

Uncertainty Management with JCAT

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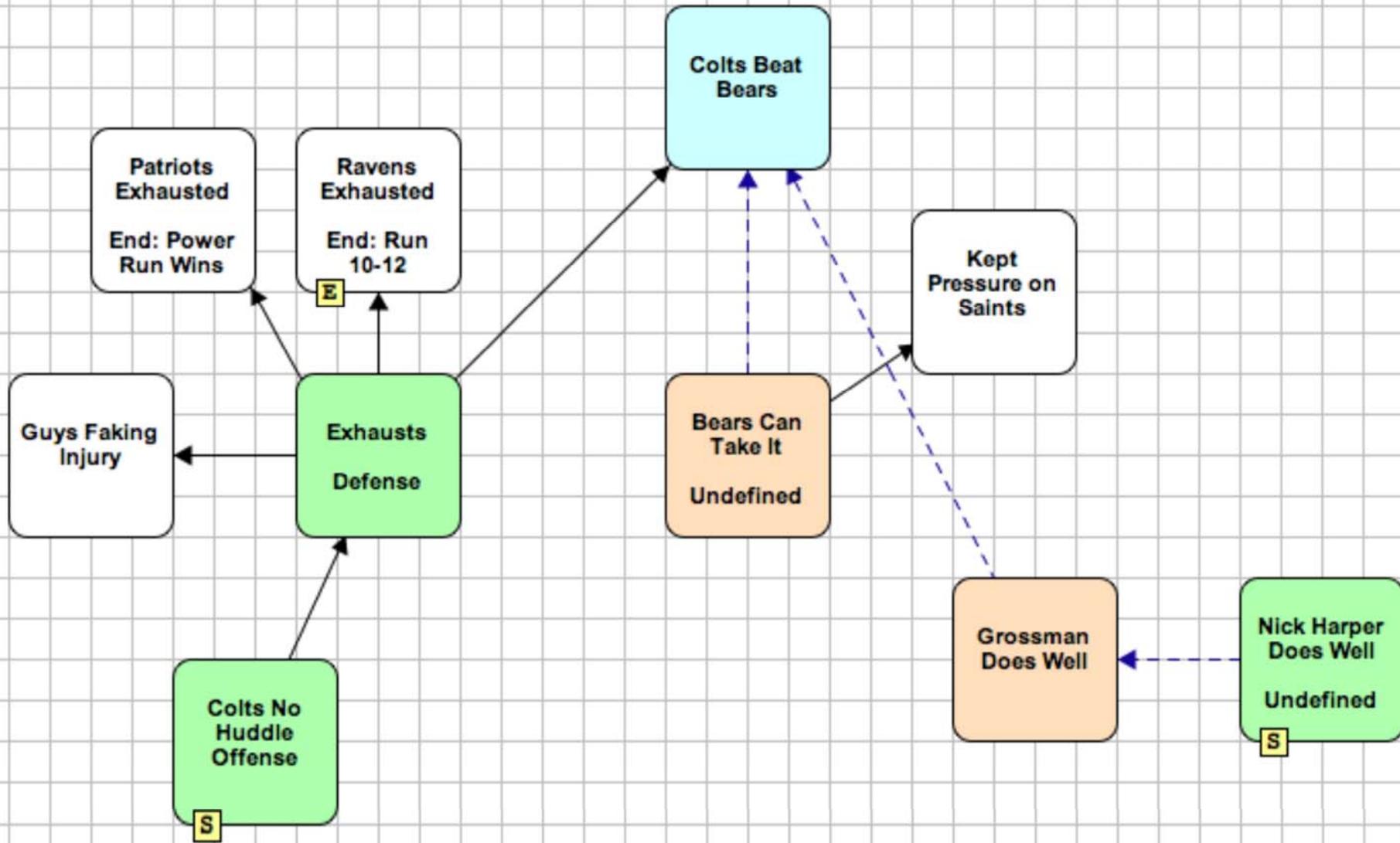
JCAT

- Best thought of as a ‘spreadsheet’ for uncertainty management
 - Excel:
 - You put in the items and dollar amounts
 - Excel does the numeric calculations
 - JCAT
 - You put in a study or a plan
 - JCAT does the uncertainty calculation
- Theoretically sound
 - More on that later

JCAT

- An alternate way to represent a study or a plan
 - Emphasizes causes and effects
 - Focuses on uncertainties involved
 - Models temporal evolution
 - Supports quantitative “what if” analysis
- An alternate, computer assisted method for drawing conclusions
- Is *not* a model that gives “answers”.

Dr. Z.



