UF UNIVERSITY of FLORIDA

IGERT Integrative Graduate Education and Research Traineeship

AM:W3

Data Communication and Decision Support Tools in CERP

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A theory has only the alternatives
of being right or wrong.

A model has a third alternative:
it may be right but irrelevant.

-Manfred Eigen

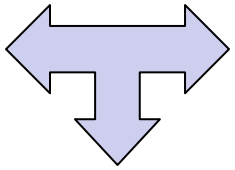
The Physicist's Conception of Nature

Re-conceptualizing "Science to Policy"

A problem of "communication"?

...or one of integrating knowledge to improve quality of decisions?

Scientific knowledge:
-natural system functions
-cause/effect relationships
-probability of outcomes



decision

Contextual knowledge:
-matters of concern
-limitations and options
-social preferences

Research Questions

- Does science need to be conveyed from scientists to a distinct group of decision-makers in Everglades restoration?
  - If so, these would be 'distinct' groups of people.
- What is the usefulness of ecological models as a communication tool for ecosystem restoration?
  - Bridge a gap between 'scientists' and 'decision-makers'?

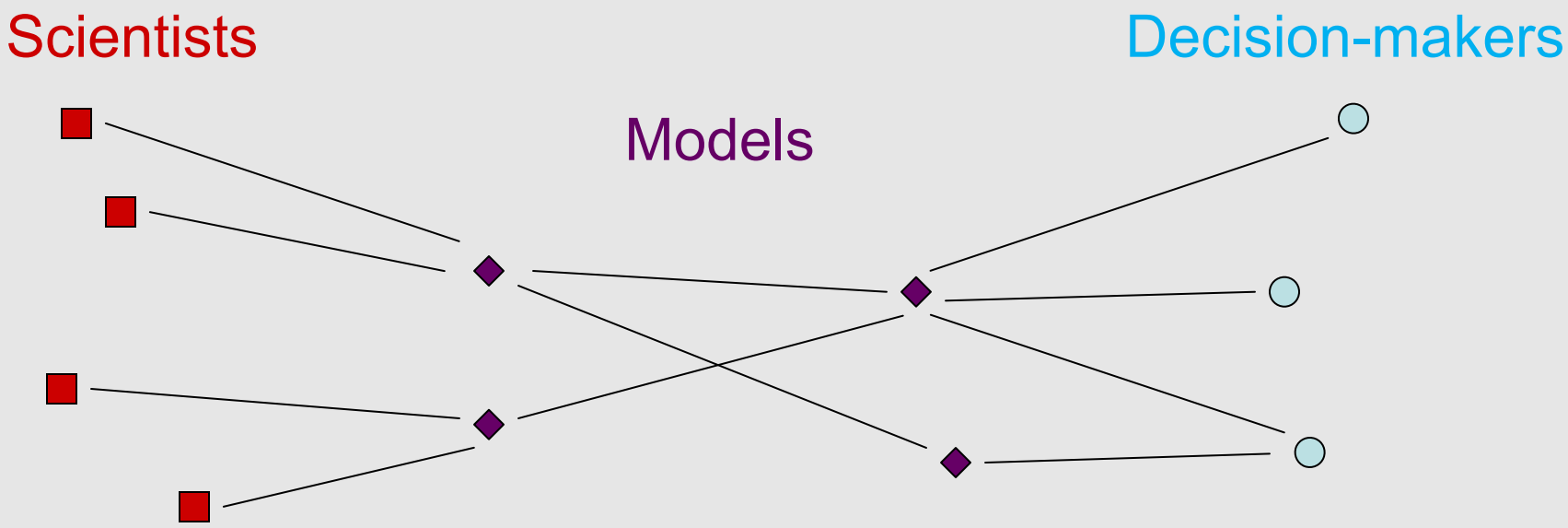
  OR
  - Integrate expertise?

