A Mental Models Approach To Strategic Risk Communication

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Strategic Risk Communication

- **The essence of strategic risk communication is simple:**
  - **Create a synergistic collaboration among science, technical, management and communications professionals. Prepare an expert model to integrate expert knowledge.**
  - **Learn what people already believe about options and why they believe it.**
  - **Tailor communication to this knowledge and the decisions people face.**
  - **Subject communication strategies and messages to careful empirical evaluation to ensure effectiveness.**
  - **Measure communication process and effects outcomes for continuous improvement.**
- **Key objective: enable decision-makers and stakeholders to make well-informed decisions and take appropriate actions.**

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Insights from Research

Mental Models Define Judgment

- **Mental models:**
  - **Are webs of belief that guide learning and interpretation and through decision-making, define judgment and shape behavior.**
  - **Prevent people from seeing alternate perspectives or options.**
  - **Define the boundaries of thought and action.**
- **Mental models must be addressed through strategies and communications that:**
  - **Build on where people are at today in their thinking.**
  - **Are tailored precisely to the decisions they must make.**
- **The Bottom Line:**
  - **Insight into mental models enables organizations to develop strategies and communications tailored to those factors that most influence critical decisions.**

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CO Case Study

Research Purpose

Purpose:

- **To improve TSSA (client) understanding of Ontario homeowners' beliefs and underlying rationale concerning health risks associated with CO in the home, and the decisions homeowners make as a consequence of their mental models.**
- **Develop a research-based communication strategy to encourage homeowners to take appropriate action to reduce risks associated with CO exposure in the home. Such action will include annual maintenance of fuel-burning equipment.**
- **Approach: Mental Models Method.**

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Expert Model Definition

- **The Expert Model is an influence diagram illustrating an overall system.**
- **It offers a summary of important technical knowledge about key topics needed to inform decisions about them and illustrates the relationships of varying factors within that system.**
- **Working with the TSSA CO Team, Decision Partners developed an Expert Model - a picture of the system - of the context in which homeowners make decisions about reducing carbon monoxide risk in the home.**

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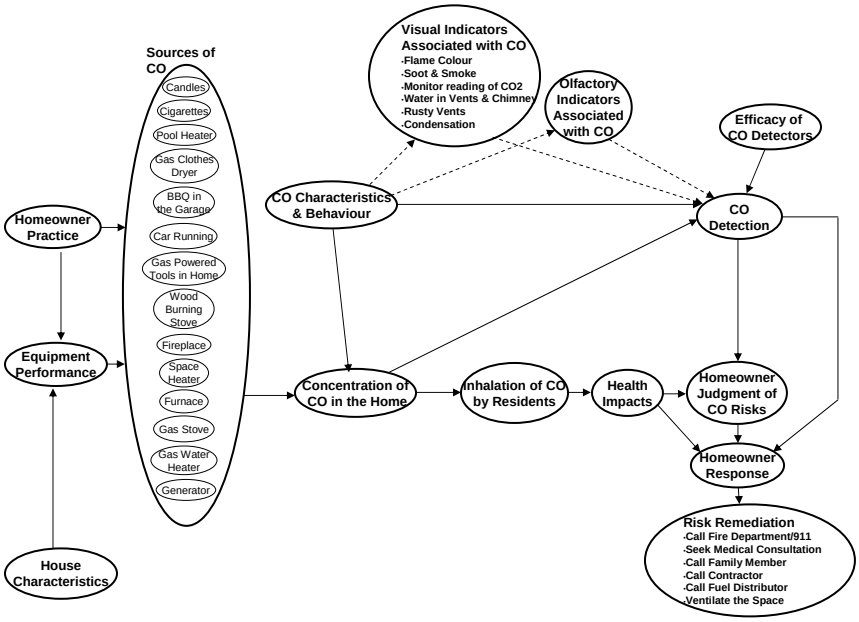
Simple Expert Model: Reducing Carbon Monoxide Risk in the Home



