

Ill-Defined Goals: Implications for Planning and Decision Making

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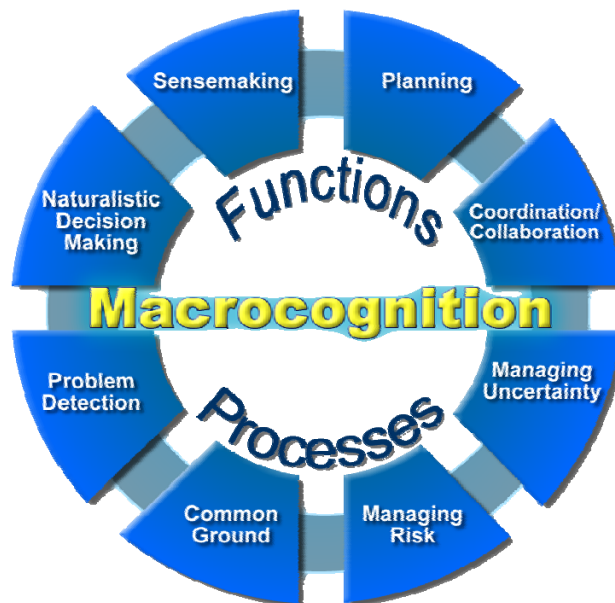


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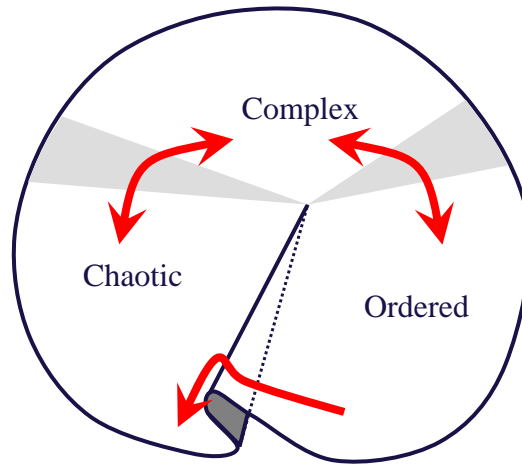
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Systems vary in Stability and Structure



Bolsot & Snowden (in prep)



Features of Naturalistic Decision Making





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Rational Choice Model of Decision Making

Evaluation Dimensions	Options		
	A	B	C
1	✓		
2		✓	✓
3	✓		
4	✓	✓	✓
Total	3	2	2

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Rational Choice Model of decision making

Evaluation Dimensions	Options		
	A	B	C
1	✓		
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3	✓		
4	✓	✓	✓
Total	3	2	2

Limitations

- Requires too much time
- Requires too much data
- Can result in worse performance
- Gaming the method
- Zone of Indifference



