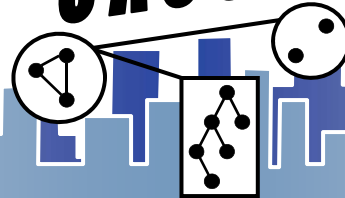


**CASOS**



# An Agent-Based Framework for the Active Multi-Level Modeling of Organizations

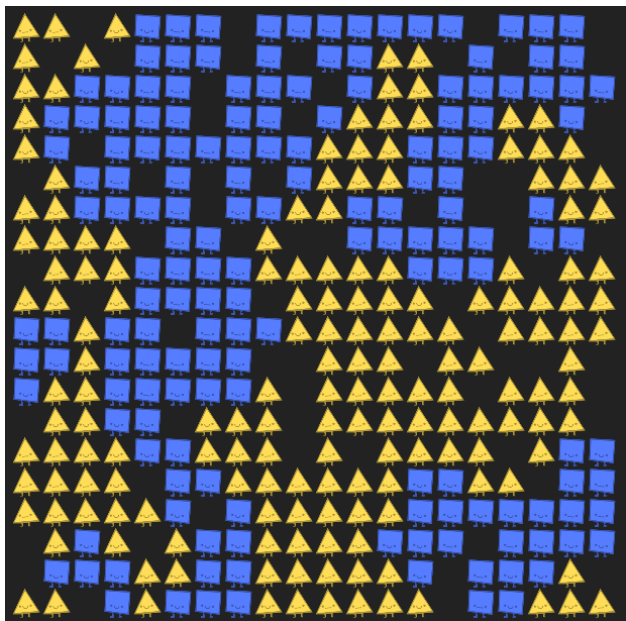
Geoffrey P. Morgan  
Kathleen M. Carley

# Key Points

- Multi-Level Phenomena exist, and are of significant interest to organizational researchers
- Multi-Level Phenomena require Active Multi-Level Modeling to create good/useful models
  - Active Multi-Level Modeling is ABM at multiple levels of granularity
  - A specific sub-family of multi-modeling
- Data-Centric Modeling is key to rapid development of topical/applied models : data must support instancing at different granularities



# Agent-Based Models and Emergence



Parable of the Polygons  
(<http://ncase.me/polygons/>)  
– An interactive version of  
the Schelling Model



A swarm of Blue Jack Mackerel form a "bait  
ball", which confuses predators

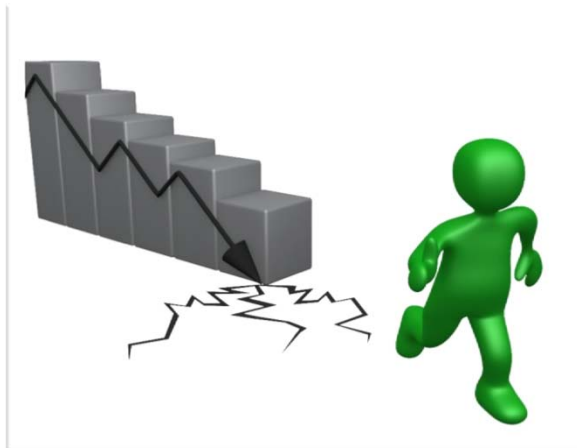
Beautiful elegant useful models with a  
single level of agency

# Multi-Level Phenomena

Definition: *Phenomena that occur with actors at multiple levels of granularity*



Change Resistance



Turnover



Organizational Resilience

# Change Resistance

Definition: Overt or covert resistance to a introduced organizational change

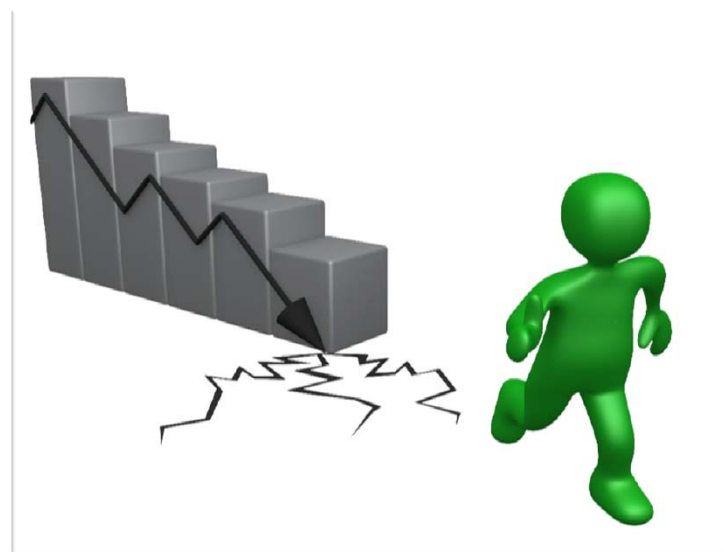
- Noted Risk Factors:
  - Individuals feel they are harmed by the change
  - Individuals don't understand the need for the change
  - Organization has gone through multiple changes in recent memory
  - Organizational culture is not transparent and trusted
  - Organization introduces change poorly



# Turnover

Definition: The percentage of workers leaving an organization over a given unit of time