TSSA CO Research

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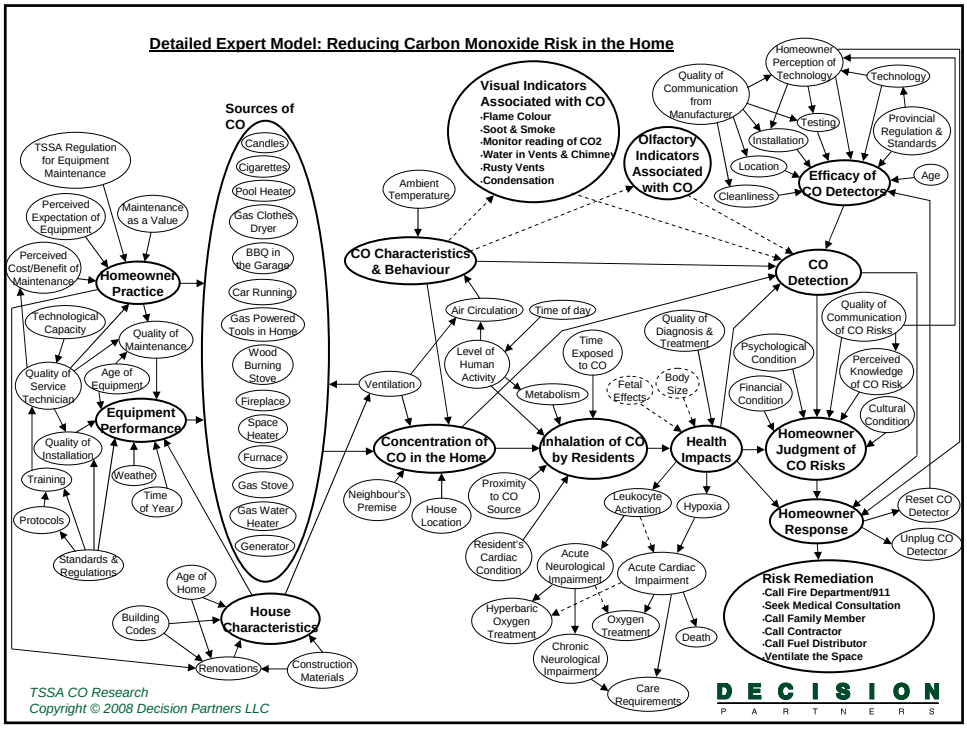

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Interview Protocol Topics

- **The protocol focused on the following areas:**
  - **General knowledge about CO, including CO characteristics and behaviour.**
  - **The specific sources of CO in the home and what causes those sources to produce CO.**
  - **The means of detection of CO in the home and the homeowner's response to detection.**
  - **General health impacts from CO exposure.**
  - **Communication about the risk of CO in the home.**

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Sample

- **Sarnia: 20 homeowners over 60 years of age.**
- **Greater Toronto: 20 homeowners over 60 years of age.**
- **Barrie: 20 homeowners between the ages of 20-40 who had owned their home for 10 years or less.**
- **The Sarnia and Toronto cohorts are referred to as 'seniors' throughout the report. The Barrie cohort is referred to as 'new homeowners'.**
- **Of the 60 interviewed, 25 were men and 35 were women.**