Zone of Indifference





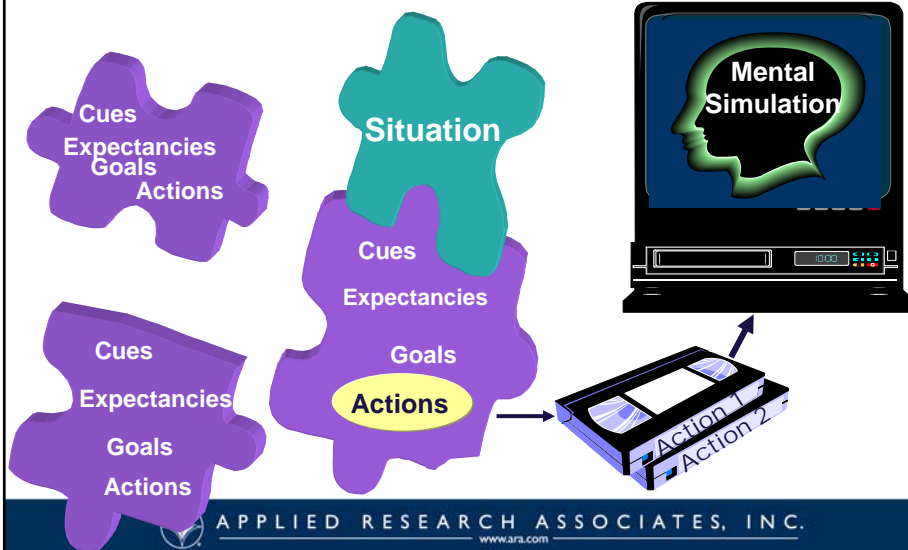
Fireground Decision Making Study



Experts - 23 years (N = 26)
Critical Incidents
Context Rich Natural Task
Dynamic - 5 changes/incident
Time Pressure - 78% of cases < 1 minute
Real Consequences



Recognition-Primed Decision (RPD) Model (Klein, 1989)





Key features of RPD Model

1. First option is usually workable
Not random generation
2. Satisficing
Not optimizing
3. Evaluation through mental simulation
Not Rational Choice
4. Focus on elaborating and improving options
Not choosing between options
5. Focus on situation awareness
Not Courses of Action
6. Decision maker primed to act
Not waiting to complete the analyses



Intuition + Analysis

Both intuition and analysis are needed for effective decision making:

- Intuition: Using prior experience to recognize situations
- The RPD model combines intuition and analysis





Implications for Decision Aids

Two theories of Decision Making

Multi-Attribute Utility Theory

Needs to support these process and functions:

- generate multiple COAs
- generate multiple evaluation criteria
- a way to weigh criteria
- a way to select a COA based on Utility Theory

Recognition-Primed Decision Making

Needs to support these processes and functions:

- ☞ generate 1 COA
- ☞ Support sensemaking to identify critical cues
- ☞ identification of relevant goals/dismiss irrelevant goals
- ☞ identification of appropriate expectancies/flag violations
- ☞ COA simulation/wargaming

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**Cognitive
Dimension**

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Management by Objectives

➤ Tenets of MBO

- Define objectives to start.
- Determine a path to that end state.
- Identify the tasks to move forward on that path.
- Prepare a time schedule for each task.
- Measure progress in moving towards the goal.



Decision Making Exercise: Taking a Stand

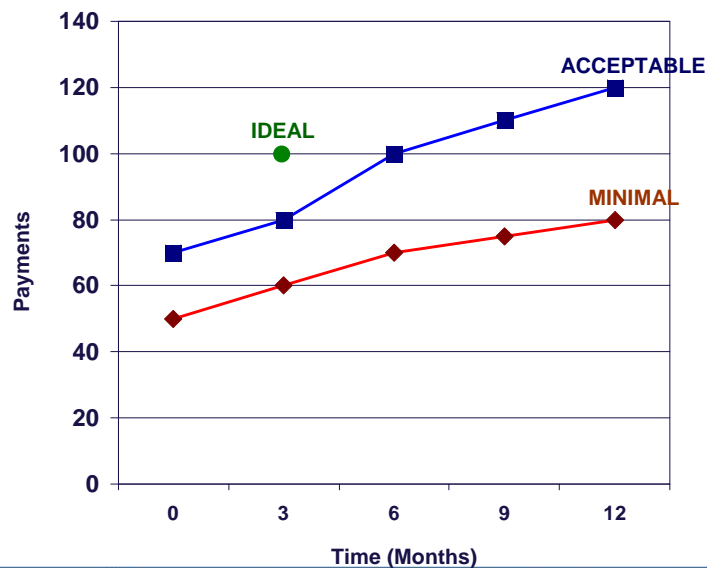
- **Role:** You are a manager at IMPART, a mfg company.
- **Background:** A large customer, George Johnson, is in arrears.
- **Situation:** Steve, your supervisor, is under pressure from HQ to clear up these bills. You tell him you have set up a meeting with George.
- **Steve's Intent Statement:** "I want this settled – paid in full – in the next 3 months."