- Noted Factors:
  - Organizations that are going through significant challenges experience higher turnover
  - Individuals which are highly embedded in the organization are much less likely to leave
  - Organizational socialization procedures can reduce chance of turnover

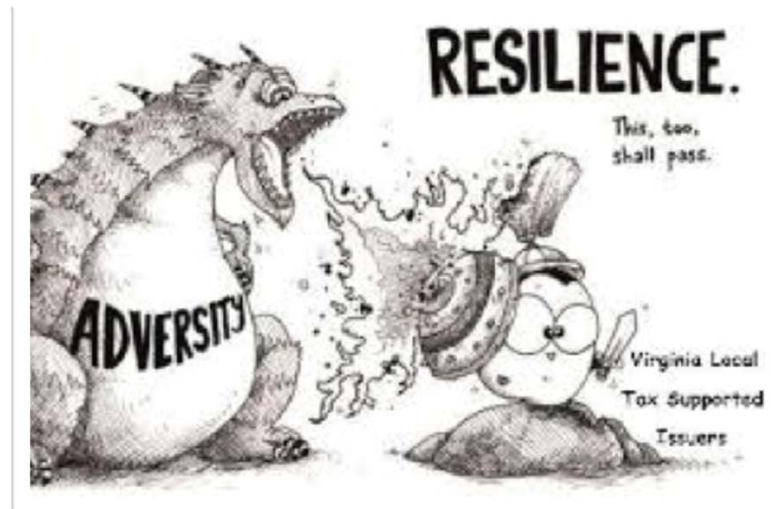




# Organizational Resilience

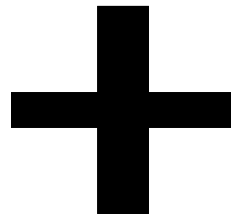
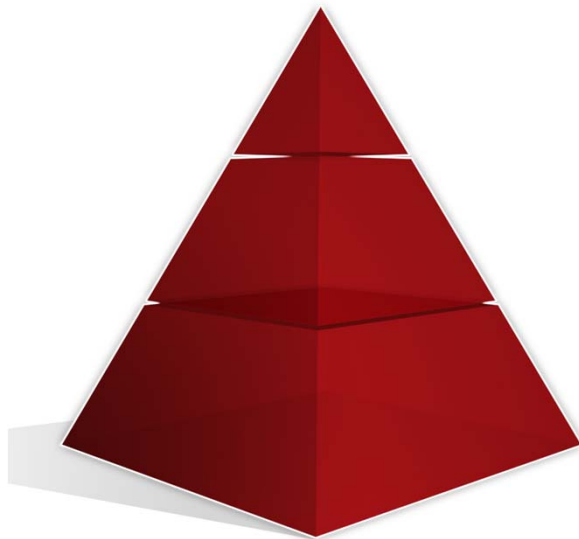
Definition: The ability of an organization to anticipate, prepare for, and respond to organizational crises

- Noted Factors:
  - Groups are resilient if they are more heterogeneous
  - Individuals are more resilient if they have resources they need
  - Resilience response is shaped by the organization's ideology
  - Organizational guidance which ignores individual practice harms resilience

