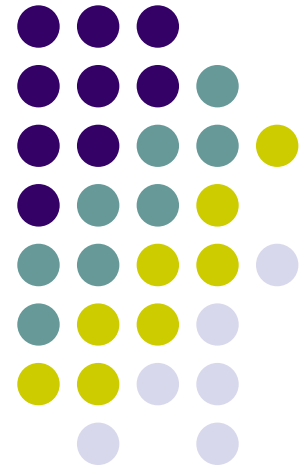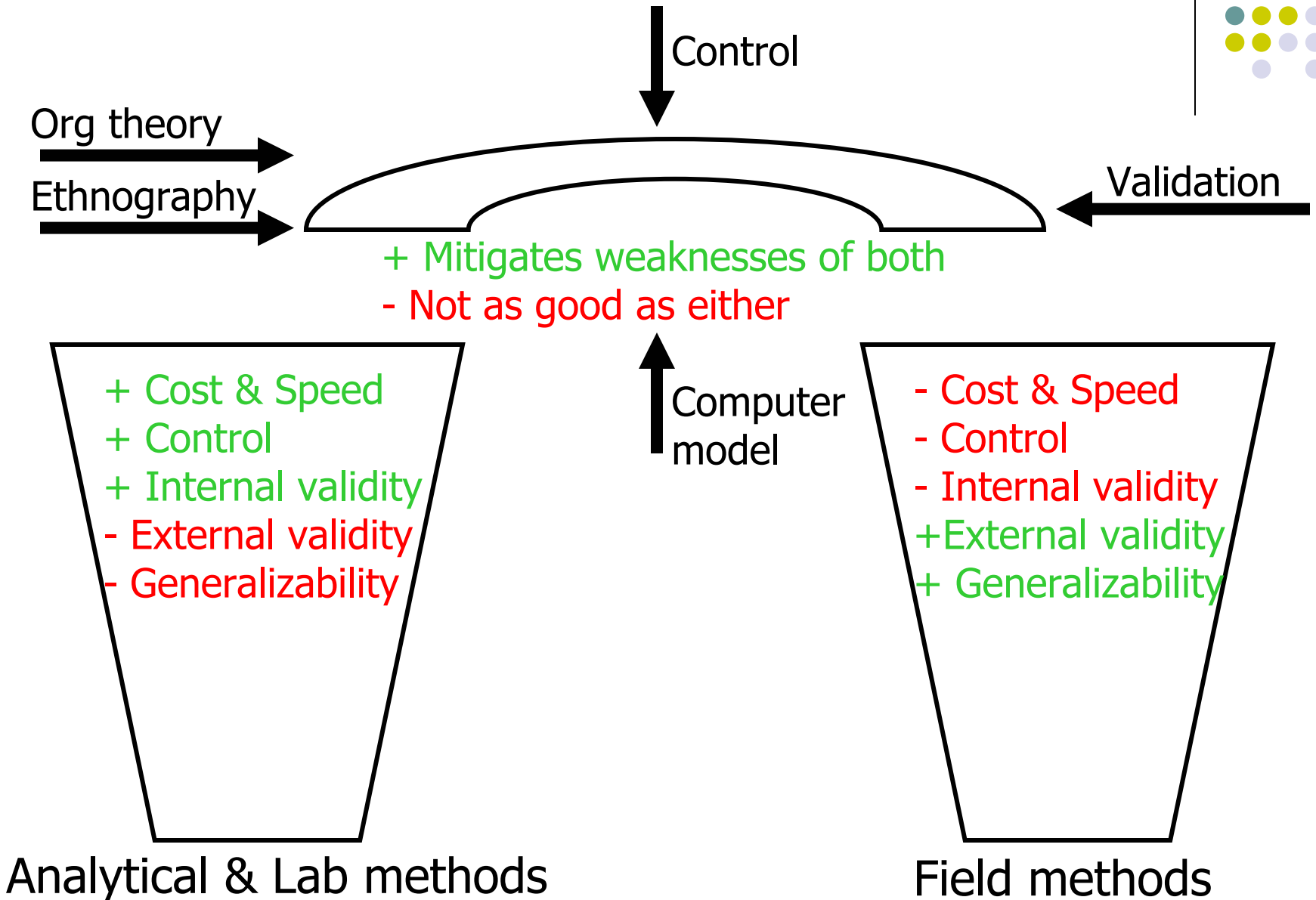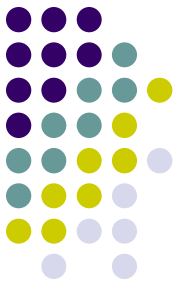# Computational Experimentation in C2