Which of George's offers would you accept?

- I'll pay you 80% today, but that's it.
- I'll give you half now, half in 6 months.
- I'll give you 1/3 now, 1/3 in 4 months, and 1/3 in 8 months.
- Steve's Intent Statement: "I want this settled – paid in full – in the next 3 months."





Well-Defined Goals vs. Emergent Goals

➤ Well-defined goals:

- Paint these barracks with 2 coats of paint in 1 week
- Seize objective cobra by 1400 tomorrow

➤ Emergent goals cannot be defined in advance

➤ Emergent goals have to be discovered during the attempt to reach them (Klein & Weitzenfeld, 1978)

➤ Examples:

- Firefighters
- Free Iraq (OIF)
- Operation *Provide Comfort*
- Y2K



Wicked Problems (WPs) (Rittel & Webber, 1973; 1984)

➤ Solutions to WPs aren't true/false but good/bad

➤ There is no immediate and no ultimate test of a solution to a WP

➤ WPs have goal features that are incomplete, changing, sometimes contradictory

➤ Attempts to solve WPs often lead to a new and deeper understanding of the problem





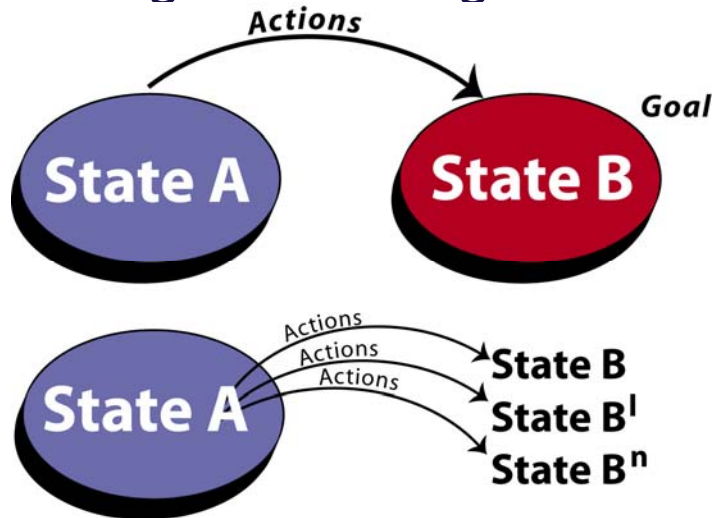
Operation Provide Comfort

"The mission was **continually changing**. We didn't just get instructions up front, look at the expected end state, and go and do it. We were **probing** our way through every stage—often thinking when we reached one stage that we were at the **end state**. **But** then we'd see other paths opening that we'd have to follow. Once we'd stabilized the refugees in the hills, we **realized** we had to move them out of the hills; then we **realized** we had to put them in a sustainable area; then we **realized** we had to bring them home; then we realized we had to protect them from the Iraqis. Tasks emerged from other tasks. **We were developing them as we went**. And we had **no idea** what the **end state** would be **until we got there**."

—Tony Zinni, GEN (Ret) USMC

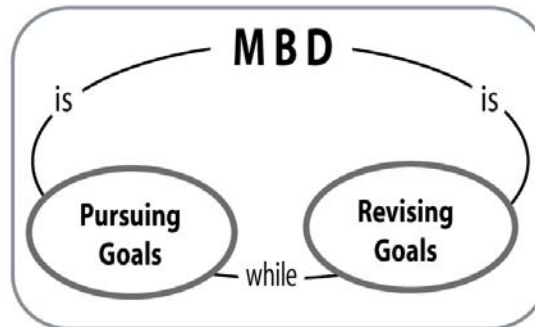


Planning with Emergent Goals





Management by Discovery (MBD) is revising goals as you pursue them



MBD helps you manage organizations, projects and people under unpredictable conditions -- when you can't nail down the goals and schedules.