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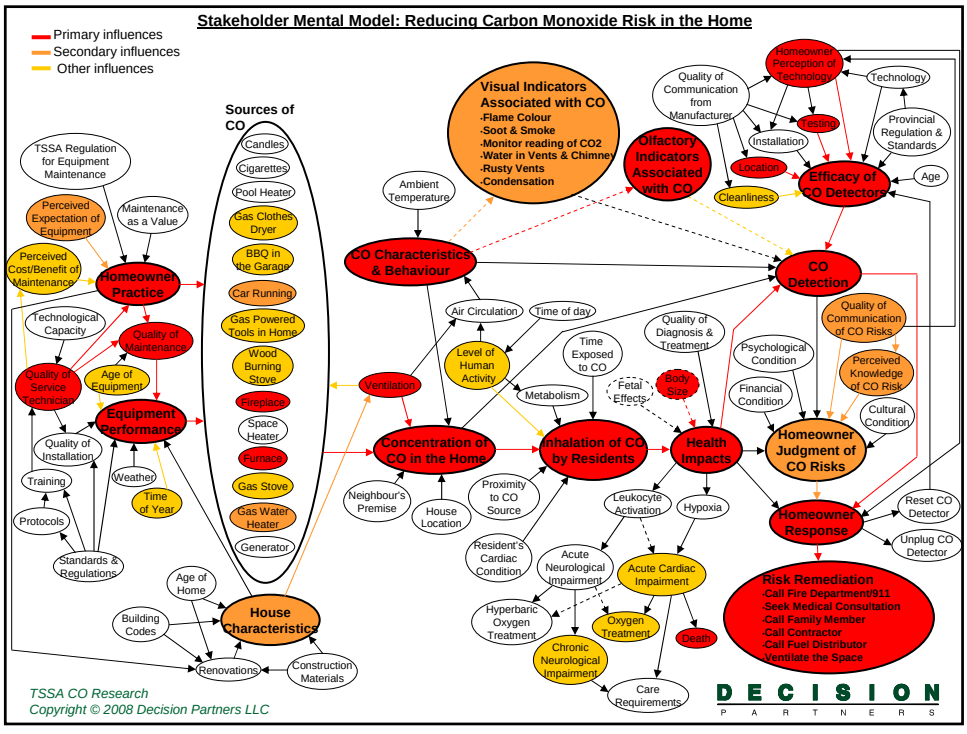

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Communication Strategy

Communication Goal:

- **To improve homeowners' ability (and that of other Communities of Interest) to minimize risks associated with CO exposure through strategic communication designed to enable well-informed risk decision-making on their part.**

Focused Strategies:

- **Seniors living in original homes.**
- **New homeowners.**
- **Cardiac patients.**
- **Fuel-burning equipment contractors.**
- **CO detector manufacturers.**

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Realizing the Value Potential

Decision Partners® provides advanced strategy, research and communications services for understanding and focusing decision-making.

An international team of management professionals and scientists, our methods draw from current understanding in the relevant academic disciplines, including decision science, risk perception, risk communication and marketing science.

Decision Partners® is the world leader in the use of expert modelling and mental models research to generate strategies and communications. For more information about Decision Partners, contact:

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Measuring Mental Models of Construction Management Decision-making

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Create the Future

Construction Management

- Dynamic decision-making environment (Sterman 1992):
  - Multiple interacting components (schedule, cost, resource distribution)
  - Interactions are non-linear
  - Multiple feedback loops
- Decision-making
  - Involves unexpected crisis scenarios
  - Goal is to mitigate impacts and meet schedule and budget goals

Problems

- Experienced managers are retiring
  - Void in expertise
  - “Don’t know what they know” - tacit knowledge
- Construction education and training
  - Focus on resource interactions
  - Limited focus on human-resource interactions and
  - Cognitive aspects of human decision-making