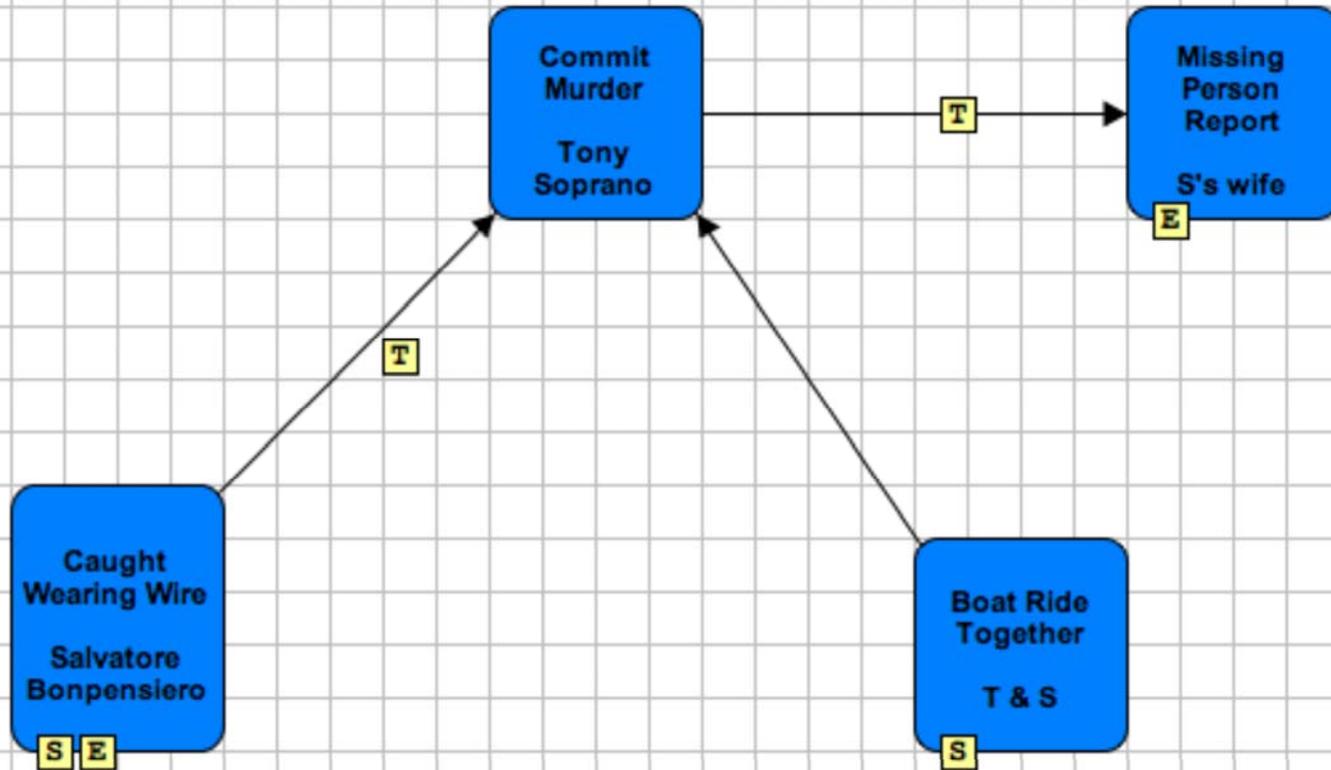
Model Structure

- Boxes are Events
- Line from A to B is an event meaning “causes”
 - With some probability
 - “A causes B” is also an
- Dotted line ... meaning “inhibits”
- Events also have temporal properties
 - Delay
 - Persistence