MBD prepares you to re-frame and adapt as you go along.



Management by Discovery (MBD) builds on MBO

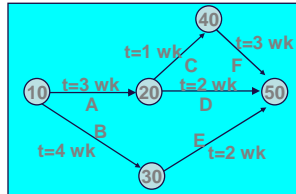
- **Define objectives to start.**
 - Then try to clarify and change those objectives based on what gets learned.
- **Determine a path to the end state.**
 - Then create alternative paths to keep options open while revising the end state.
- **Identify the tasks to move forward on that path.**
 - Prepare to add, combine, delete and reshuffle the tasks.
- **Prepare a time schedule for each task.**
 - Replace this with a contingency schedule as you learn more about interdependencies.
- **Measure progress in moving towards the goal.**
 - Make sure your deliverable is acceptable, valuable, and available when needed.
 - Prepare to negotiate about the goals throughout the project.



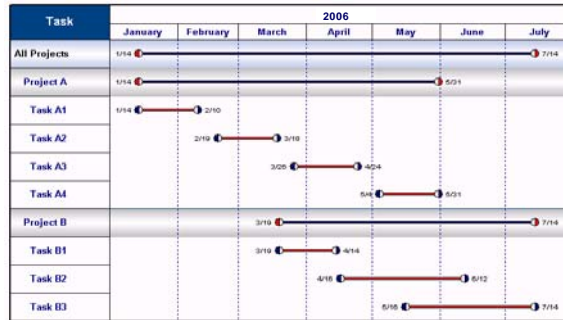


The Wrong Planning Tools

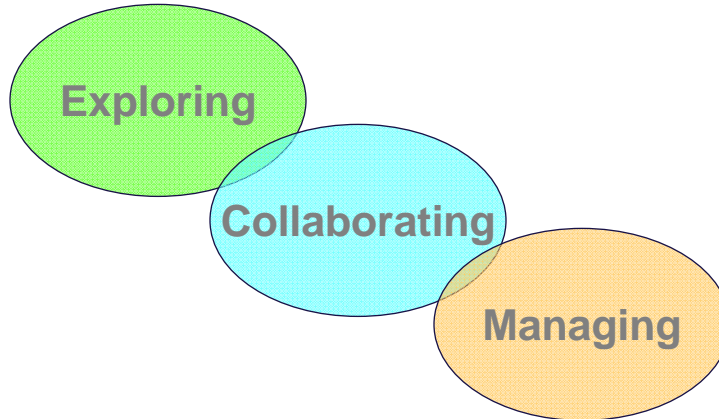
➔ **PERT charts**



➔ **Gantt charts**



MBD Tools Focus on:





MBD Spectrum

- **When the goals are clear**
 - MBD helps to understand goal tradeoffs.
- **When the goals are semi-clear**
 - MBD helps to take advantage of opportunities to learn more about them.
- **When the goals are ill-defined (wicked problems)**
 - MBD helps to make discoveries along the way about what you really need
- **MBD is a different mindset: Not “How to reach the goal” but “How to learn from failures and experiences what the goal really is.”**
- **Question: Who would you pick to handle a difficult mission under complex conditions?**
 - One you can count on to follow directions.
 - One who is most capable of making discoveries.

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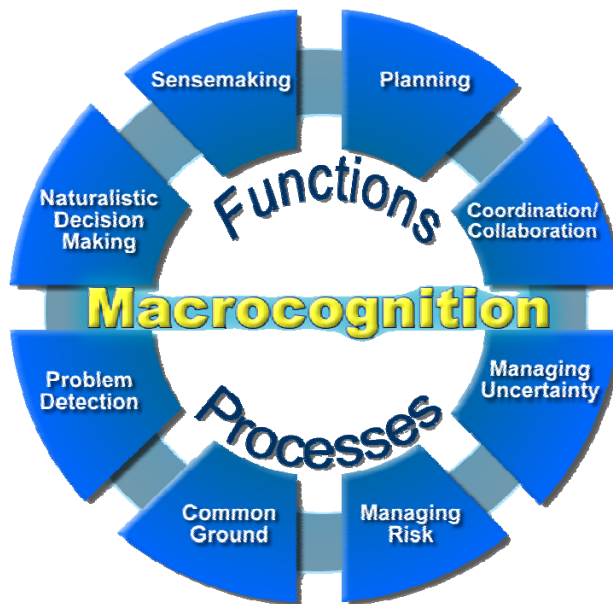