Methods

- Sent online surveys to 989 past and present GEER participants
- Survey design
  - Roles / responsibility self-categorization, to test whether science, decision-making, model development duties overlap
  - Drop-down menu choices to record links to a range of hydrologic/ecological models
  - Open-ended qualitative measures of communication-related concepts such as:
    - Transparency of model assumptions
    - Possibility of use/interpretation by non-experts
    - Usefulness as "reservoirs" of scientific knowledge

Methods

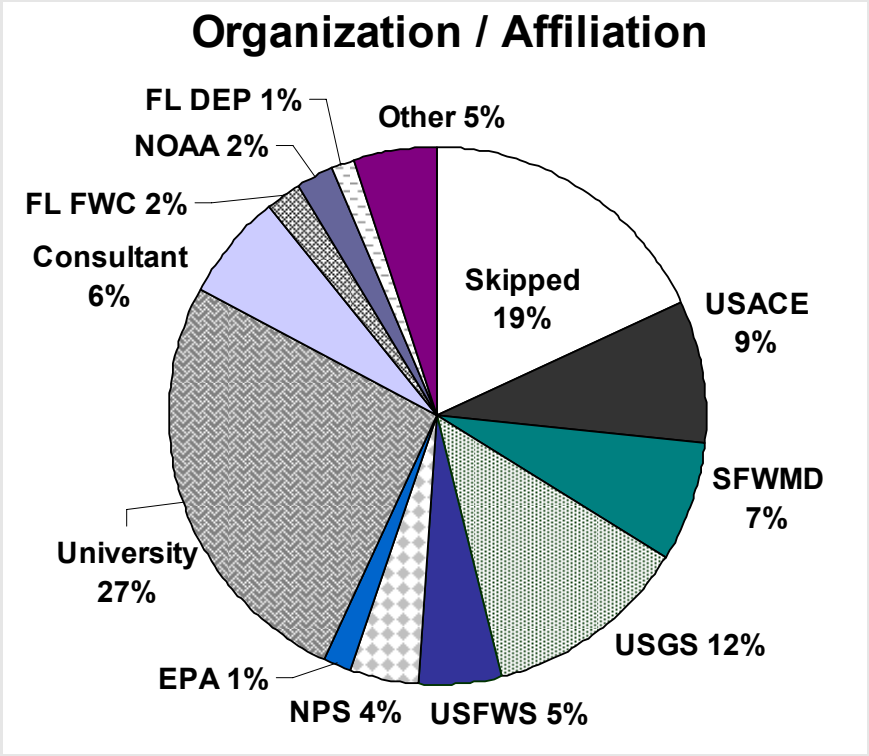
- Adapted Social Network Analysis (SNA) techniques:
  - Relational data shows links between actors
  - Computer models as 'social actors'
  - Tagged actors with attributes
  - Mapped relationships in UCINET software

