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

(Track 2: Organizational Issues)

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Hypothesis Testing of Edge Organizations:
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Abstract (200 words max)
This paper continues our efforts to model, simulate and ultimately optimize work and knowledge flows in Edge organizations. We use the extended POW-ER 3.0 framework to model and compare two organizational forms (Edge vs. Hierarchy) being used by participants in a counter-intelligence student exercise, ELICIT — first without, and then with, learning micro-behaviors enabled in POW-ER 3.0. We compare empirical observations of student teams conducting the ELICIT exercise once in each of two structural configurations with outputs from POW-ER 3.0 computational simulation models representing teams in executing the ELICIT task in these two structural configurations. Comparing ELICIT observations with predicted results from a POW-ER model has the potential to further calibrate and validate POW-ER for potential use in analyzing and designing C2 organizations. Empirical, experimental data on learning and forgetting have already provided the basis for defining and modeling agent learning and forgetting micro-behaviors in POW-ER 3.0. Thus, a second set of experiments compares changes in empirical results of teams that engage in successive rounds of the ELICIT exercise with predictions of organization-level learning from POW-ER 3.0. This allows us to continue calibrating the accuracy of POW-ER 3.0 learning micro-behaviors for predicting organization-level C2 knowledge flows in Edge vs. Hierarchical organizations.

Draft Outline

1.0 Introduction and Motivation

Edge and C2 organization structure, goals, and backgrounds will be explained (Alberts and Hayes, 2003)

2.0 Background

2.0.1 Work and Knowledge flows

Individual and organizational levels of information and knowledge flow will be explained (Simon, 1950; Argote, 1999; and Nissen, 2006). Knowledge inflows and outflows will be discussed, (Dierickx and Cool, 1989).

2.0.2 Relevant Organizational Modeling

Previous attempts to model and simulate Edge vs. Hierarchical organizations using OrgCon and SimVision (Nissen, 2005; Orr, Nissen, 2006) will be discussed.

Previous attempts to model learning in POW-ER and calibrate it against data from student teams via the AROUSAL exercise (MacKinnon, 2006) will be discussed.

2.0.3 Hypotheses

1. That C2 organizations will exhibit “bottlenecks” that hinder work flow in uncertain and dynamic C2 environments

2. That C2 organizations will exhibit “bottlenecks” that hinder knowledge flow when compared to Edge organizations in uncertain and dynamic C2 environments.

3. That limiting the lines and types of communication will limit knowledge flow.

4. That organizational level learning is hindered by hierarchical structures when compared to edge organizations.

5. That for repeated games, human participants will demonstrate learning as shown though improved numbers and frequency of correct answers and that this will be replicated in the POW-ER simulation model.

3.0 ELICIT Experimentation

The ELICIT game will be discussed.

Each of these factors will be varied separately, then combined in pairs, then modeled via POW-ER with multiple interventions acting simultaneously to achieve a *full-factorial* design.

Our experiments will be designed to explore:

1. Differences in Work Flow and Knowledge Flow between Edge and Hierarchy organizations, performance implications
2. Predicted bottlenecks of work and knowledge flow among both organizational forms.
3. Evolution of skill growth among two different organizational forms

We expect that as organizations increase in layers of command as well as limited access to knowledge we will observe increased times to respond correctly to a given assignment.

4.0 POW-ER Models

The POW-ER models of both the Edge and Hierarchy organizations of the ELICIT game will be illustrated, explained, and their outputs analyzed. Level of detail abstractions and assumptions will be discussed. Our uncalibrated and draft hierarchy and Edge models are shown below in figures 1 and 2.