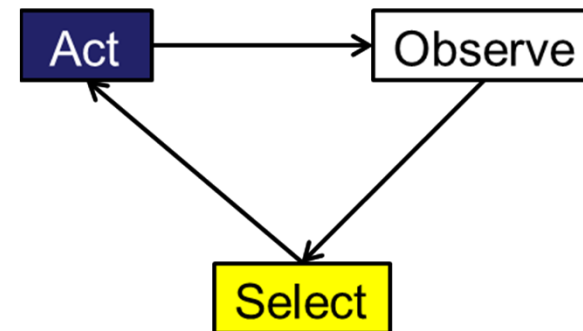


# Multi-Modeling for Multi-Level Phenomena

Org Model

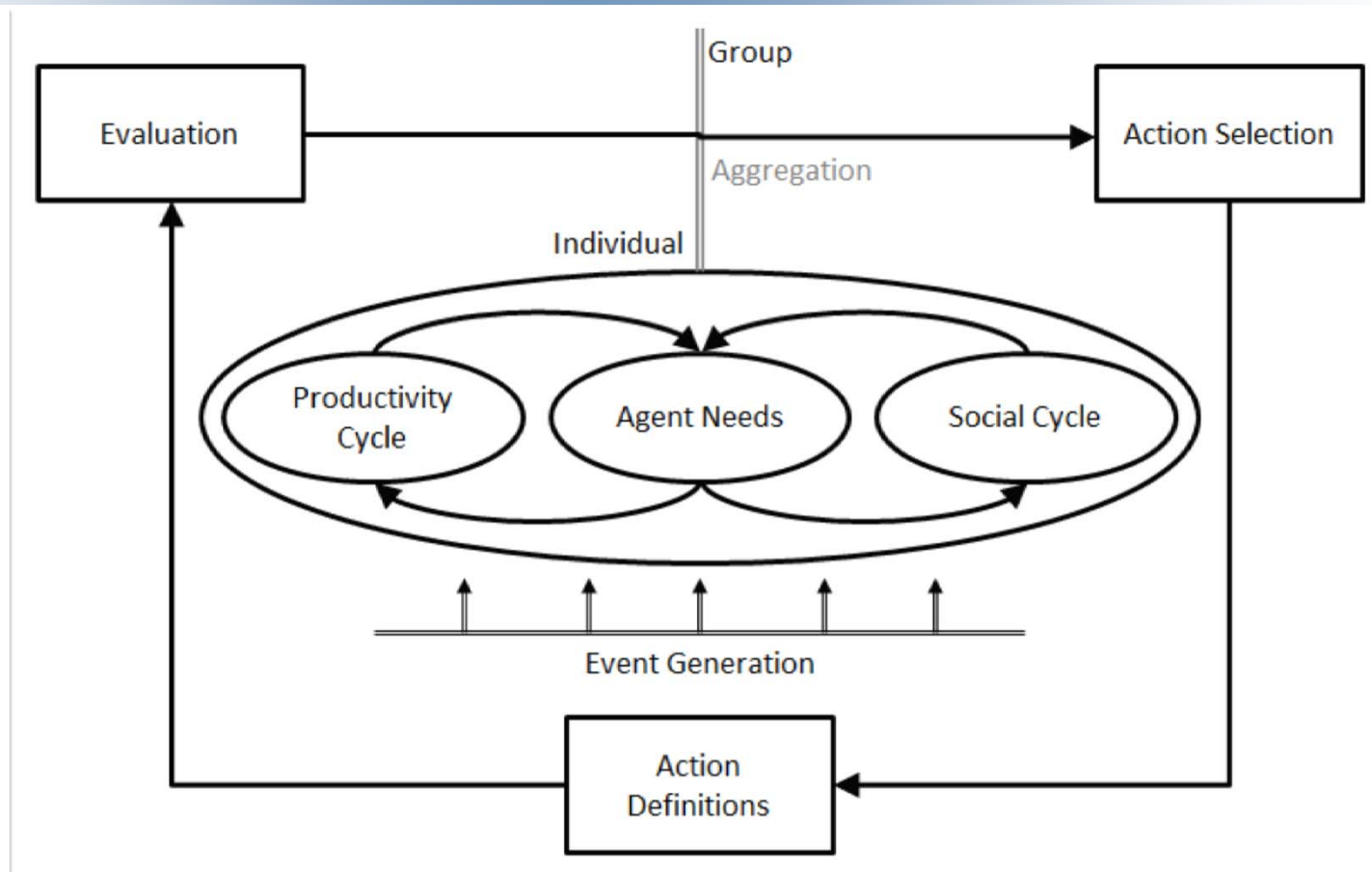
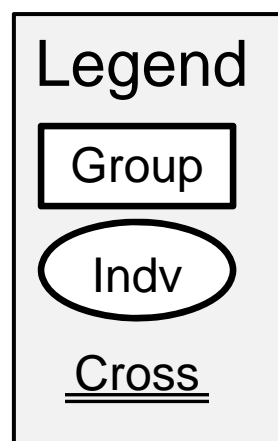


ABM Decision Loop





# Proposed Framework



Three+ models with intentional inter-operation!

# Data-Centric Modeling



James Hardy/AltoPress/Maxppp

# Use Cases

## FAA Policy Change



ERIC PEARLE / TAXI/ GETTY

## Horizontal Merger of a Multinational



# Use Cases

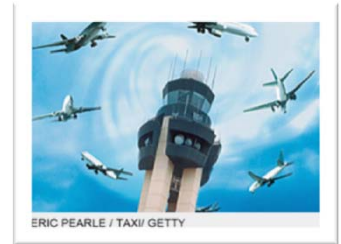
## FAA Policy Change



ERIC PEARLE / TAXI/ GETTY

## Horizontal Merger of a Multinational





# Policy Change at the FAA

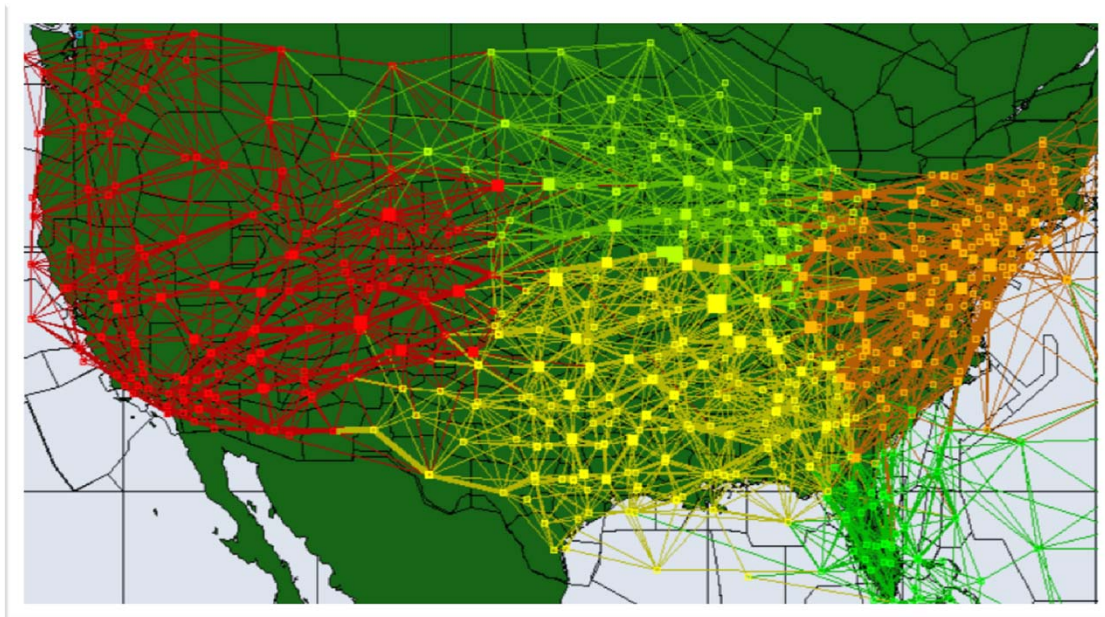
Get insight on the best way to introduce NextGen air traffic control processes to CONUS airspace management