Implications for Planning

- **We drown the CDR in data, then offer aids to process these data (disconnecting the CDR from the situation), and wonder why CDRs won't use the systems.**
 - Fusion algorithms are proposed to handle the information explosion but these introduce their own uncertainty.
- **Our ability to obtain information has overwhelmed our ability to make sense of it.**
- **“Getting the right information to the right place at the right time” puts the focus on information. But the purpose of the information is better sensemaking and decision making.**
- **Traditional approaches work well when the system is well ordered – need new models for ill structured environments.**

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Concept of Management by Discovery (MBD)

- **MBD is a strategy for achieving desirable outcomes in the face of complexity, wicked problems, and ill-defined goals.**
 - “Desirable outcomes,” vs. “the desired outcomes.”
- **25-30% of programs/projects involve wicked problems and ill-defined goals.**
 - These are often the most critical and high priority efforts.
- **Management by Objectives (MBO) works best in well-ordered situations.**
- **Focus of MB/Discovery is on rapidly learning what the goals really are.**
 - Versus MBO which locks into reaching the initial goals.
- **MB/Discovery framework includes a set of tools to promote rapid learning and adaptation.**



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Contributions of CSE

- ⇒ **CSE is the effort to support the cognitive requirements of work.**
 - ⇒ Clarifies the cognitive requirements of the work.
 - ⇒ Helps to anticipate how the system will help/hinder that work.
 - ⇒ Brokers design tradeoff discussions.
 - ⇒ Describes the impact of design choices on the execution of cognitive work.
 - ⇒ Provides expertise about the way systems are used.
 - ⇒ Applies information, rather than managing it.
 - ⇒ Suggests cognitive measures.
- ⇒ **CSE tools**
 - ⇒ CTA methods, abstraction hierarchies, etc.
- ⇒ **Aspects of CSE**
 - ⇒ Identify the most important cognitive functions.
 - ⇒ Determine how these are performed.
 - ⇒ Determine why difficult and what kinds of errors are commonly made.
 - ⇒ Determine the types of tacit knowledge needed.





	Classical Plan/Execution	Flexible Execution
End State	Known	Unknown
Prior	Alternative COAs Contingencies	Alternative goals Potential actions Intent Statements
Commander Intent	Fixed	Continually Adjusted Shows Goal Priorities Shows Trade-offs
Strategy	MBO MDMP	Goals Seeking Actions -and- Actions Seeking Goals
Display	Progress	New Opportunities

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Milestone Planning

- ➔ **Flight plan in aviation:
Getting from Point A to
Point B**
- ➔ **Monitoring progress toward
goals only makes sense if the
goals don't change**
- ➔ **But: Point B may not exist**
 - ➔ Planning for ill-defined goals
 - ➔ Simultaneously solve and discover goal
properties



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Why is CSE useful?

- **Information technologies are intended to acquire and disseminate information.**
 - Information technologies will require information management.
 - But information management cannot be the output of information technologies.
 - Information technology applications must improve decision making and sensemaking.
- **And how will the system developers ensure that IT accomplishes this goal?**
 - That's where CSE is required.
 - How the developers can be confident that the system will effectively support decision making and sensemaking, particularly in challenging situations?
- **ROI for Cognitive Systems Engineering**
 - Improved performance
 - Time and money
 - Likelihood of system acceptance