Dr. Mark E. Nissen, Naval Postgraduate School
Raymond R. Buettner, Stanford University
CCRTS 2004, San Diego

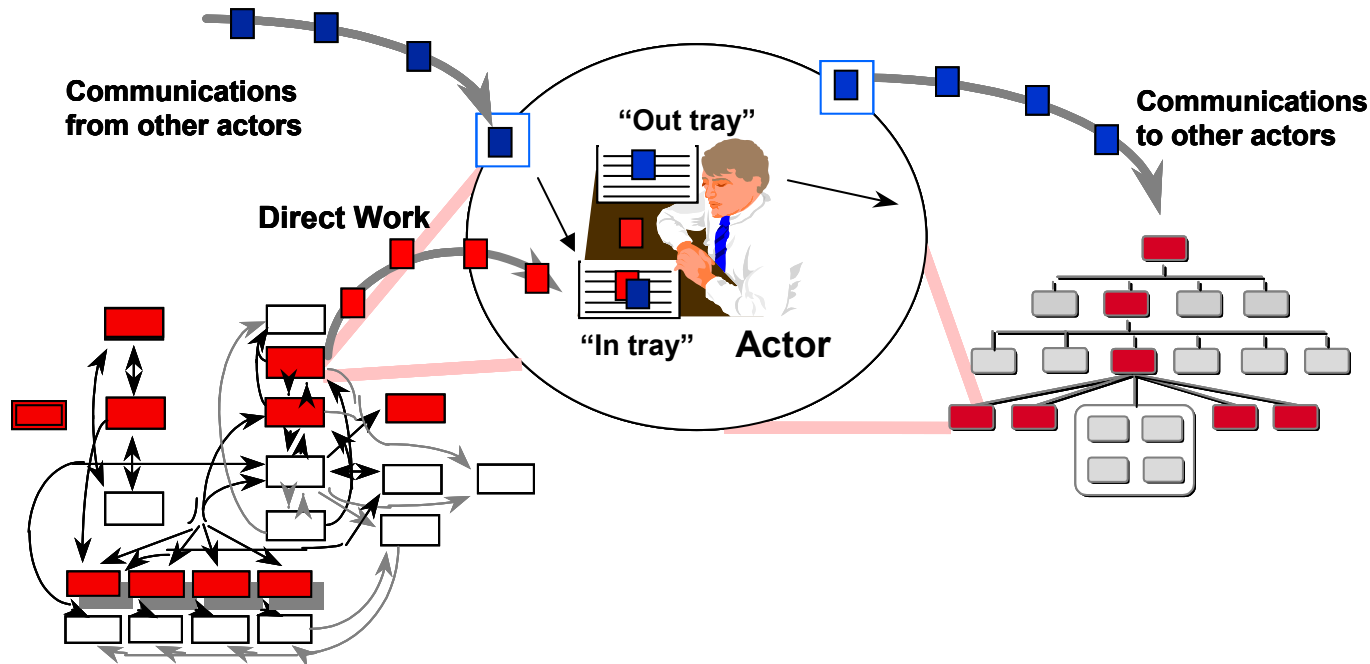# Computational Experimentation

Control

Org theory

Ethnography

Validation

+ Mitigates weaknesses of both
- Not as good as either

Computer model

+ Cost & Speed
+ Control
+ Internal validity
- External validity
- Generalizability

- Cost & Speed
- Control
- Internal validity
+External validity
+ Generalizability

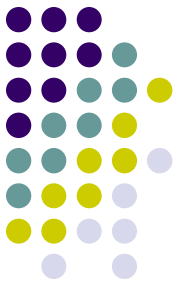Analytical & Lab methods

Field methods

VDT Modeling

- Agent-based models
  - Semi-formal – complement NL
  - Ontological: ODs + WFs (+ IFs + KFs)
  - Computational: work volume (direct, coord, rework)
 - Model organizations of large size & complexity