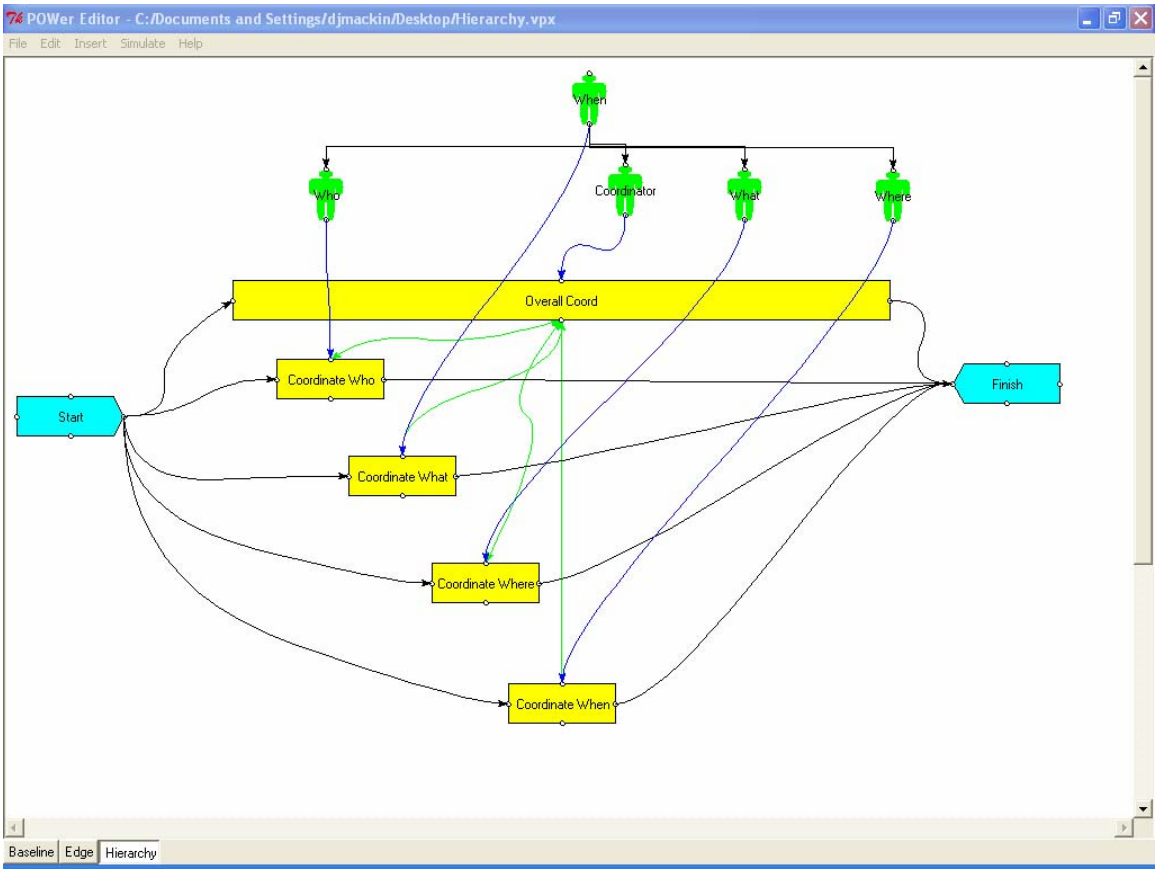

Figure 1: Hierarchy Organization of the ELICIT game. Showing communication links (green) between the tasks and overall coordination with a two-level organization.