- Understand the differences in communication and process workload from NextGen
- Explore different methods of introduction

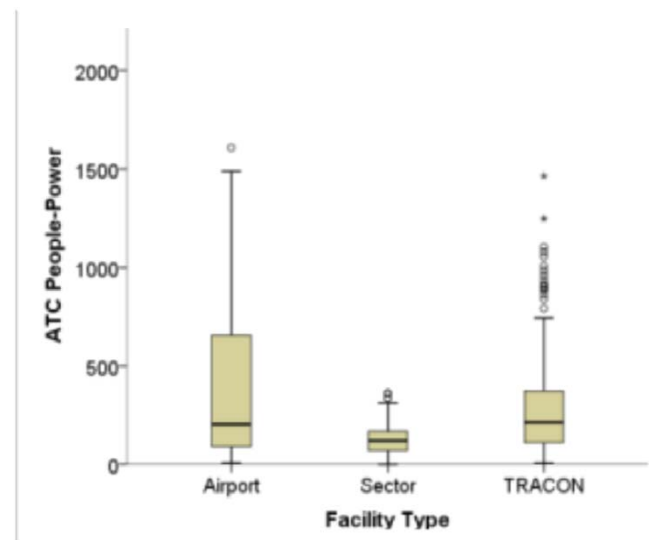
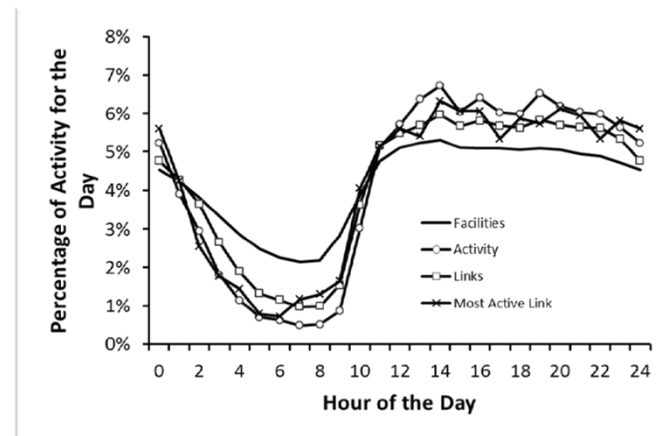




