A Mental Models Approach
To Strategic Risk Communication

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.
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.

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.
CO Case Study
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.
CO Case Study

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.
CO Case Study
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.
CO Case Study
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.

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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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
  – $E_{t+1} = \text{update}(E_t, D_t)$
  – $D_t = \text{SM}(E_t)$
• Pattern Recognition
  – \{Set of Conditions\} $\Rightarrow$ \{Set of Observations\}
  \[
  \left( \bigwedge_{x \in C} x \right) \rightarrow \left( \bigwedge_{y \in O} y \right)
  \]
  – 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)

CONcepts

Plan of Action
- Hire labor
- Crash schedule
- Procure material
- Delay delivery

PROpositions

- Manage labor
- Manage schedule
- Manage material
- Manage space

FACets

- Project Cost
- Project Schedule
- Company
- Reputation
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Workshop on Cognitive Aspects of Decision-making, Washington DC
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 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)