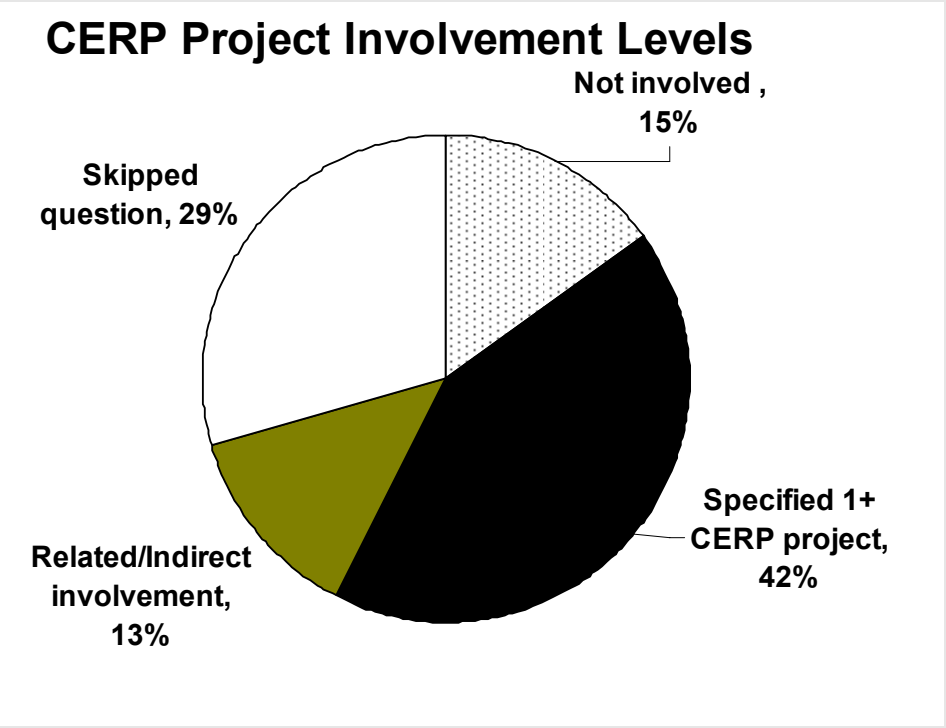


Overview of Respondents

n = 139 (Mon 7/28 at noon)

14.1% Response Rate





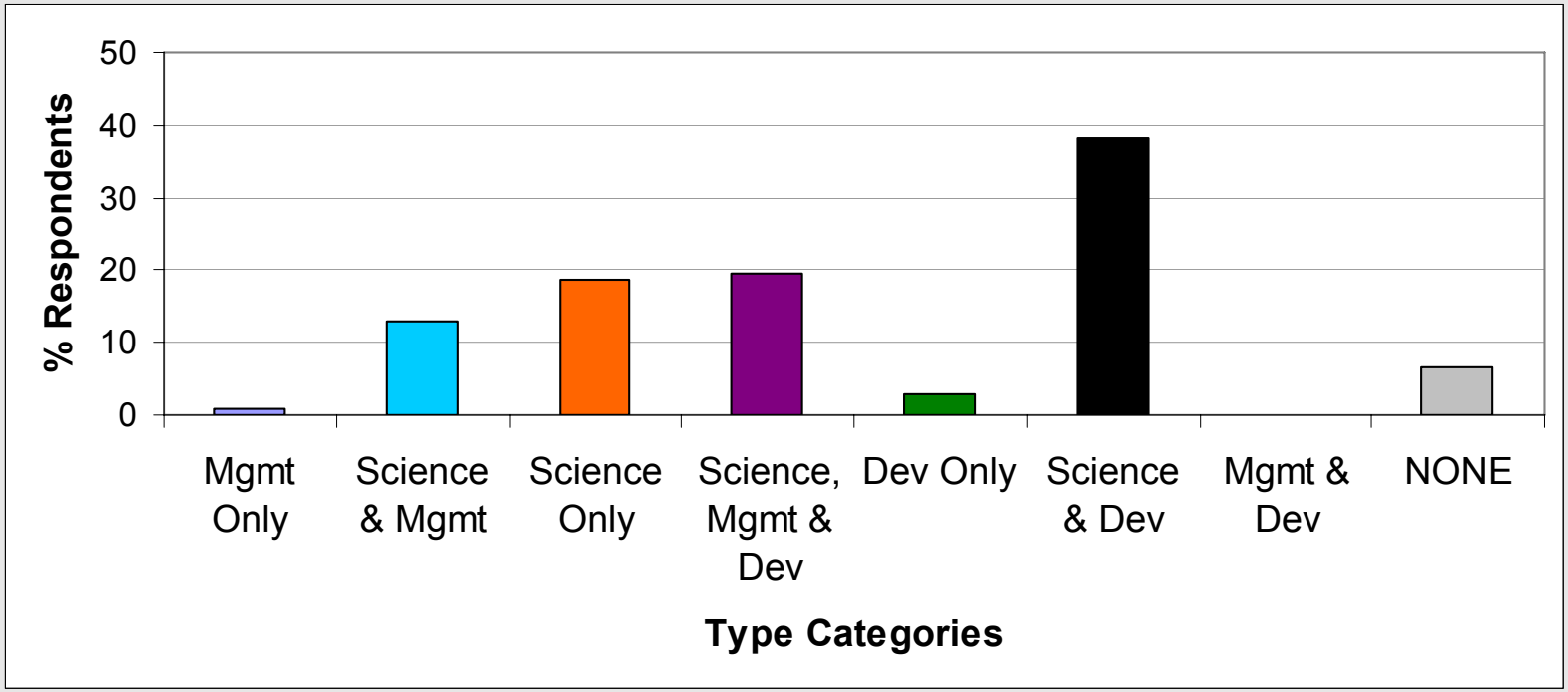
Science/Decision/Modeling Roles

Overlapping Categories:

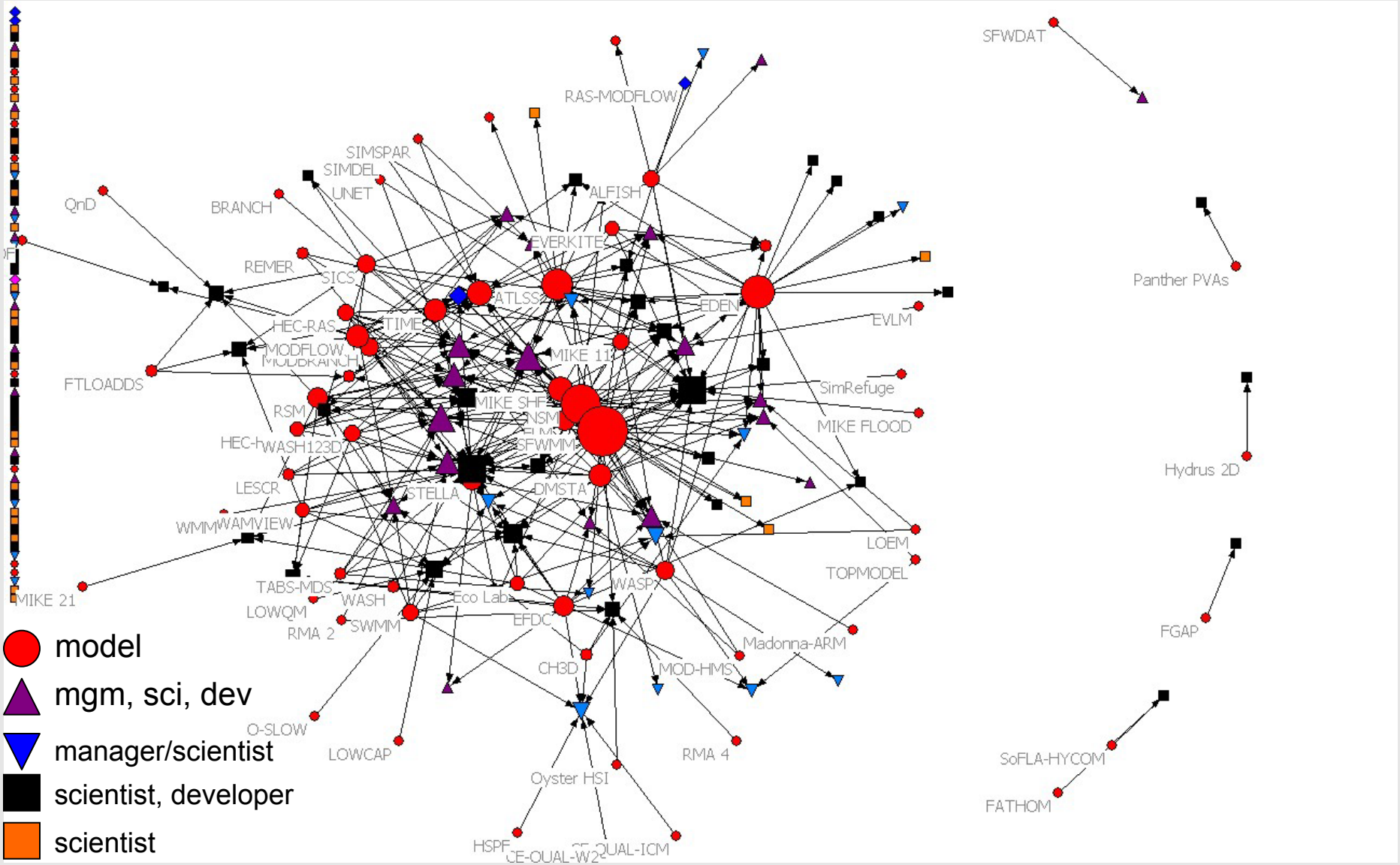
- 35% made management decisions
- 89% involved in scientific research
- 63% helped develop models

