CRGP Collaboratory for Research on Global Projects

# Hypothesis Testing of Edge Organizations: Empirically Calibrating an Organizational Model for Experimentation

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# Agenda

- Motivation
  - Research Questions
- Points of Departure
  - Previous hypothesis testing
  - POW-ER extensions
  - Cognitive Science: Learning and forgetting rates
- Calibration and Validation
  - AROUSAL Exercise
- Extended agent-based computational model POW-ER
  - ELICIT model
    - Experiments
- C2 Application
- Next Steps
- Theoretical Contributions

# Motivation

- Edge Organization definition
  - No headquarters to rely upon
  - Requires: shared awareness / self synchronization
- Knowledge flow is especially critical for Edge Organizations
  - High levels of strategic & operational knowledge needed at nodes
  - Enables “agility” in an uncertain environment
  - Understanding knowledge growth & decay in Edge organizations - critical for optimizing performance

# Research Questions

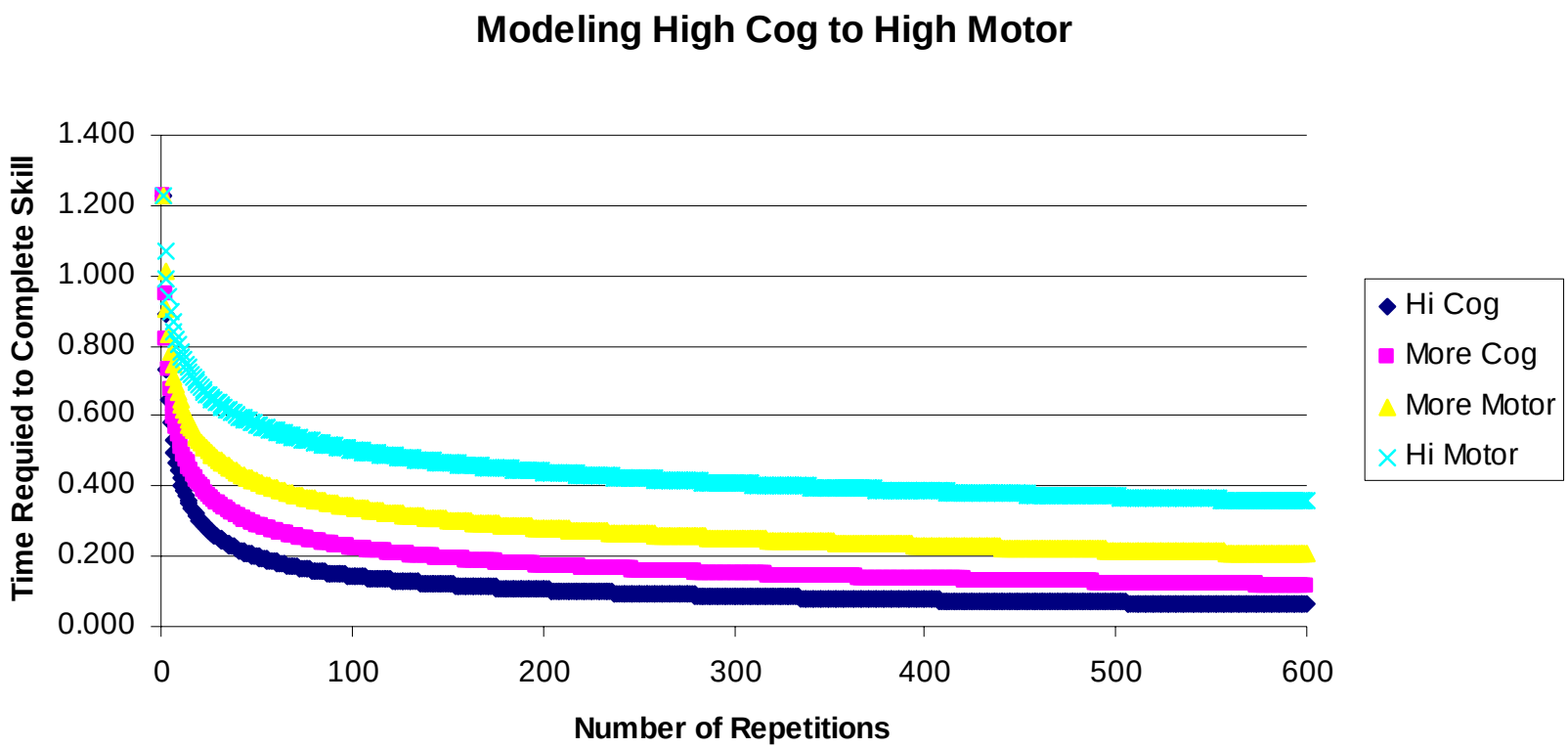
- How can we model and simulate Edge vs. Hierarchy organizational forms engaged in similar project-oriented tasks, taking account of the impacts of individual learning and forgetting on performance outcomes for the two structures?
  - How can individual skill acquisition and decay be computationally modeled, calibrated, and validated?
  - How are Edge vs. Hierarchy organizations and projects effected by the sum of individual participants' skill growth and decay?