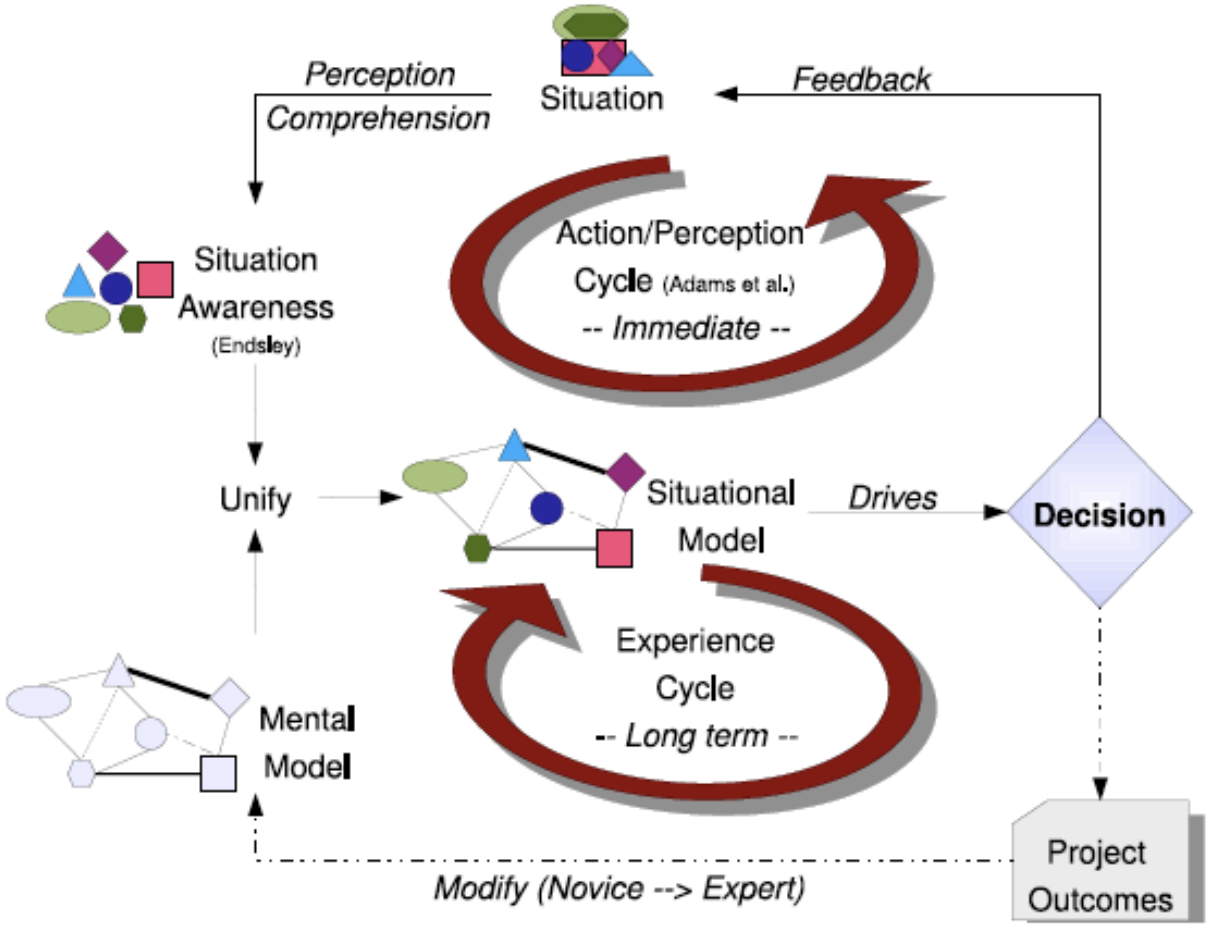
The Cognitive Approach

- Formally Explore Expert-Novice Mental Models
  - How do experts approach problem solving?
  - What involves the shift from novice to expert?
  - Can we formalize tacit expert knowledge?
  - Can we enhance construction education?

Theoretical Underpinning

- Expert-novice Cognition (Bransford et al, Chi et al.)
  - Experts recognize patterns, novices focus on particulars
- Mental Models
  - Dynamic models of individual organization of domain knowledge that driving decisions
  - More useful as qualitative representations
- Situational Awareness (Endsley 2000, Adams et al. 1995, Kirlik & Strauss 2006)
  - What is the role of situational awareness (SA) in effective decision-making?
  - Is SA a product/process?
  - Difficult to measure: based on constructs such as memory and perception

The Situational Model Framework



Formal Methodology

- Use a situational simulation test-bed to collect human decision-making data
- iCDMA - First Person CM Strategy Game: goal is to complete project in the face of fast developing scenarios