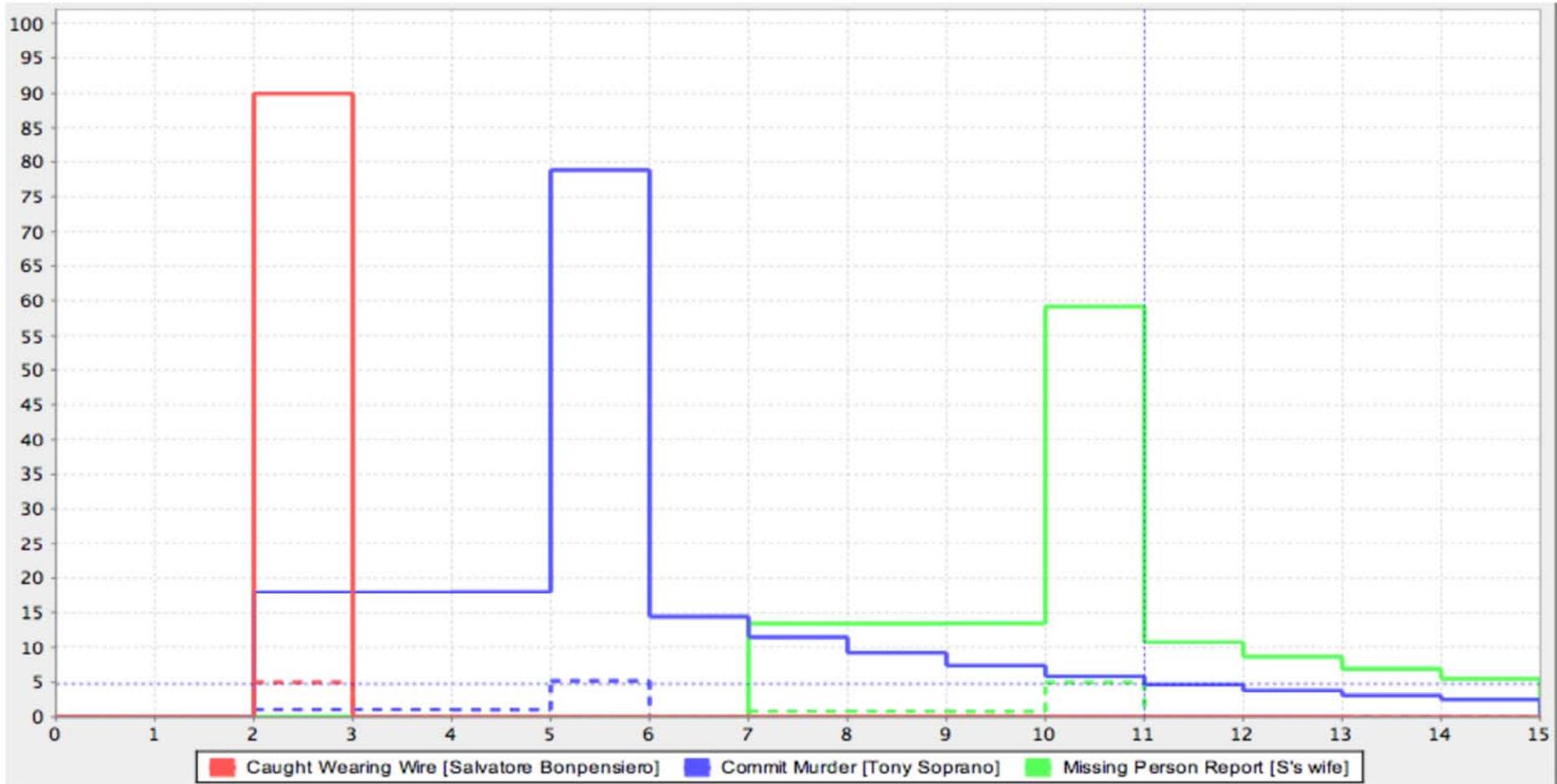
Probabilities

- Uncertainty is inherent in any plan or study
- If the uncertainty has not been quantified, that does not mean that
 - There is no uncertainty
 - The uncertainty cannot be quantified
- JCAT insures consistent aggregation of estimates.
 - Forward