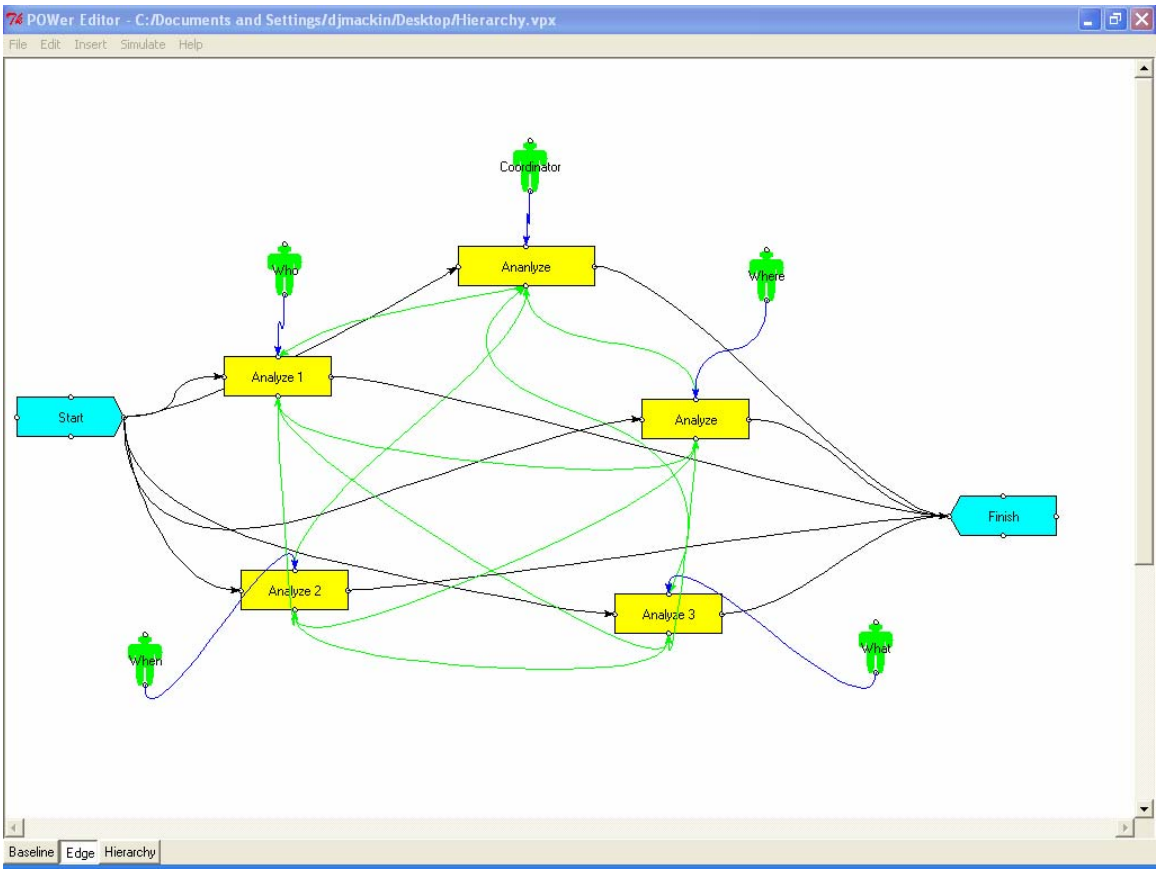

Figure 2: Edge Organization of the ELICIT game. Showing direct communication between all tasks with a flat, "Edge" organization.

5.0 Findings

Comparisons will be made and analyzed between empirical ELICIT output and POW-ER simulation output for both a single trial (no learning) and multiple trials (with learning) of the ELICIT exercise. This will support ongoing calibration of the workflow model in POW-ER 3.0 and of the learning micro-behaviors that have recently been embedded in POW-ER.

Thus far it has been shown that humans perform better on the ELICIT game in the Edge structure as measured by our "number of correct answers per 10 minute interval" metric. We hypothesize that the simulation output will demonstrate this same advantage. This will be reported in our final draft of the paper and reported at the conference.

Empirical ELICIT game output, obtained thus far, is shown in figures 3 and 4 where correct answers over ten minute intervals from the two organizations are compared.