# Activity and Staffing Data

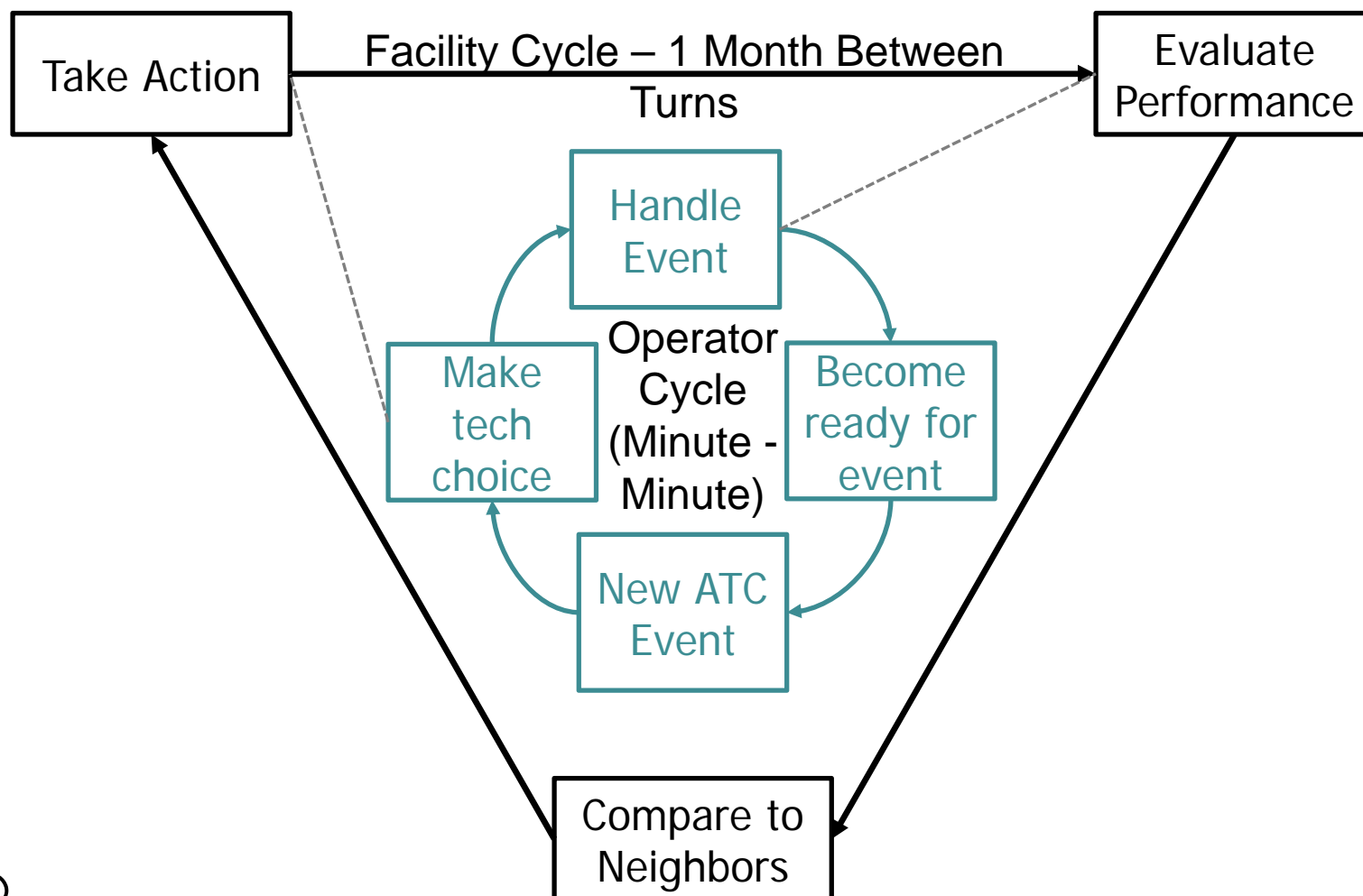


Carley, Lee, and Morgan (2013)

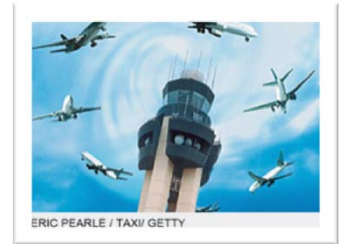




# FAA Simulation Cycle







# Research Questions

1. As flight activity increases, does wide adoption of NextGen procedures tend to reduce the change in outcome service metrics?
2. Do different methods of rolling out NextGen have system-wide effects, or is it merely a relationship to the proportion of facilities that have, use, and support NextGen?
3. Are NextGen procedures robust to large-scale disruptions, even when baseline activity is higher?



# Use Cases

FAA Policy Change



Horizontal Merger of a  
Multinational



# Horizontal Merger of a Multinational



- Large Multinational, purchased another large company
  - Wants to understand the integration process
  - Asked academic researchers if they wanted to help
- Allowed collection of email-server data for multiple months at multiple points in time
  - Collection Period 1: Right after merger announcement
  - Collection Period 2: A year later
  - Collection Period 3: Another year later
- Encouraged employees to participate in org surveys administered by research team



# Survey Data

- Survey was run on a sub-sample of employees. The survey collected various indices, including:
  - Organization Culture (Denison and Mishra 1995)
  - Job Satisfaction (Cammann, Fichman et al. 1983)
  - Commitment to the Organization (Allen and Meyer 1990)
  - Group Identification (van Dick, van Knippenberg et al. 2008)
  - Perceptions of Organizational Justice (Niehoff and Moorman 1993)
- 4849 People surveyed, Year 1
- 4915 People surveyed, Year 2
- 4300 People surveyed, Year 3
- ~11,000 People surveyed in total





