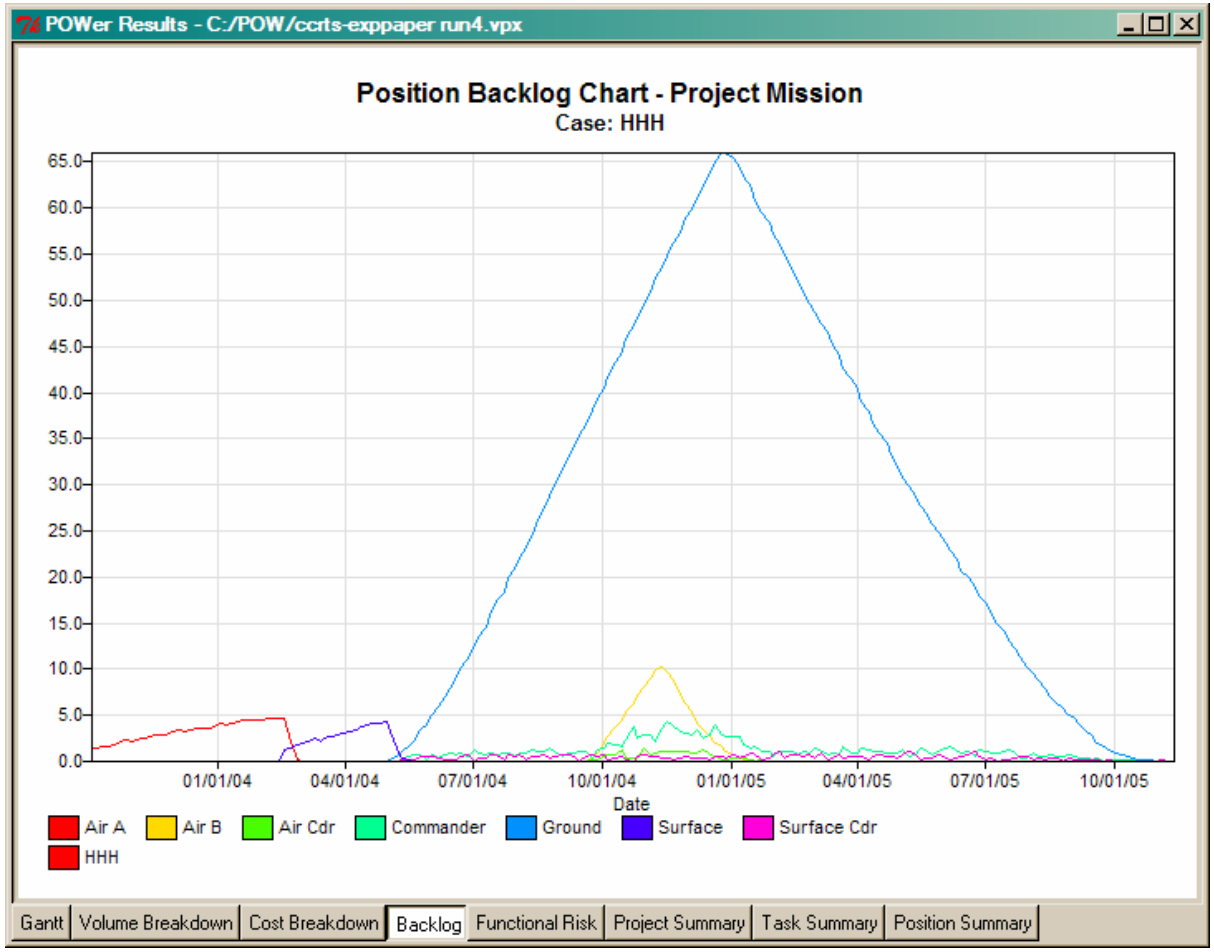
The POW-ER Simulation Framework

- **P**roject, **O**rganization, **W**ork for **E**dge **R**esearch
- Address VDT limitations in modeling dynamic, highly distributed organizations
- Modular framework consisting of:
  - Graphical model editor
  - VDT-based discrete event simulation engine
  - Chart and report generator
- Models and data stored in XML format files
  - Allows data interchange with third-party tools

POW-ER - Model Editor Screenshot



POW-ER – Graphical Outputs



Proof of Concept Extensions

- Cross-Cultural Effects
  - Model interaction between actors from differing national, cultural, or organizational backgrounds
  - Distinct micro-behaviors tied to cultural background
- Knowledge Networks
  - Models impact of ad-hoc functional knowledge networks on an organizational performance
  - Explicit peer-to-peer “community of practice” relationships
- Trust Effects
  - Level of trust between two actors is based on their similarities in culture, and organization, role within the project team and overlapping skill sets

Knowledge-Driven Simulation - Goals

- Model flow of information and knowledge
  - Advanced communication and information systems
  - Formal and ad-hoc peer-to-peer networks
- Tasks driven by operational considerations and availability of needed information and resources
  - Actors assigned to tasks dynamically based on availability, proximity, and applicable skills
- Measure effects on performance resulting from:
  - Incorrect, incomplete, contradictory information
  - Alternative reporting and decision-making policies
  - Use of various tools and systems

Knowledge-Driven Simulation - Model

- Environment is a collection of objective *facts*
  - Facts are categorized by relevant skills, locations, etc.
  - Facts are observed by actors and systems
  - Facts can change over time
- Actors form *beliefs* about facts
  - Beliefs from observation, other actors and systems
  - Confidence levels determined by skills, trust in sources
- Tasks acted upon based on beliefs
  - Tasks have prerequisite facts
  - Tasks change existing facts and/or produce new ones
  - Quality of outcome determined by relevant beliefs

Discussion and Future Research

- The POW-ER platform has proven to be a robust, easily extensible follow-on to VDT
- Proof-of-concept extensions require further validation and refinement
  - Case studies of command and control scenarios, including ethnographic research
- Development continues on the knowledge-driven simulation engine
  - Will provide the critical capabilities needed to model and analyze the full range of Edge organization capabilities

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End of Slide Presentation

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