# Points of Departure

- Hypothesis Testing of Edge Organizations
  - Nissen, 10th ICCRTS, 2005
  - Orr and Nissen, 11th ICCRTS, 2006
- Cognitive Science
  - Learning and Forgetting rates
    - Anderson, 2005
    - Sikstrom and Jaber, 2004 and 2002
  - Skill Classification
    - Dar-El et al, 1995

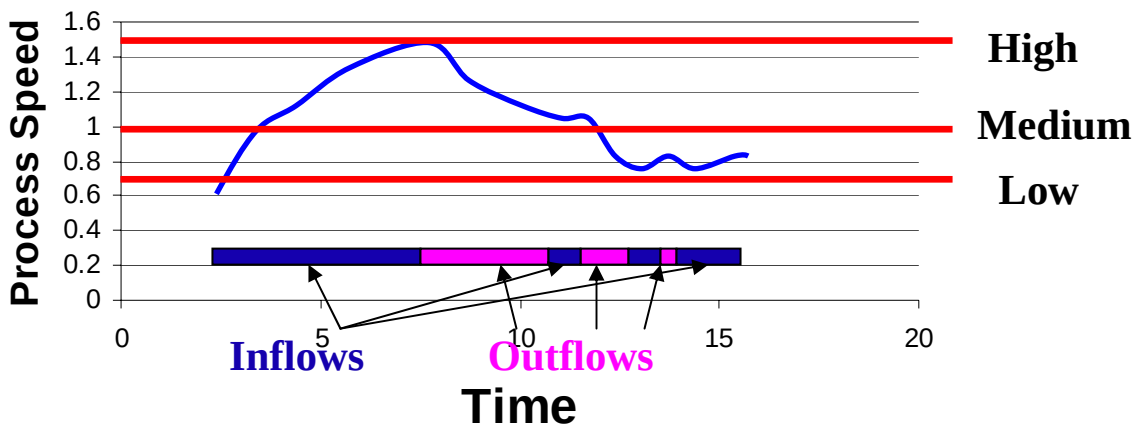
# Theoretical Point of Departure
## Skill Context (Dar-El et al., 1995)

- Different skill types seem to have different learning curves
  - Ranging from highly cognitive to highly motor skills