# Email Dataset

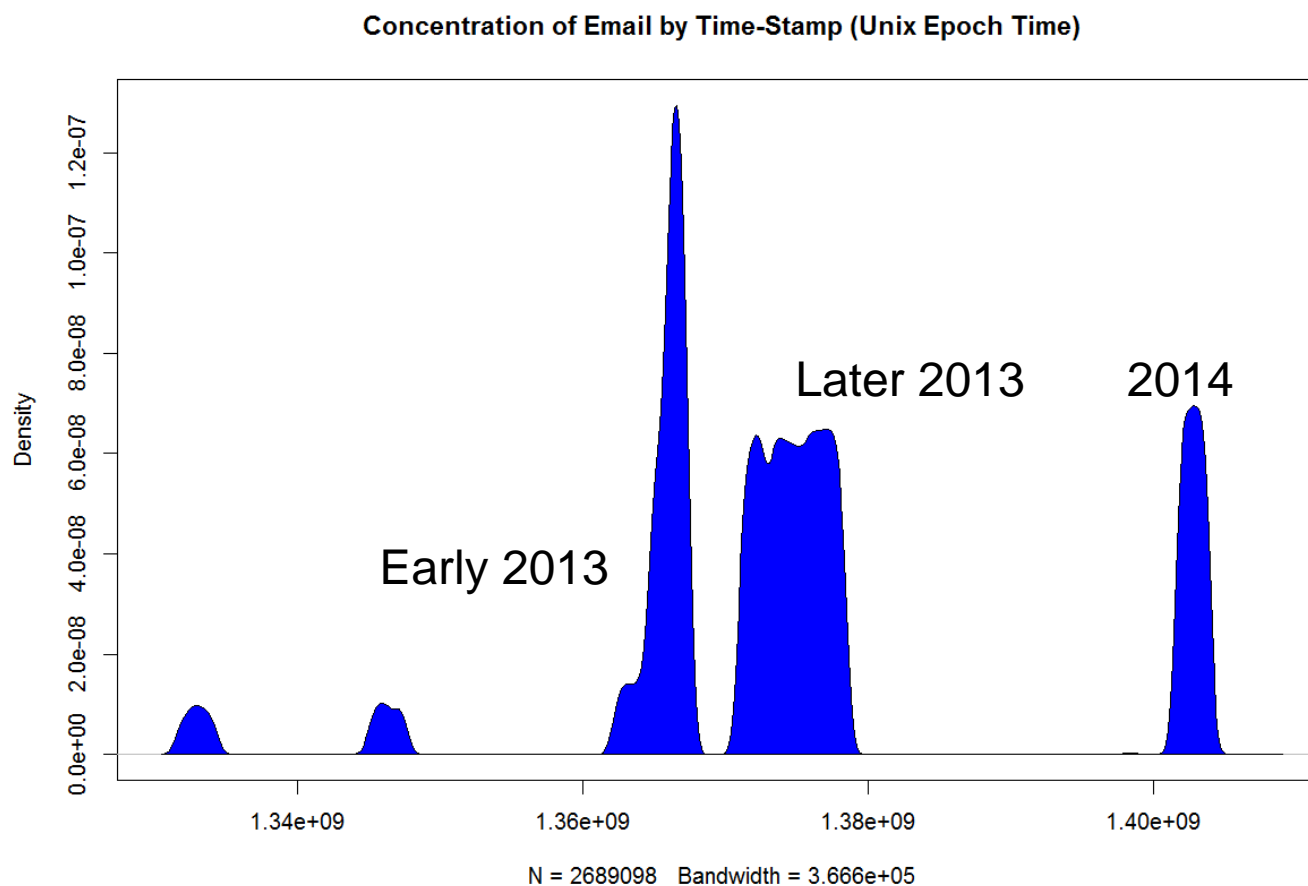
- Filtering:
  - English Emails (identified by Tika API)
  - Sent to a small group of people (less than 7)
  - At least one sender and receiver must have taken the survey in any of the three years
- After filtering to 'known actors' from surveys
  - Timeperiod 1 : 233k Emails
  - Timeperiod 2 : 700k Emails
  - Timeperiod 3 : 1M Emails
- Average Subject Length: 32 Characters
- Average Body Length:
  - Total Characters (includes replies): 2000 Characters
  - Novel\* Characters: 184 Characters