 - Backwards
- Probabilities in, probabilities out
- Empirically testable: e.g. Dutch Book
- Better than 'words'
 - It's friggin' cold.

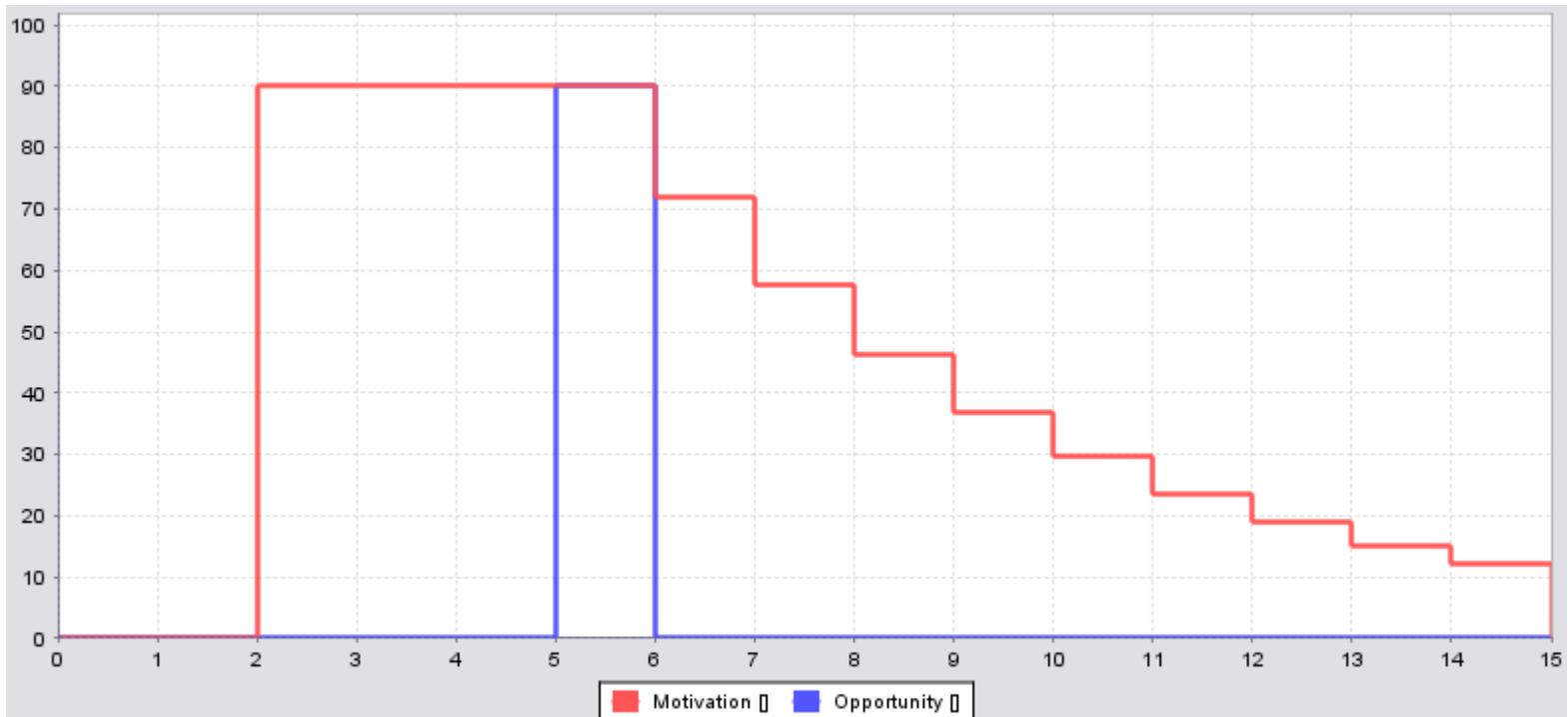
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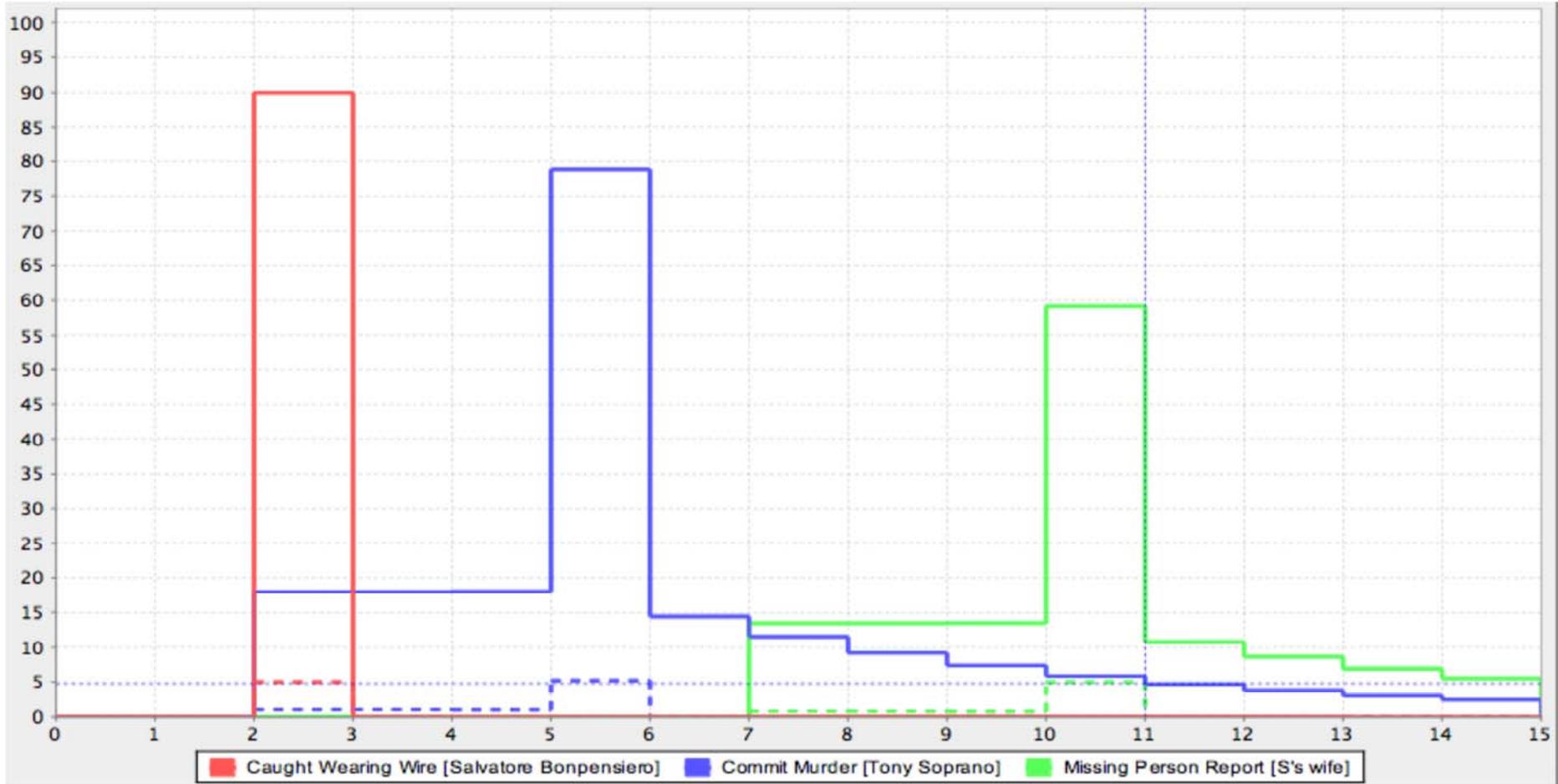
Prediction & Inference