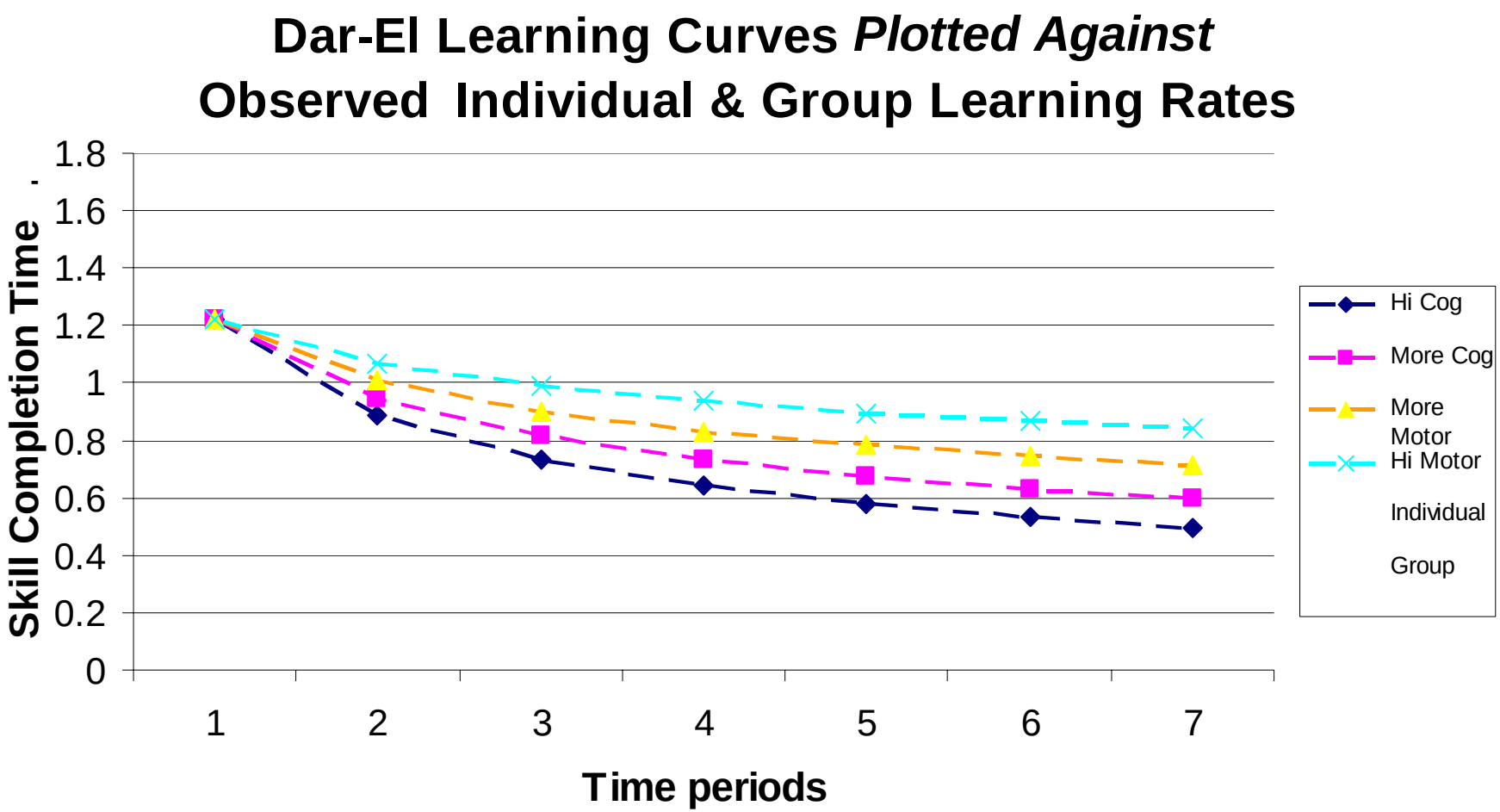


# Conceptual Model
## Individual Skill Acquisition and Decay

- Extensions to POW-ER computational modeling
- Develop fine-grained agent knowledge metric
  - Provide for dynamic, continuous knowledge over time
- Focus on individual knowledge
  - Inflows through OJT
  - Outflows through decay