Formal Methods

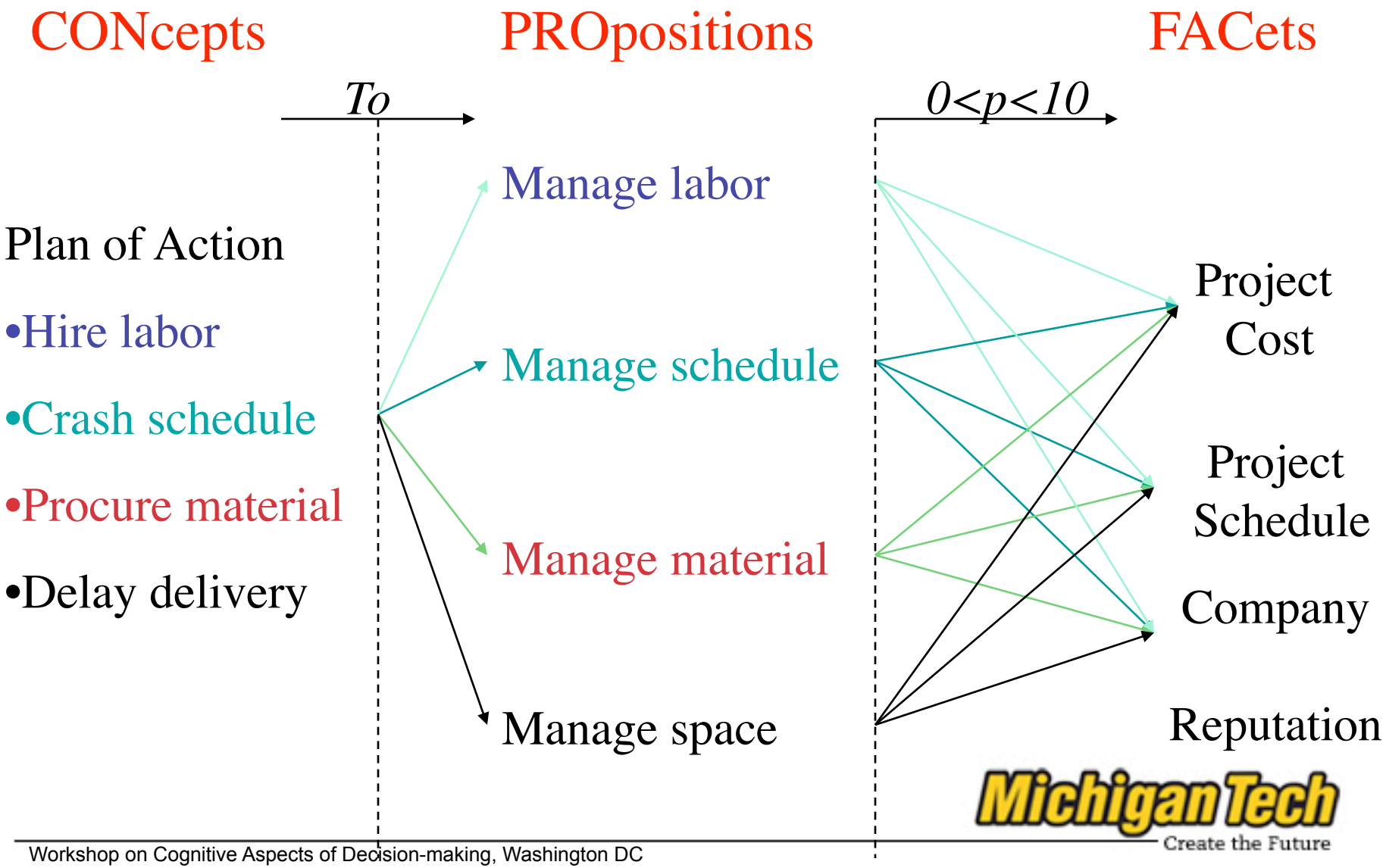
- Vary users and projects
- Formal Model
  - E_{t+1} = update(E_t,D_t)
  - D_t = SM(E_t)
- Pattern Recognition
  - {Set of Conditions} => {Set of Observations}

$$(\bigwedge_{x \in C} x) \rightarrow (\bigwedge_{y \in O} y)$$

  - Stochastic approach: Given a set of conditions, what is the most likely set of observations

$$\forall x, y | x \in C, y \in O : P(y|x) > P(y|\neg x)$$

Analysis: *CONPROFAC (Winn)*



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Quantitative Analysis: Structuredness Index

Qualitative Analysis: Responses

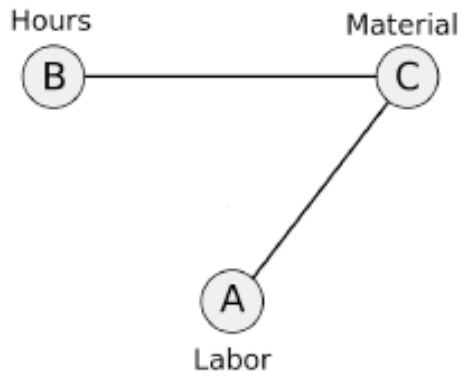
Plan of Action

- Hire labor
- Crash schedule
- Procure material
- Delay delivery

	Labor Mgmt	Schedule Mgmt	Material Mgmt	Space Mgmt
Project Cost	5+	5-	…	…
Project Schedule	…	…	…	…
Company Reputation	…	…	…	…