Research Design

- VDT Model: high-level C2 organization
  - Generic but representative
  - Focus on modeling & experimentation
- IVs
  - Bureaucracy (central, formal, levels, meetings)
  - Coord load (interdep, comm, noise, project level)
  - Knowledge inventory (skill level, capability match)
- DVs
  - Mission duration (elapsed time to completion)
  - Mission risk (work left incomplete at end)
- Full-factorial
  - 8 simulation scenarios
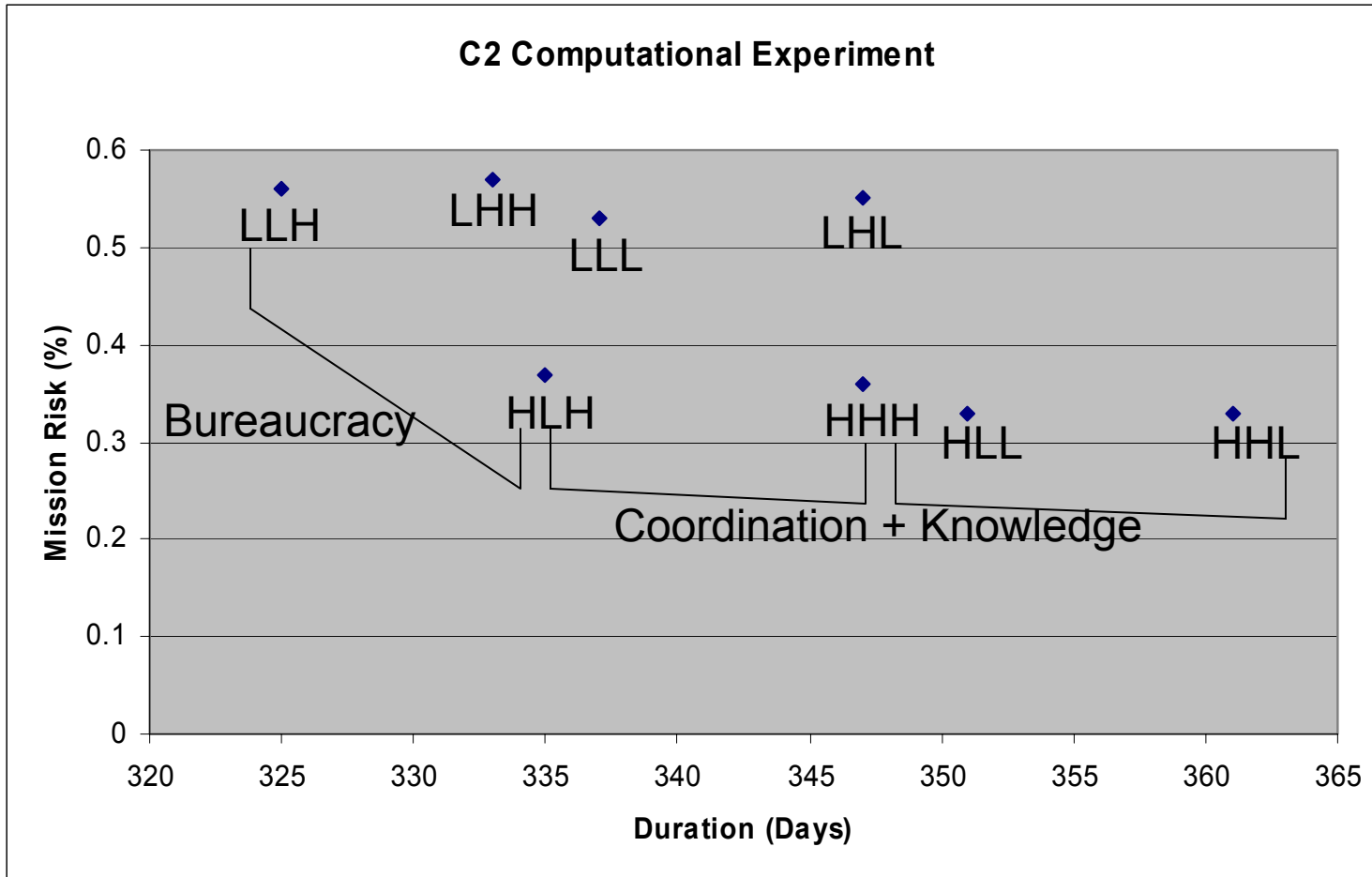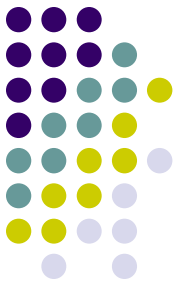 - Monte Carlo – 100 runs each