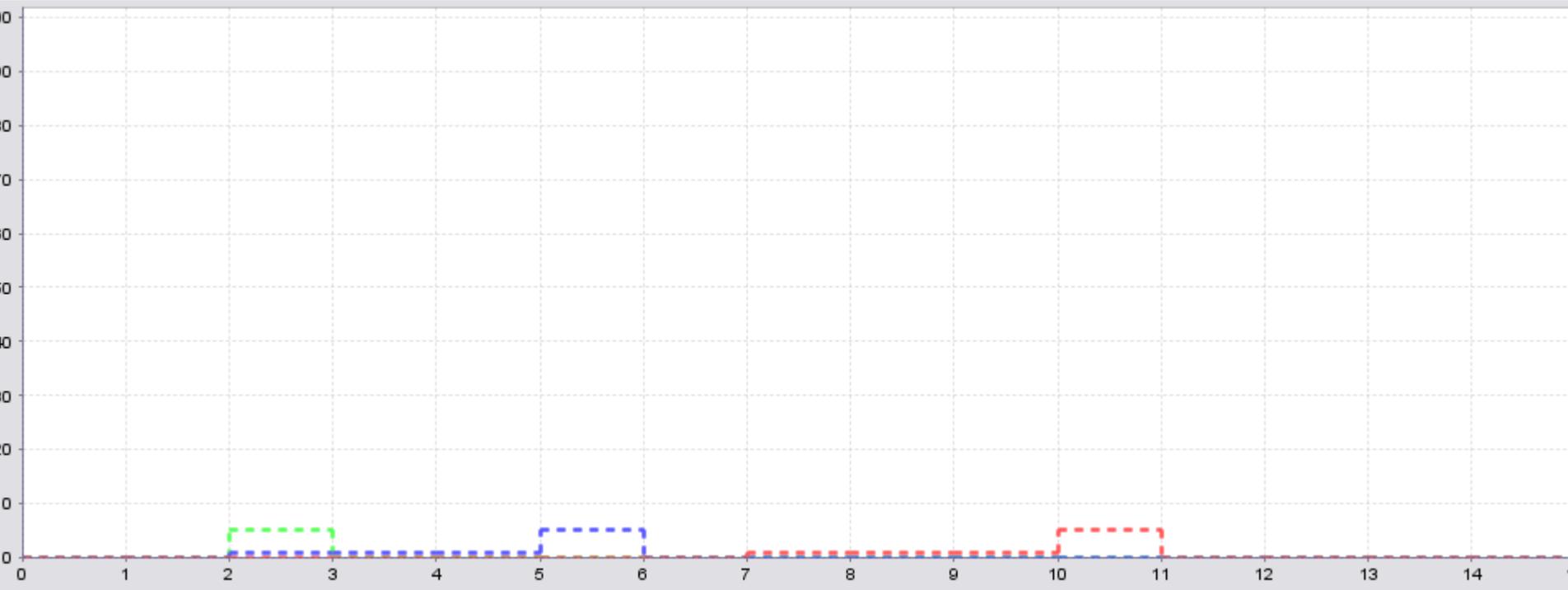
Motivation Persists



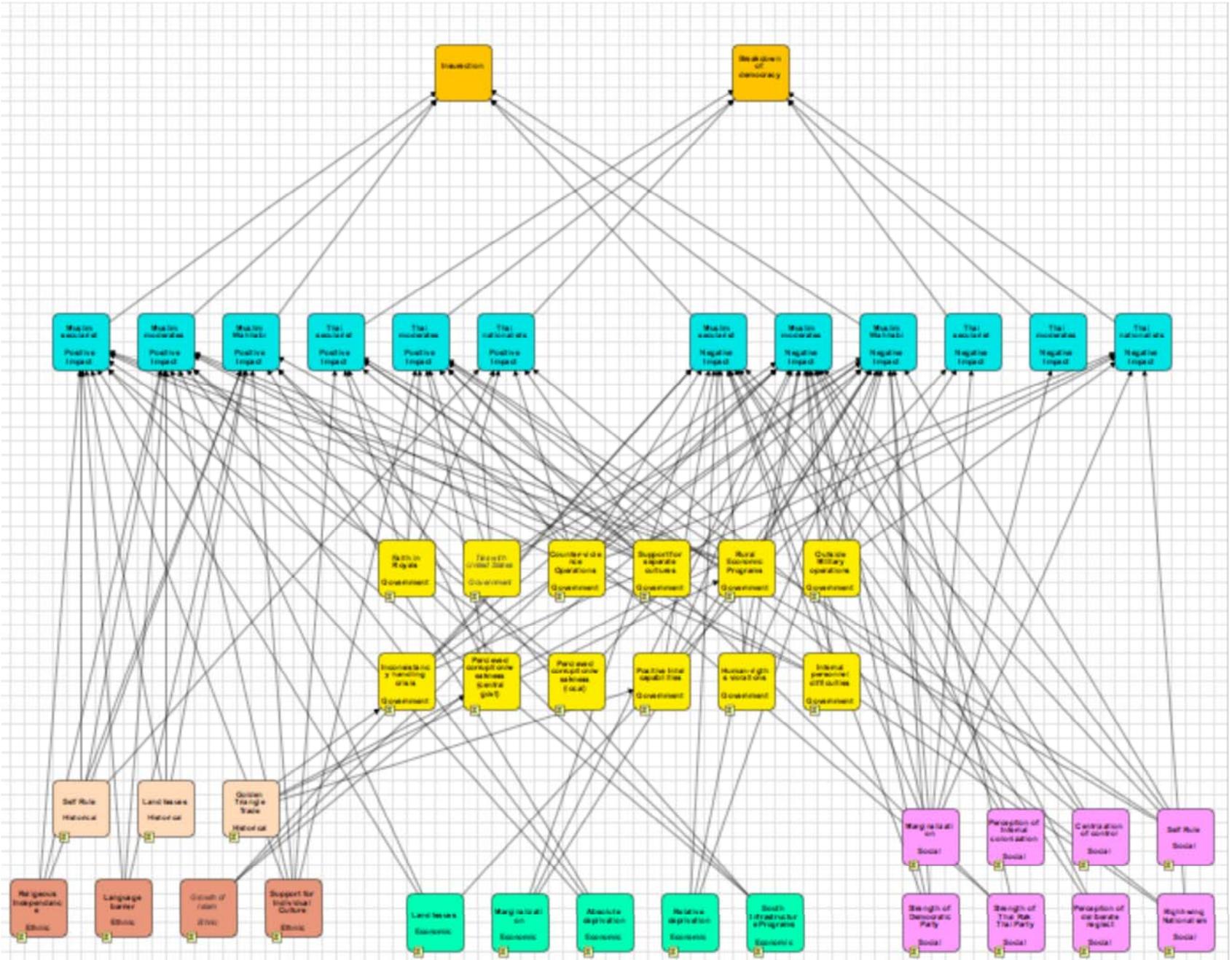
Prediction & Inference



Explaining the Past