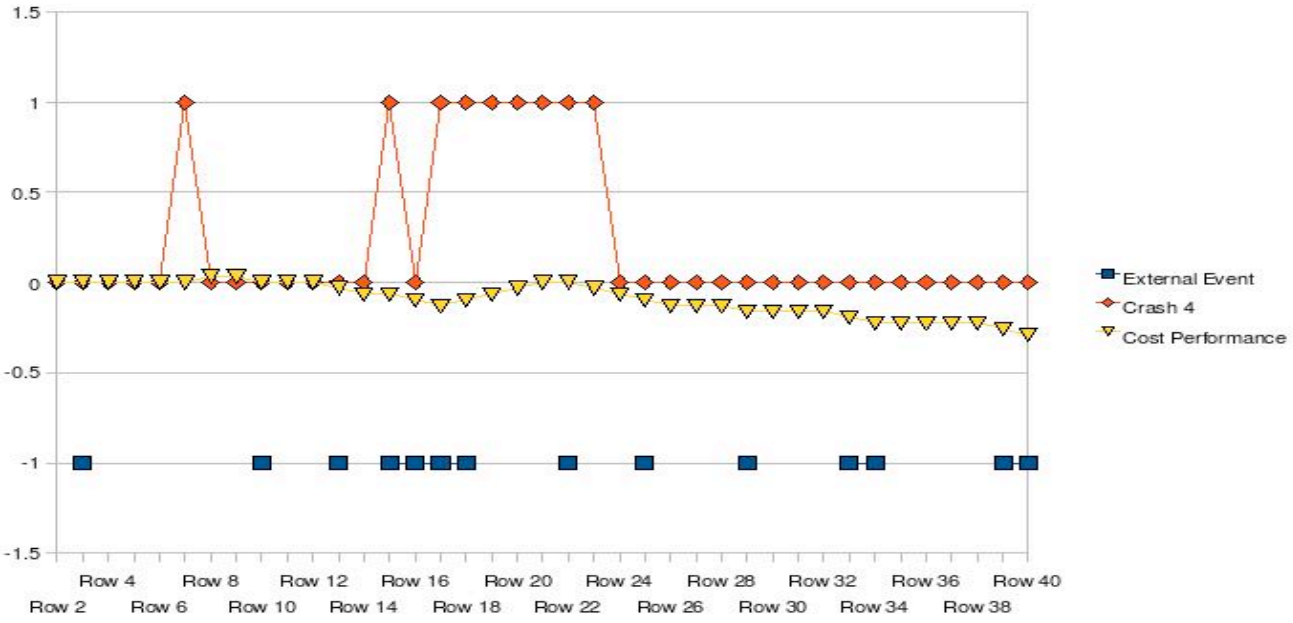
Graphical Models

- Develop Association models
- Assume decision variable interactions to be hierarchical



Temporal Analysis

- Impact of external events: Ability to mitigate
- Time between - impact, perception, action, reaction



Related Applications

- Mental models of risk perception and its impact on decision-making
- Individual mental models interacting within social networks and contexts to produce emergent behavior

Adoption of Green Construction Practices: ABM in Professional Networks

- Individual decision-making and emergent network behavior
- What construction delivery systems are most sustainable?
- How do individual mental models of decision-making interact within the context of professional networks?
- Can epidemiological models be used to model the the cognitive aspects of group decision-making?

Implications

- Towards a formal understanding of models of cognition underlying dynamic decision-making (Mukherjee et al. 2005, Watkins & Mukherjee 2008, Watkins et al. 2008)
- Development of adaptive simulation environments that aid human decision-making (Rojas & Mukherjee 2003, 2005a,b, Anderson et al. 2007)
- Furthering construction education
  - Situational simulations in the classroom as effective education interventions (Rojas & Mukherjee 2006)