\* We wrote code to scrape off reply-chains





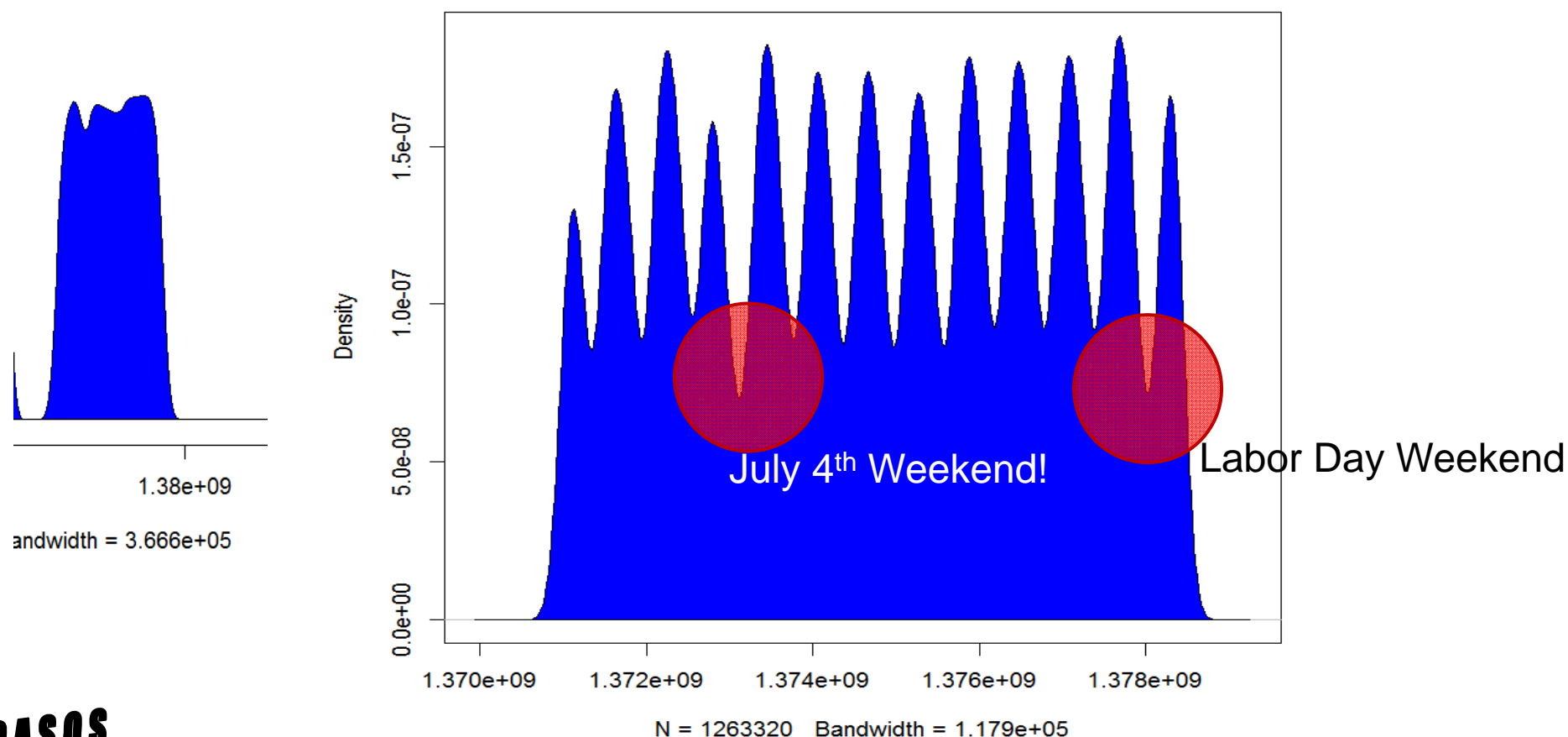
# Email Draws over Time



# Email Draws Show Expected Frequencies



Concentration of Email by Time-Stamp (Unix Epoch Time)