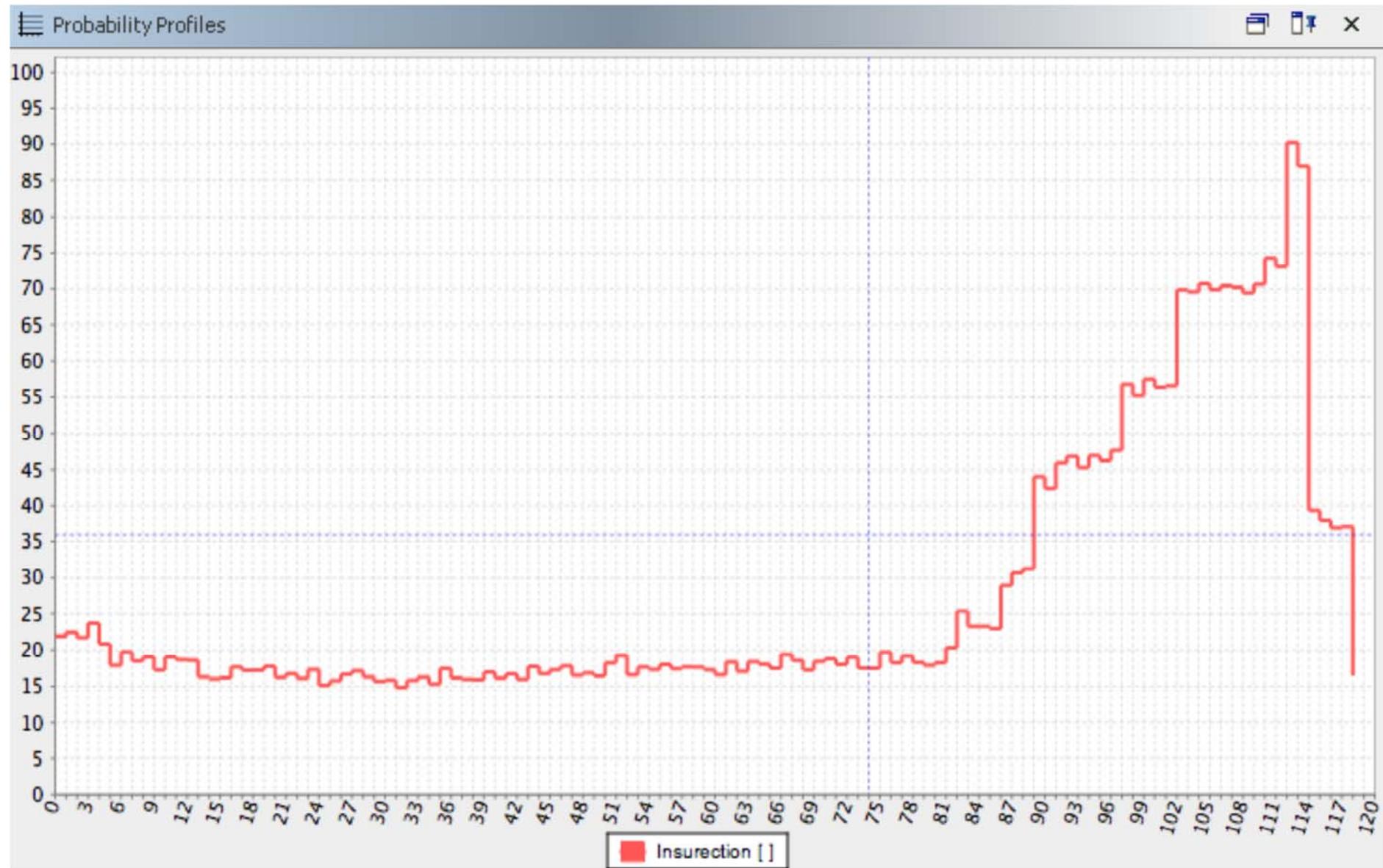
Insurrection In Thailand



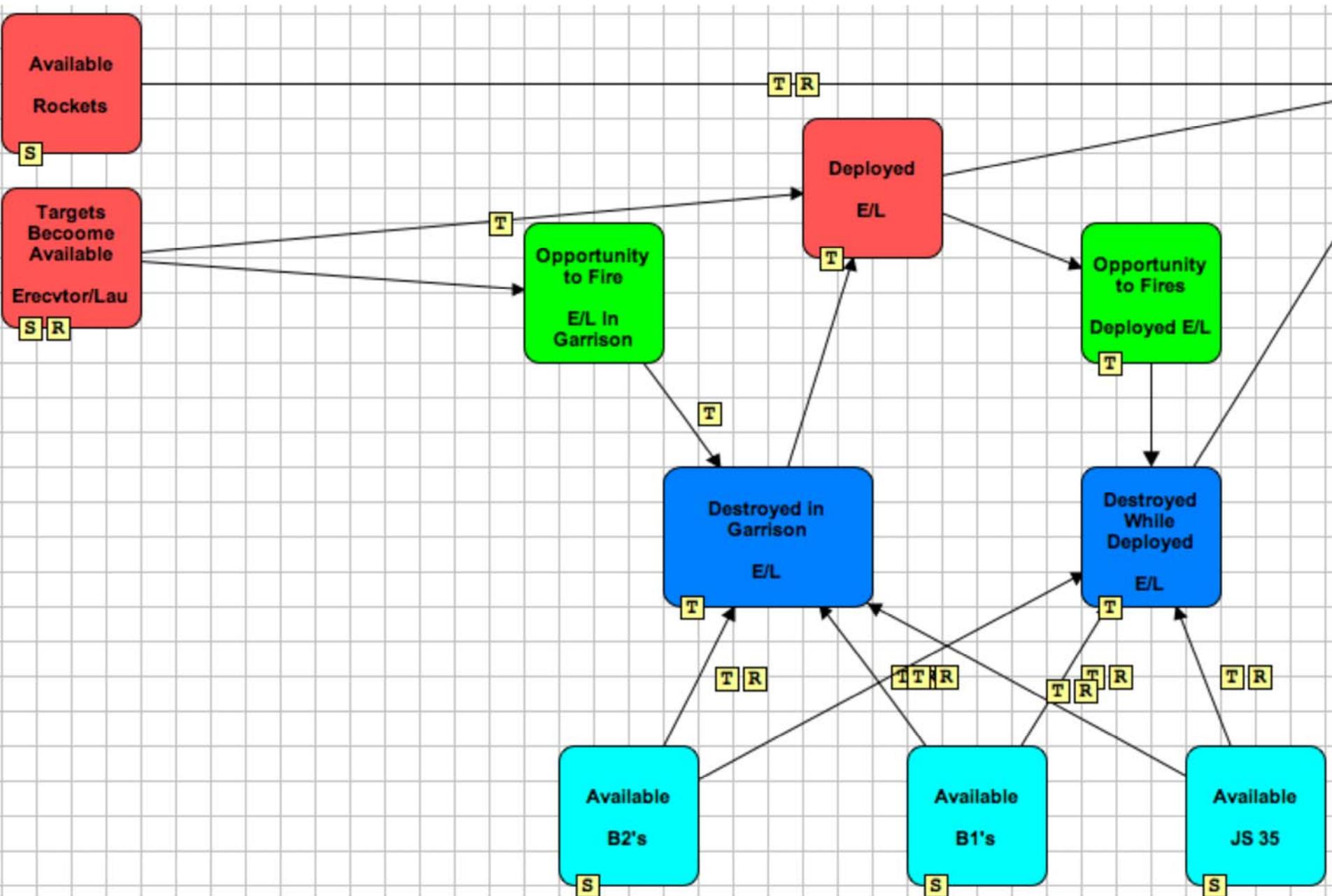
About the Thailand Model

- Built by Major Joel Montgomery
 - Reservist working at NASIC
- Based on open source materials only
- Model built “before the fact”
- Predicted last summer’s problems in Southern Thailand