Type Categories:

- < 1% Management only
- 13% Science & Management
- 19% Science only
- 19 % Science, Management, & Developing Models
- 3% Developing Models Only
- 38% Management & Developing Models
- 6% NONE of the above indicated



Social Network Analysis Map



Borgatti, S.P., Everett, M.G. and Freeman, L.C. 2002. Ucinet for Windows: Software for Social Network Analysis. Harvard, MA: Analytic Technologies.

Role of Expertise / Transparency

- YES - Expertise needed to interpret models
  - "One must know the underlying assumptions...simplifications made to allow numerical representation, the limitations and appropriate use ...and ...model error"
  - "One should be familiar with modeling"
  - "Understanding the system being modeled and the models themselves is key to interpreting the output."

- No – Models are not transparent enough
  - It takes considerable resources to "get under the hood" of many of these models.
  - "Assumptions not always clear and simulation models often not realistic biologically"
  - "Documentation ranges very broadly, from very detailed and useful to very sparse and obtuse."
  - "Too much is hidden in the model code"

Knowledge Embedded in Models

- Models are only as good as...
  - "the assumptions and the calibration of them based on actual field data."
  - "the data and the scientist(s) that creates them."
  - "the modeler assuming there is high quality data."
  - "the effort (data, science, calibration) that went into building them."
  - "the information put in and the assumptions made for its design. As such a model is not flexible."
  - "boundary conditions limit their usefulness in assessing complex hydrologic or ecological functions occurring in nature."

Modeling as a Process

- "Models provide a documented path to decisions and help to express the experienced scientist's knowledge and uncertainties in an organized way"
- "Models can be used to test hypotheses on how complex systems may function or to run hypothetical scenarios but scientific knowledge does not derive from models or equations."
- "provide a framework for specifying our hypotheses about how these systems function and interact"
- "experienced scientists...have adaptive knowledge and can think in a way that a models can't"
- "[Models] can be powerful tools on integration of data when based on accurate field and lab data, and historical data, but there is no substitute for the expertise of women and men in the field."

Observations

- Models are good tools for integrating knowledge
  - Expert knowledge used to codify variable relationships
- Models are good tools for testing existing theories and assumptions
  - Hypothesis testing & complex calculations
  - Can be compared with observed data
  - Repeatable
- BUT only as good as input data and the code

Observations

- Models do not communicate knowledge well
  - Indirect communication pathway
  - Not very transparent
  - Require training or documentation to be used
  - Proper interpretation of outputs requires expertise
    - Knowledge of modeling
    - Knowledge of the system
- Models do not interpret the meaning in science

Role for Models in Adaptive Management

- Useful process to consolidate / integrate expertise & empirical data and test assumptions

- Useful for testing hypotheses about system function if...
  - Testing explicit hypotheses with clear assumptions
  - Data are verified
  - Code is validated and model ground-truthed
  - Margin of error not too large
  - Model design is a good fit with research question
  - Interpretation of outputs in hands of experts and balanced with healthy skepticism

Further Analysis :

- Analyze "types of scientific data" included in models
- Analyze data types as an attribute of models & respondents
- Operationalize "integration capacity" of models and compare with "betweenness" degree of centrality
- Analyze associations between professional roles and model use

Questions/Comments:

For a link to the survey, more information,
or to provide additional feedback, please email:

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  Borgatti, S.P., Everett, M.G. and Freeman, L.C. 2002. Ucinet for Windows: Software for Social Network Analysis. Harvard, MA: Analytic Technologies.