VDT C2 Model
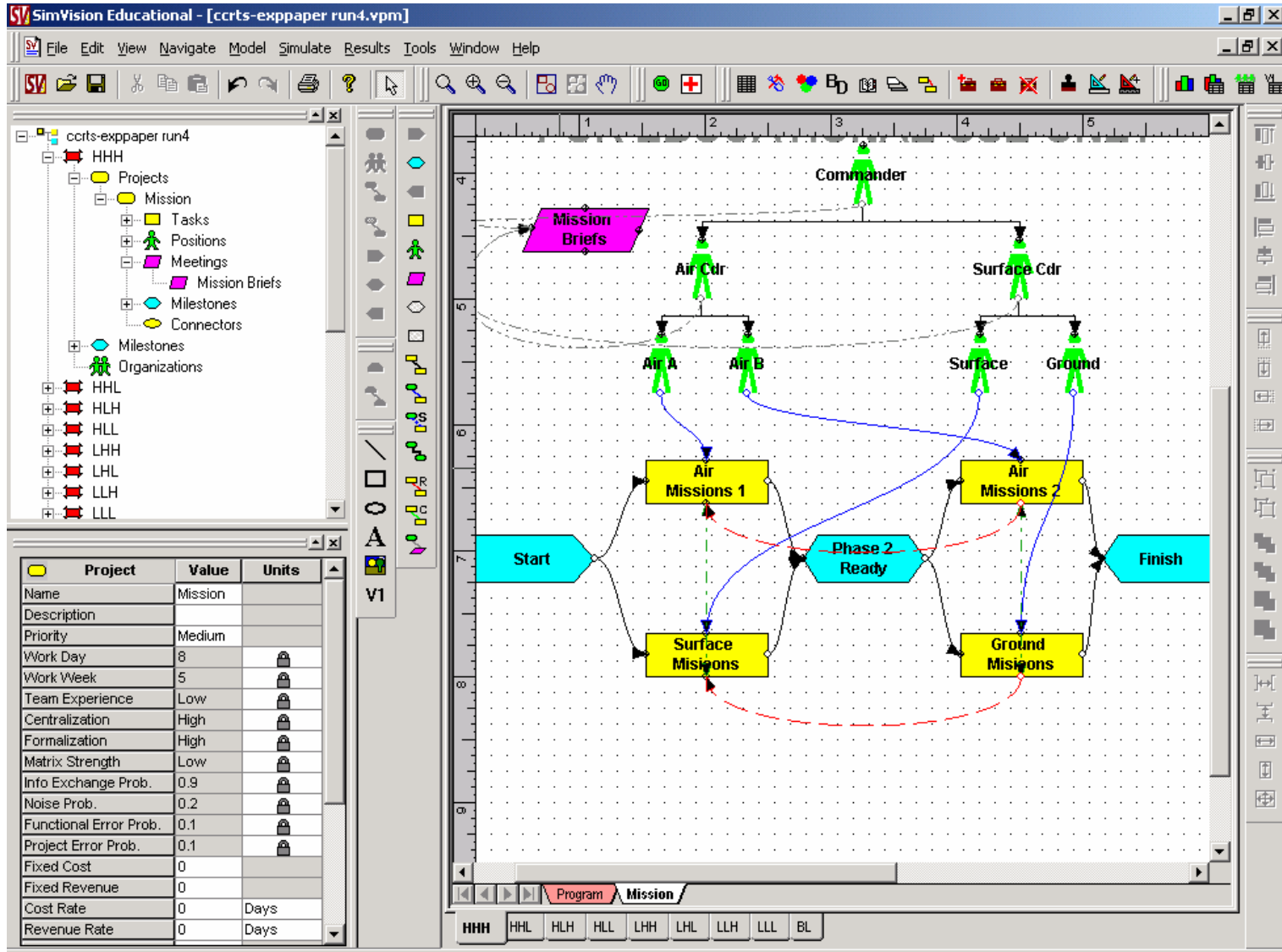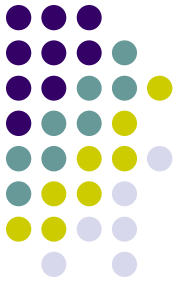
Experimental Results
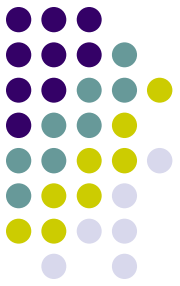
Trial	Duration	Risk
HHH	347 ***	36 *
HHL	**361** ***	33 ***
HLH	335 ***	37 ***
HLL	351 ***	**33** ***
LHH	333 ***	**57** ***
LHL	347 ***	55 ***
LLH	**325** ***	56 ***
LLL	337 ***	53 ***