Thailand Prediction

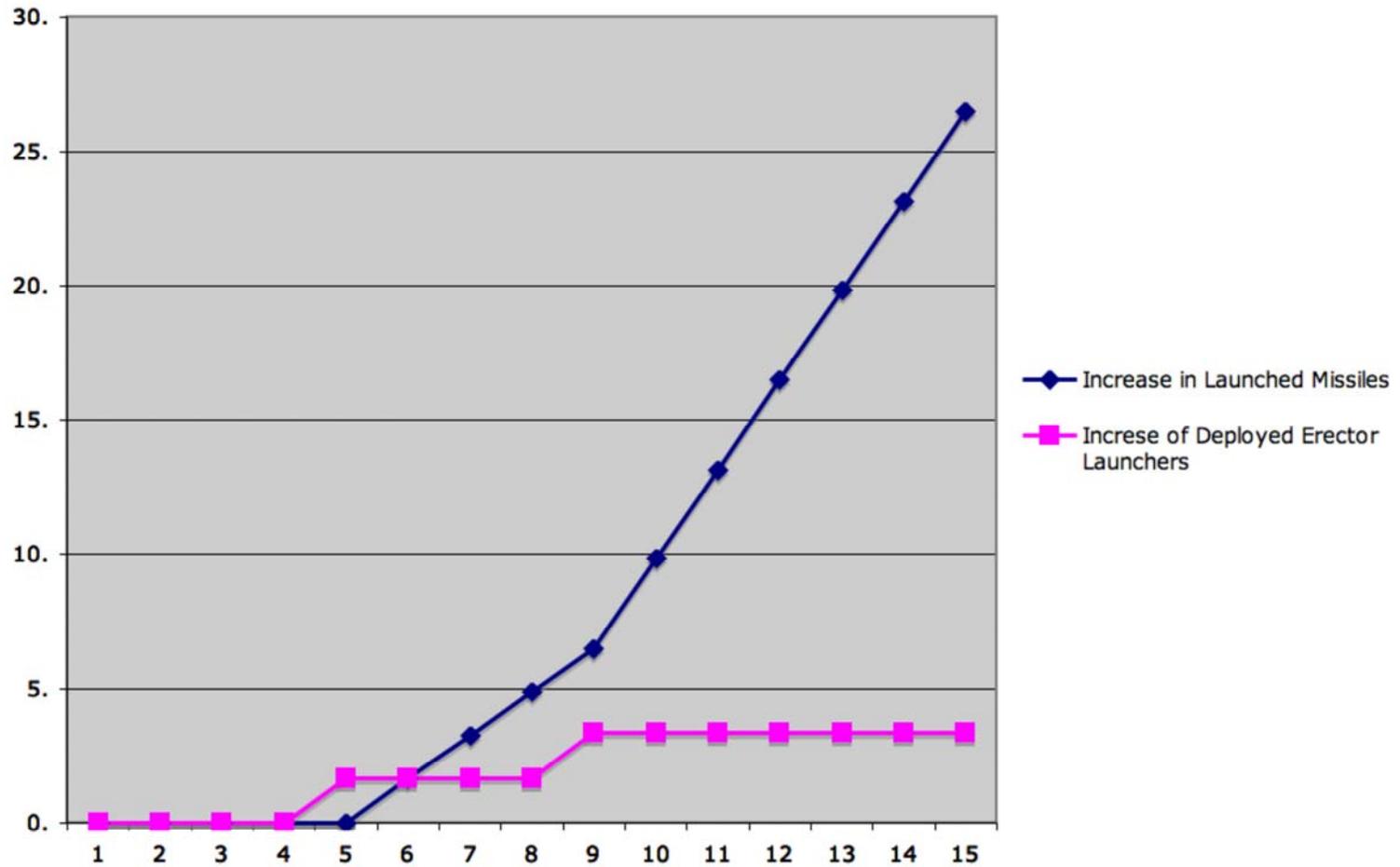


Quantitative Kill Chain w/ Uncertainty

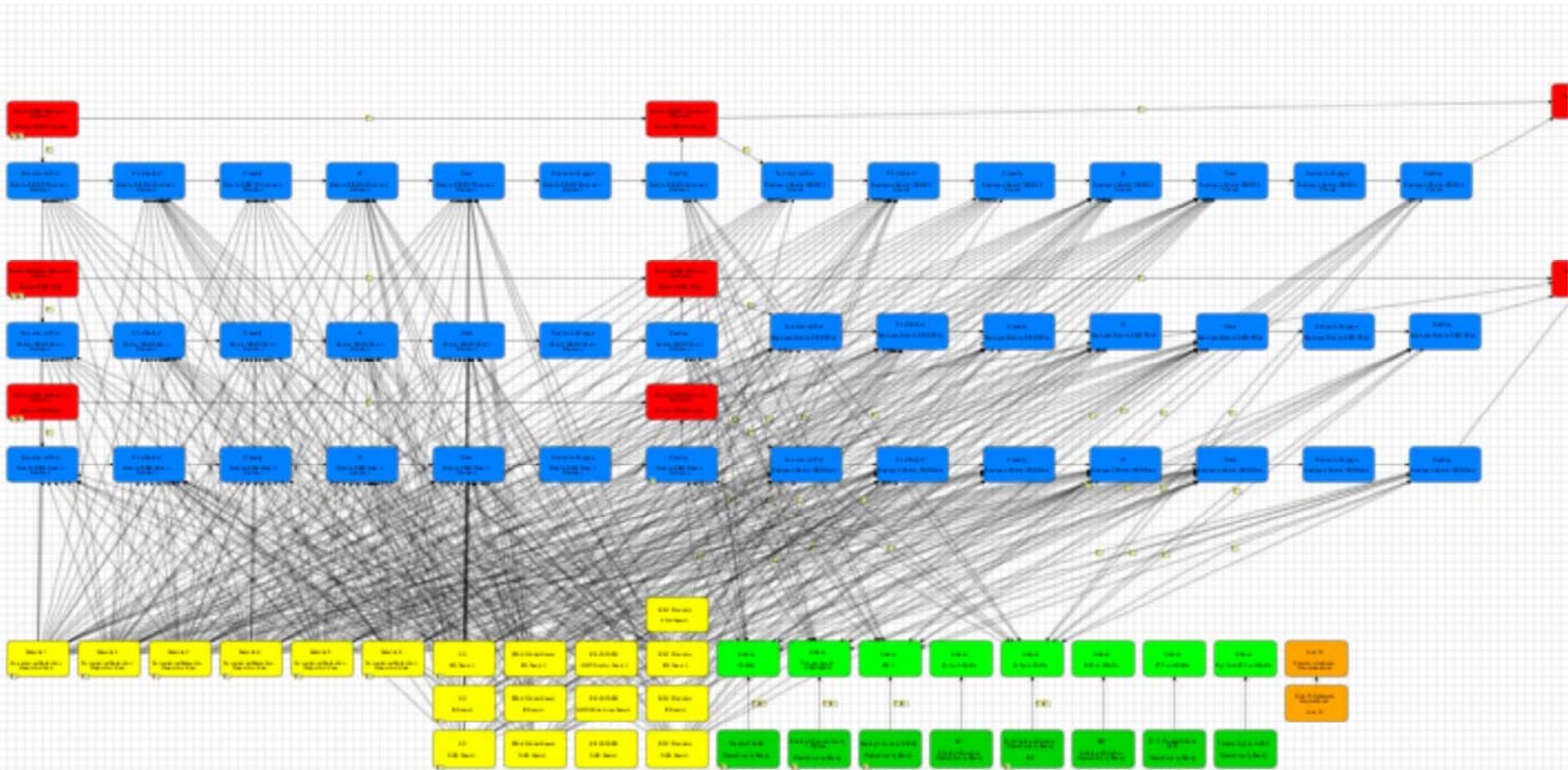


'Tracking' Tradeoff

2 tic vs. 1 tic



Big STRATCOM



About Big STRATCOM

- Built by actual expert
 - Colonel (ret) Tim Polaske
- A real problem
 - TRIAD Analysis
 - Missile defense

Benefits of Uncertainty Management

- Argument
 - Analysis
 - Clarity
 - Consistency
- Predictions (beliefs) about future events
- Analysis of past events
 - What (else) actually happened?
 - How does this revise future beliefs
- COA Analysis and “what if-ing”

Why JCAT?

- Theoretically sound implementation of Bayesian probability theory
 - Probabilities in, probabilities out
 - Excel with approximate division and multiplication???
 - Probabilities are only empirical theory of uncertainty
 - Even subjective probabilities can be empirically evaluated and tested.
- Even though Bayesian modeling is hard, JCAT does much of the work
 - Avoids many strong assumptions
 - Supports the model builder in many ways
 - Processes large temporal models

Future Features

- Computer assisted explanation
 - Support briefings:
 - What can we do to make ... more likely?
 - Why does the probability of ... change there?
 - Plan debugging
- Sensitivity analysis
 - What are the most important probabilities to think further about?
 - Which parts of the model make little difference to our overall predictions?
- Semantic SNA integration
- Support for estimating probabilities.