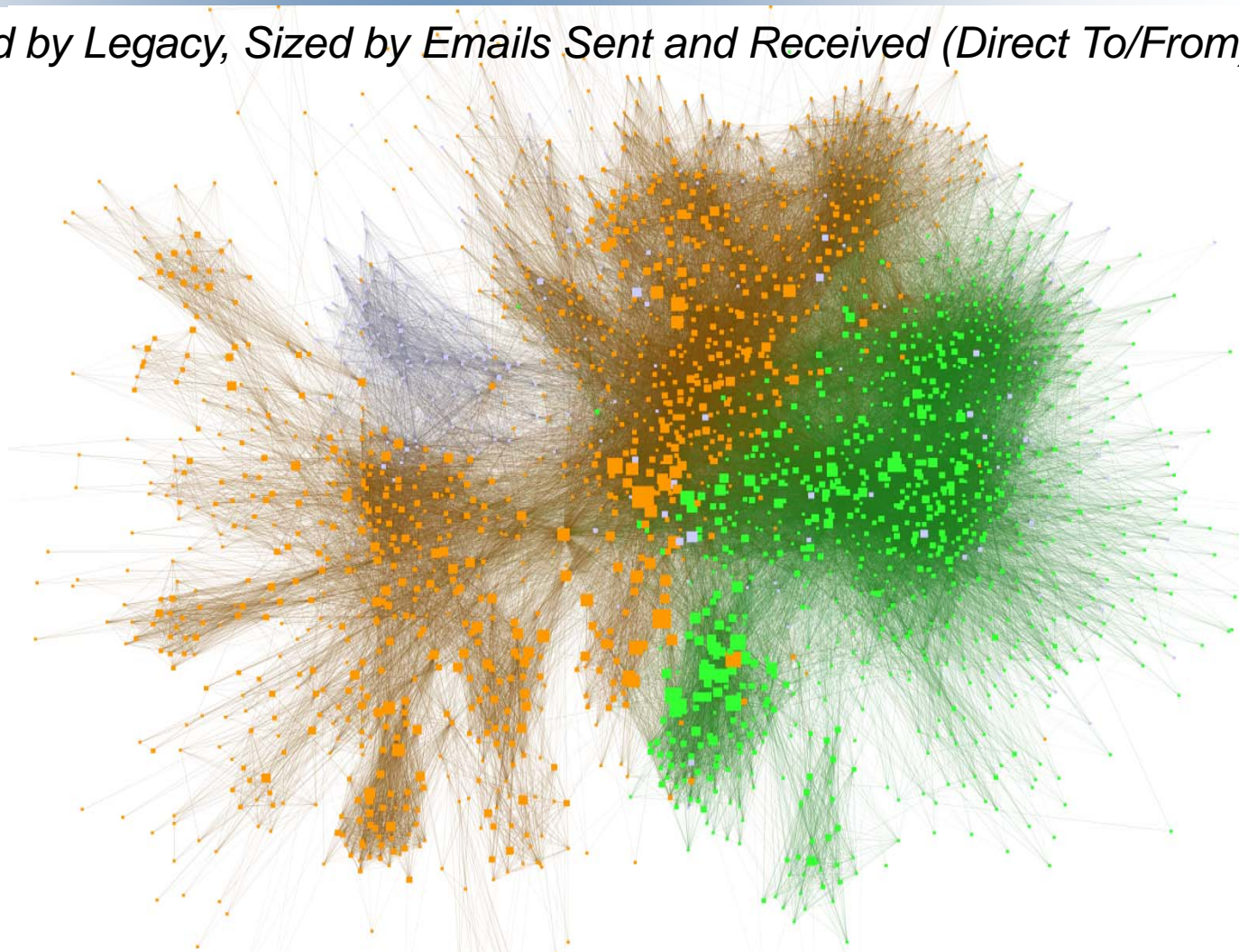




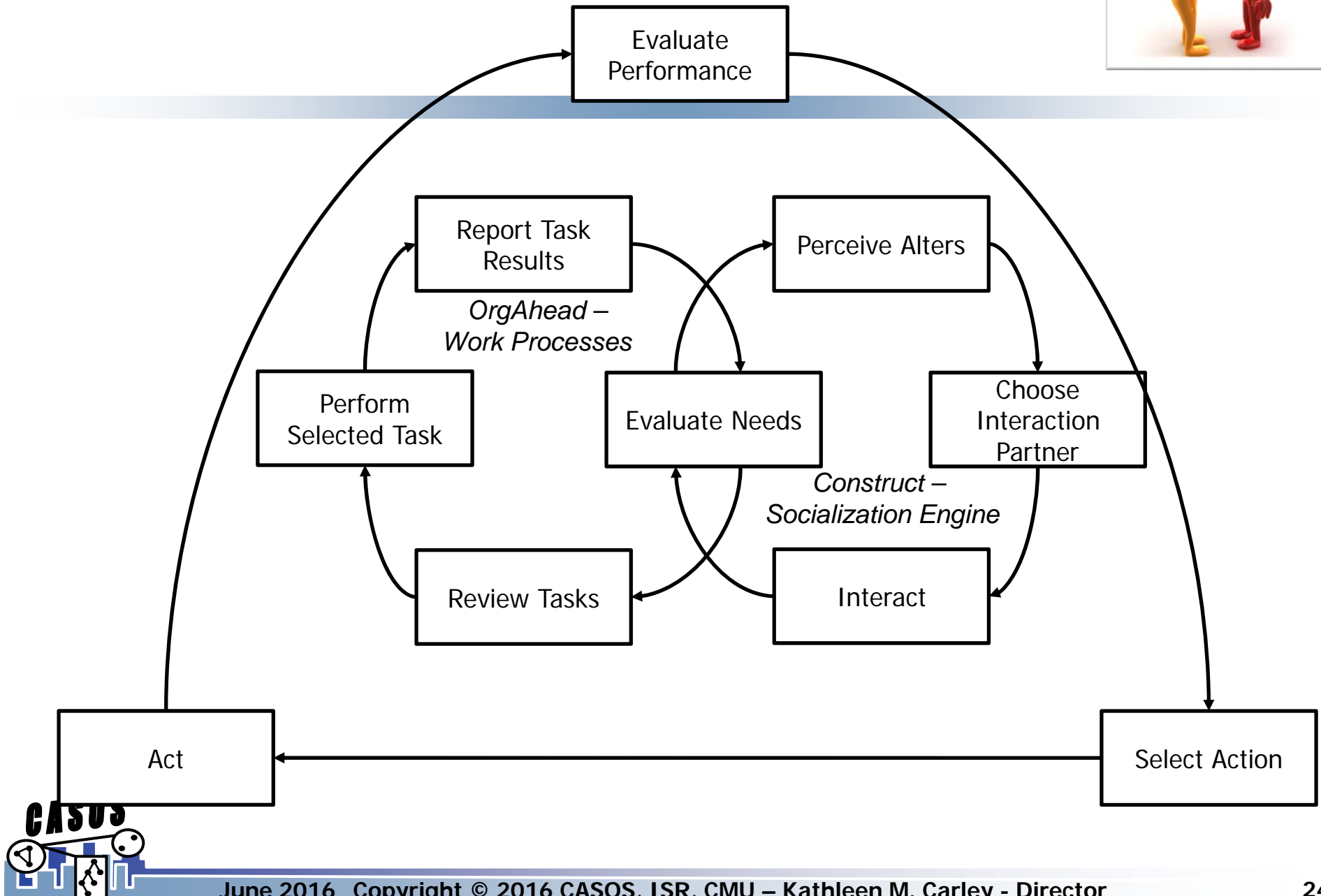


# Internal Email Interactions

*Employees - Colored by Legacy, Sized by Emails Sent and Received (Direct To/From)*



# MultiOrg Simulation Cycle





# (Sim) Research Questions

1. Can we predict departure from the organization?
2. Can we predict conflict between organizational units?

# Key Points

- Multi-Level Phenomena exist, and are of significant interest to organizational researchers
- Multi-Level Phenomena require Active Multi-Level Modeling to create good/useful models
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