*** significant at 99%; ** significant at 95%; * significant at 90%
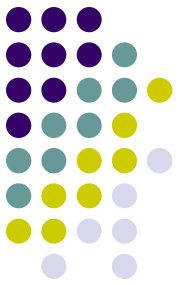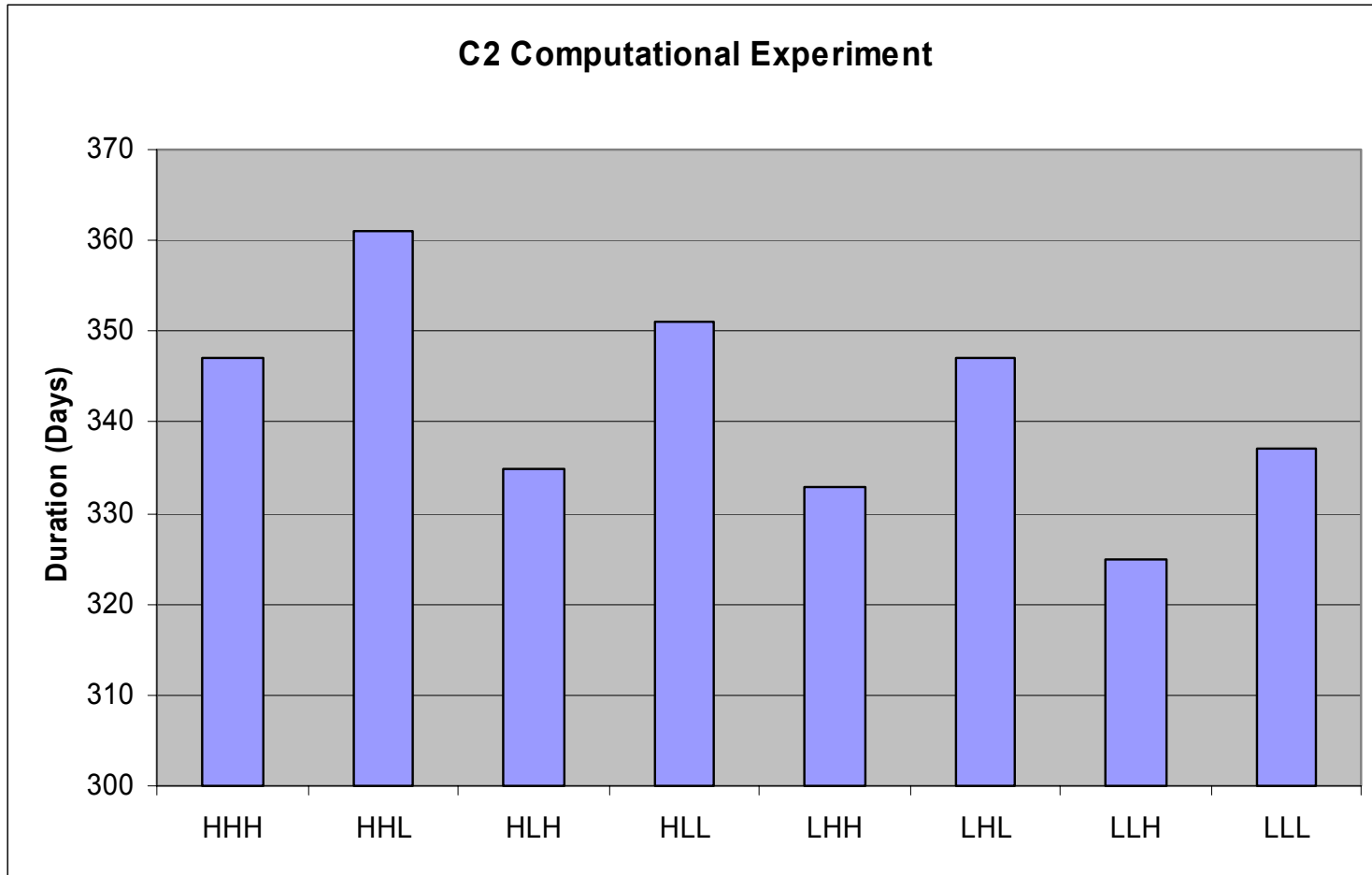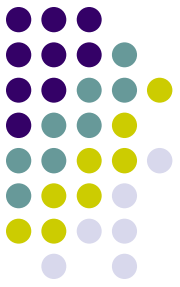
Results – Scatter Plot

Implications

- Organization is contingent
- Tension between performance measures
- Assess computationally
- Complement lab & field methods
- Implications for practice & research

Questions?

- Thank you.

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Results – Duration

Results – Risk

C2 Computational Experiment