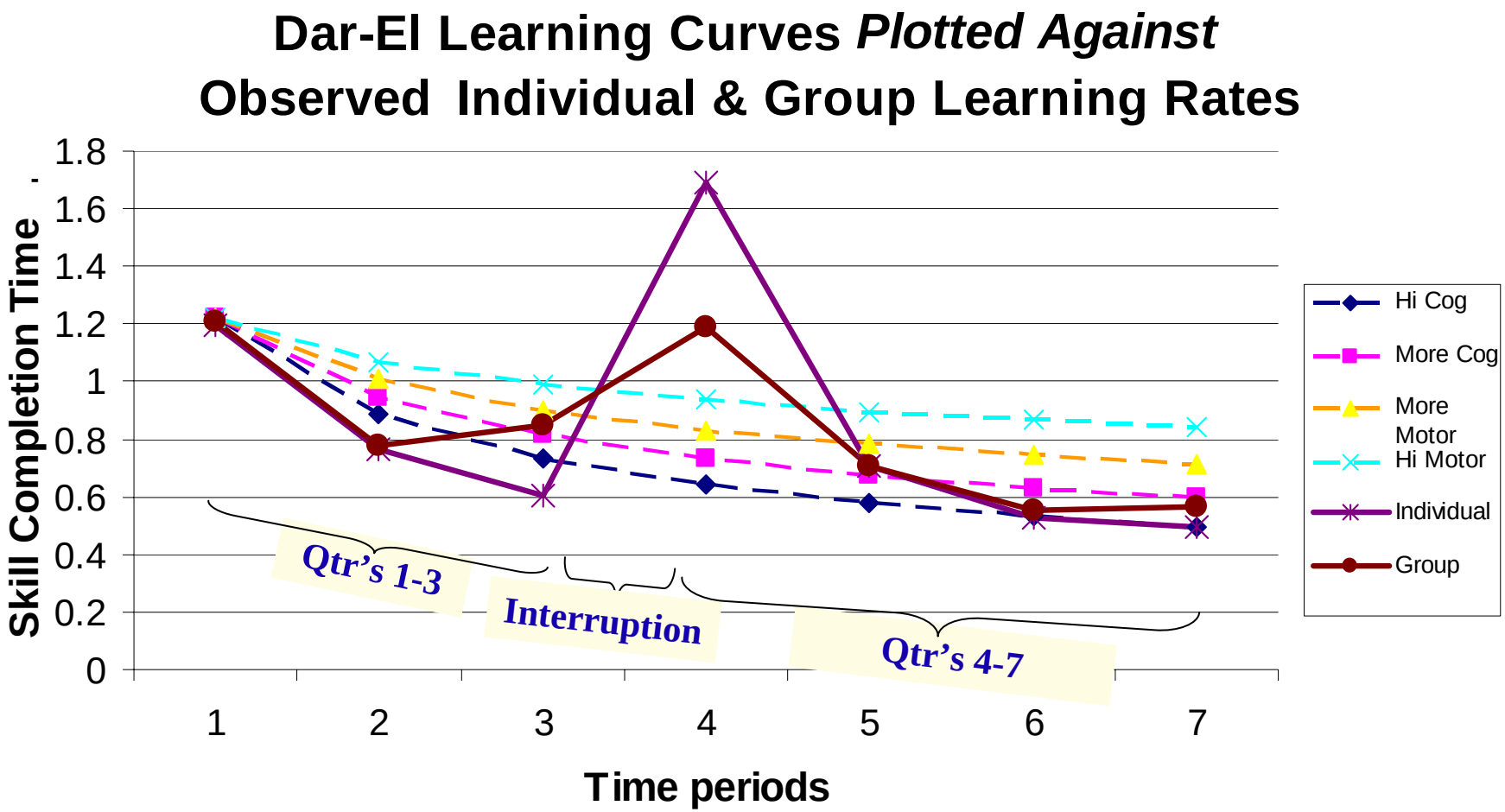


# Empirical Validation of Learning Rates



# Empirical Validation of Learning Rates

## Arousal Exercise



# Organizational Level POW-ER Models

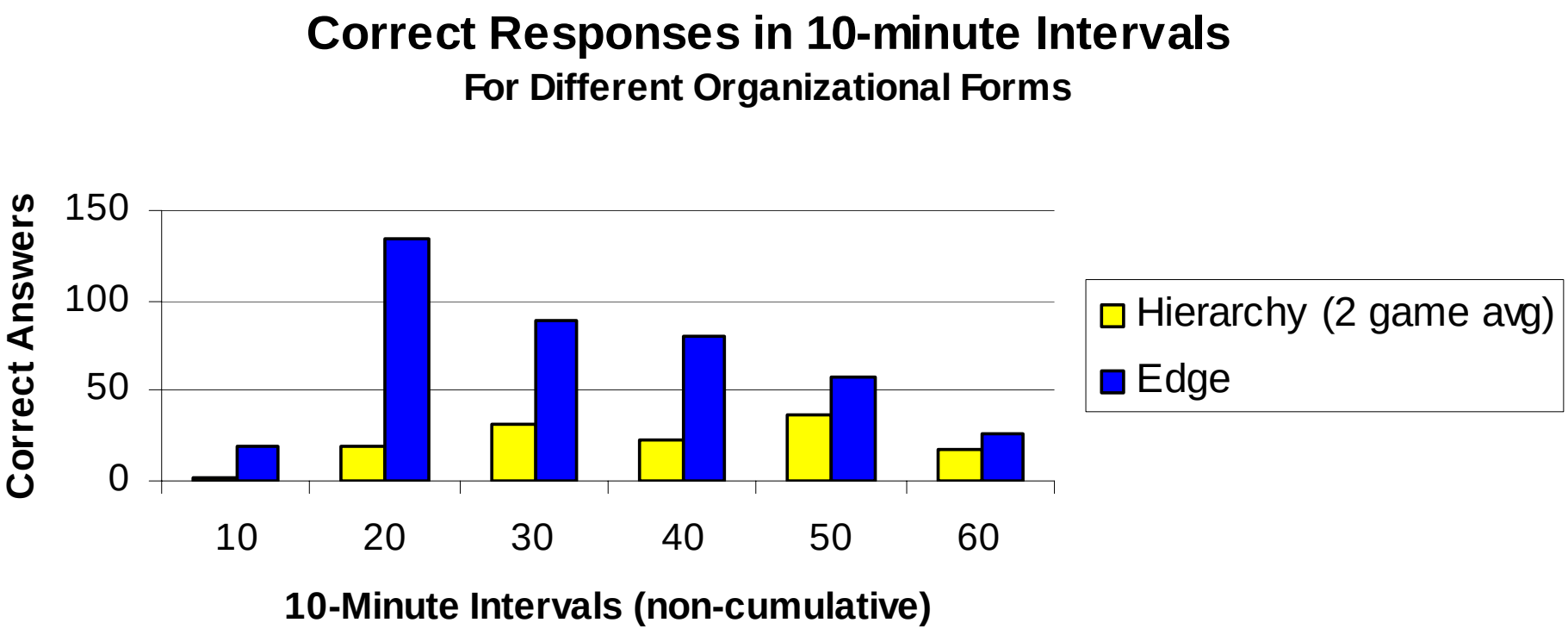
## Empirical findings from AROUSAL learning and forgetting

| Metric | Empirical Data | POW-ER Model |
|---|---|---|
| Duration (without learning) | 609 days | |
| Duration (with learning) | 348 days | |