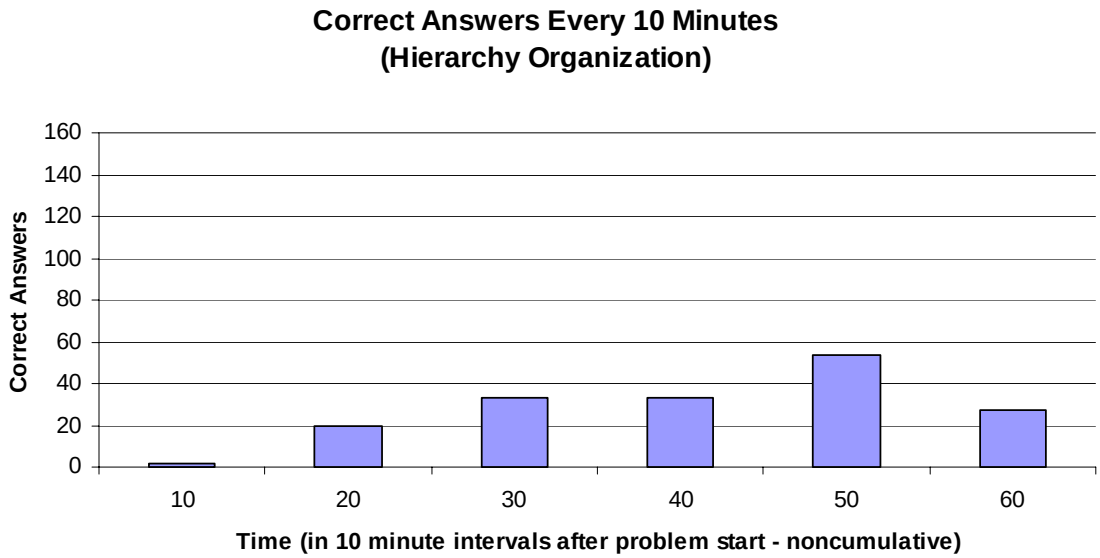

Figure 3: Hierarchy Organization output from the ELICIT game. Showing the number of correct answers given by all members of the hierarchy organization in ten minute intervals.

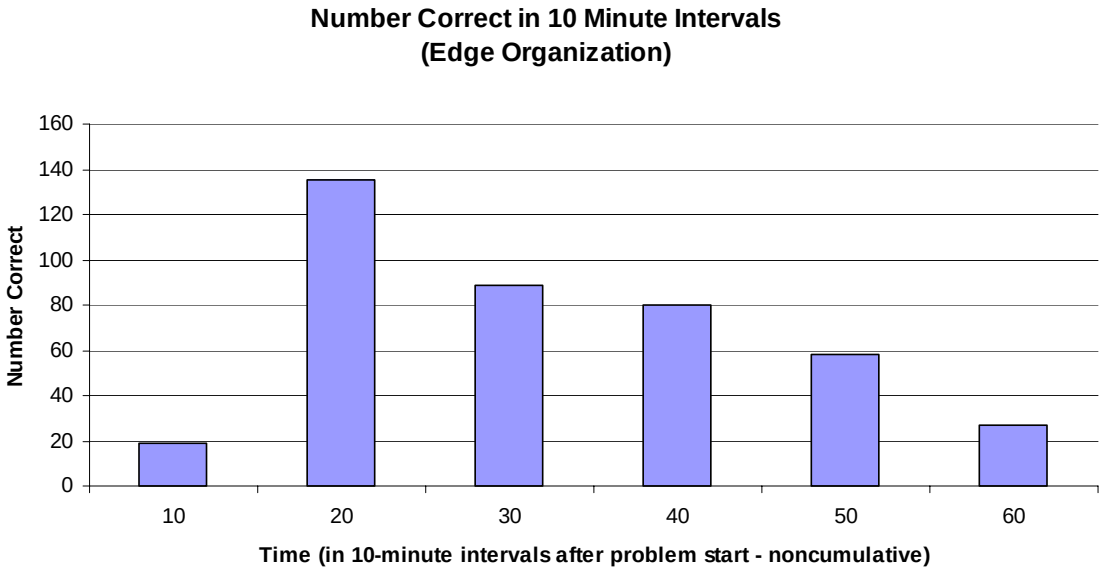

Figure 4: Edge Organization output from the ELICIT game. Showing the number of correct answers given by all members of the Edge organization in ten minute intervals.

During the next few months we expect to complete more student rounds of the ELICIT game and to complete our modeling and simulation of the ELICIT game in POW-ER for both types of organizations, thus providing further comparisons between the two organizational forms and further calibration and validation for the POW-ER model.

6.0 Conclusions

This paper describes our continuing steps in specifying the key variables that effect work flow, knowledge flow and organizational learning in both Edge and hierarchy organizations. Through an extension to the POW-ER model framework, we capture the dynamics of individual knowledge gained and lost in Edge organizations and are thus able to extend our understanding of organizational learning. This set of cross-validation experiments employs synthetic group experiments and organizational simulation to cross-validate, calibrate and refine POW-ER parameters.

7.0 Future Steps

We will include potential and expected future work.

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