| Percent Savings from Learning | 42.9% | |

# ELICIT Exercise

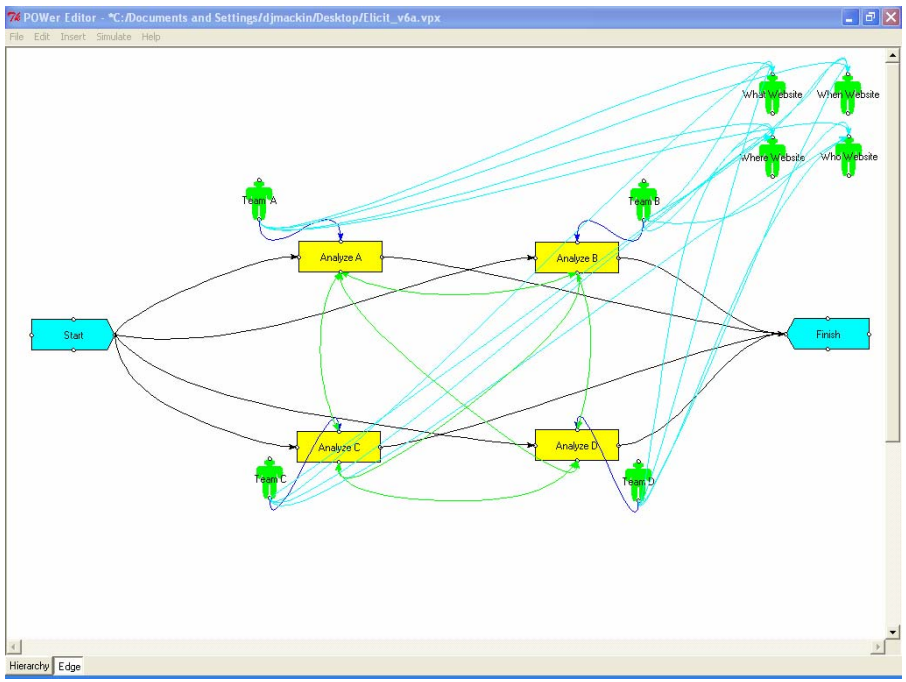
- Anti-terrorist, intelligence (knowledge) sharing game
- 17 players
- Either Edge or Hierarchy organizations
  - All players may share information with each other
  - Hierarchy is limited to viewing own team's website
  - No talking
- Each player required to identify target
  - Who, what when, where
- Allowed 60 minutes

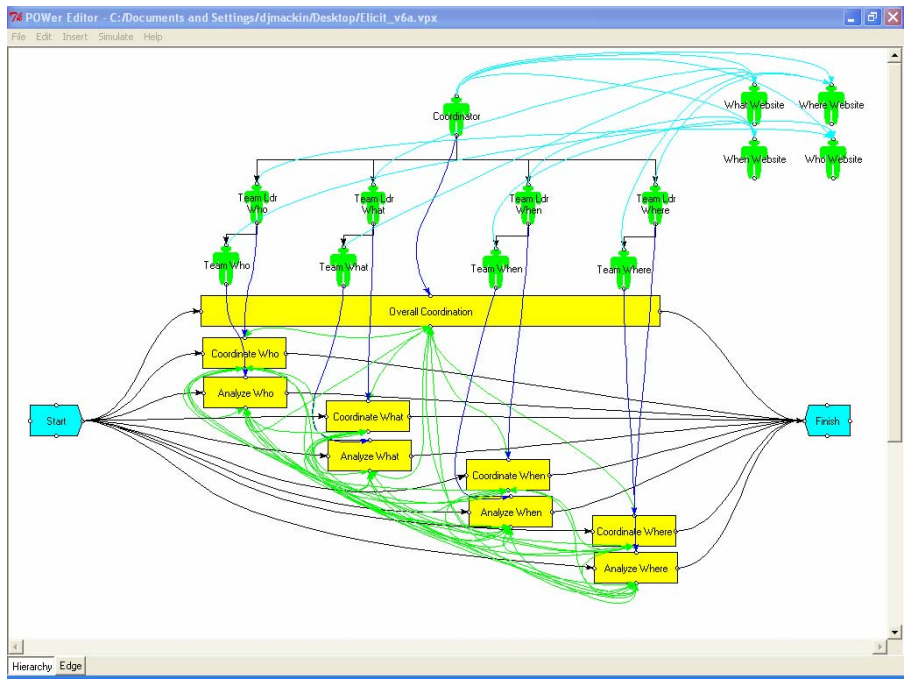
# ELICIT Exercise



# Organization Level POW-ER Models

## ELICIT Exercise: Edge and Hierarchy



# POW-ER Experimental Results

## 3 Exercise Rounds: 1 Break After 2nd Round

| Metric | Hierarchy (3 Rounds) Mean (Std. deviation) | | Edge (3 Rounds) Mean (Std. deviation) | |
|---|---|---|---|---|
| | No learning | With learning and forgetting | No learning | With learning and forgetting |
| Duration (days)* | 368.4 | 6.1% Improvement (28.5) | | 15.2% Improvement 287.1 (37.0) |
| Coordination (days)* | 730.4(23.9) | 764.0(27.0) | 425.5(22.7) | 452.3(22.2) |
| Rework (days) | 865.7(49.2) | 870.8(58.4) | 954.2(75.1) | 954.1(77.4) |
| Functional Exception Work (days) | 1471.1(848.2) | 1477.1(841.2) | 1544.0(405.8) | 1540.9(395.1) |
| Total Work (days) | 3688.2(90.2) | 3718.7(109.1) | 3677.0(143.7) | 3675.6(149.5) |
| Functional Risk* | .412(.015) | .411(.017) | .382(.019) | .381(.020) |
| Process Quality Risk* | .293(.008) | .291(.008) | .269(.011) | .267(.013) |
| Cost ($K)* | 1997.1(47.2) | 1616.1(89.2) | 1982.7(73.1) | 1501.1(123.9) |

# C2 Application

- Example: Crew training (deployment preparation)
  - Consider improvement in command's performance through adoption of edge-like organizational qualities
- Leverage experimental results to develop and test new command models
  - To predict project lengths for a single project
  - To consider impacts of other agent-based knowledge interventions
    - e.g., training and mentoring

# Next Steps

- Develop and validate further using latest ELICIT data, so that we can
  - Improve our predictions of project lengths for a single project
  - Model the effects of other knowledge interventions
    - Training, mentoring
    - Obsolescence, interference

# Theoretical Contributions

- Quantitative analysis of how micro behaviors (learning and forgetting) affect organizational performance, extending our understanding of organizational learning

- Validated and calibrated tool to develop and test individual knowledge flow impacts on Edge and other organizational forms

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