THE PROCESS OF SENSEMAKING IN COMPLEX HUMAN ENDEAVORS

Celestine A. Ntuen, Ph.D
Distinguished University Professor
The Army Center for Human-Centric C2 Decision Making
ntuen@ncat.edu
http://gandalf.ncat.edu/ihms
+1-336-334-7780 (X531): phone
+1-336-334-7729: fax

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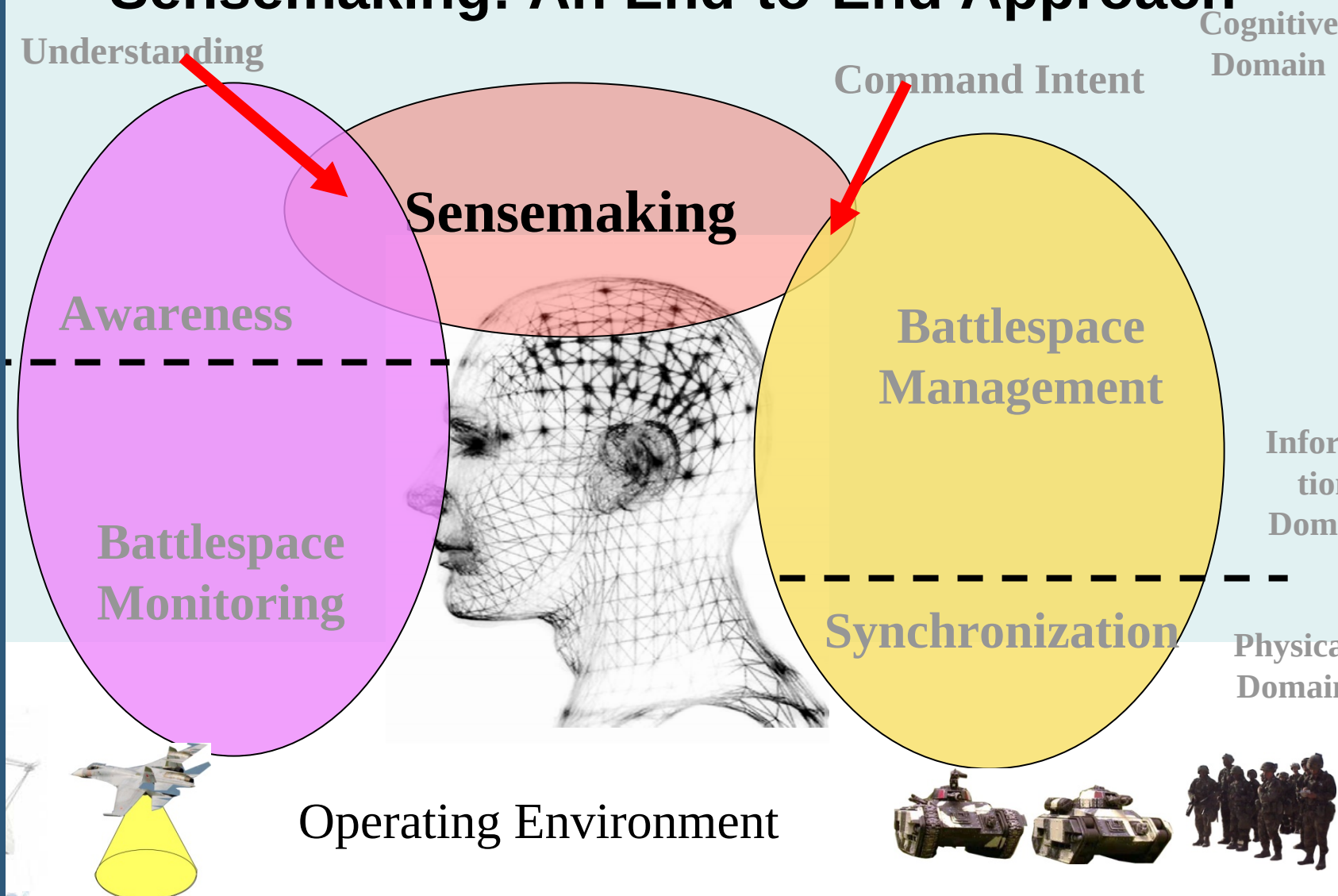
Presentation Outline

1. Introduction
2. Sample human endeavors in sensemaking tasks
3. Some models of sensemaking process
4. Suggested stages of the sensemaking process
5. Summary and conclusions

Sensemaking Challenge

To create a *systematic*, *widespread* and *persistent* **Cognitive Edge** for the warfighter

Sensemaking: An End-to-End Approach



Adapted from "Understanding Information Age Warfare" (CCRP, 2001)

Search is the mind's eye,
But sensemaking is the mind's muscle.

Stuart Card
PARC

Collection without sense-making, both automated and human,
is both wasteful and falsely reassuring.

Robert David Steele, CEO of OSS.Net, March 25, 2006

What is sensemaking?

DERIVING MEANING FROM FRAGMENTARY CUES– (DARPA'S Information Awareness Project

COLLECTING "DOTS" and BRIDGING MEANING TO HUGE VOLUME OF DATA---INQ-Tel (Arlington-based company).

A SYSTEM OF ACTIONS, SYMBOLS AND PROCESSES THAT ENABLES AN ORGANIZATION TO TRANSFORM INFORMATION INTO VALUED KNOWLEDGE WHICH INTURN INCREASES ITS LONG-RUN ADAPTIVE CAPACITY – (Schandt, 1997; pp. 8)

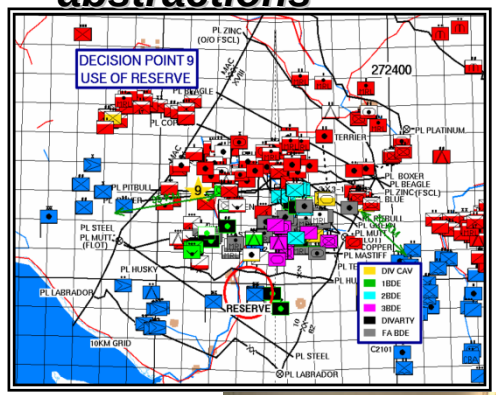
SAMPLE HUMAN ENDEAVORS IN THE BATTLE COMMAND SYSTEMS

Collaborative Sensemaking

Individual Situation awareness

Fighting the enemy

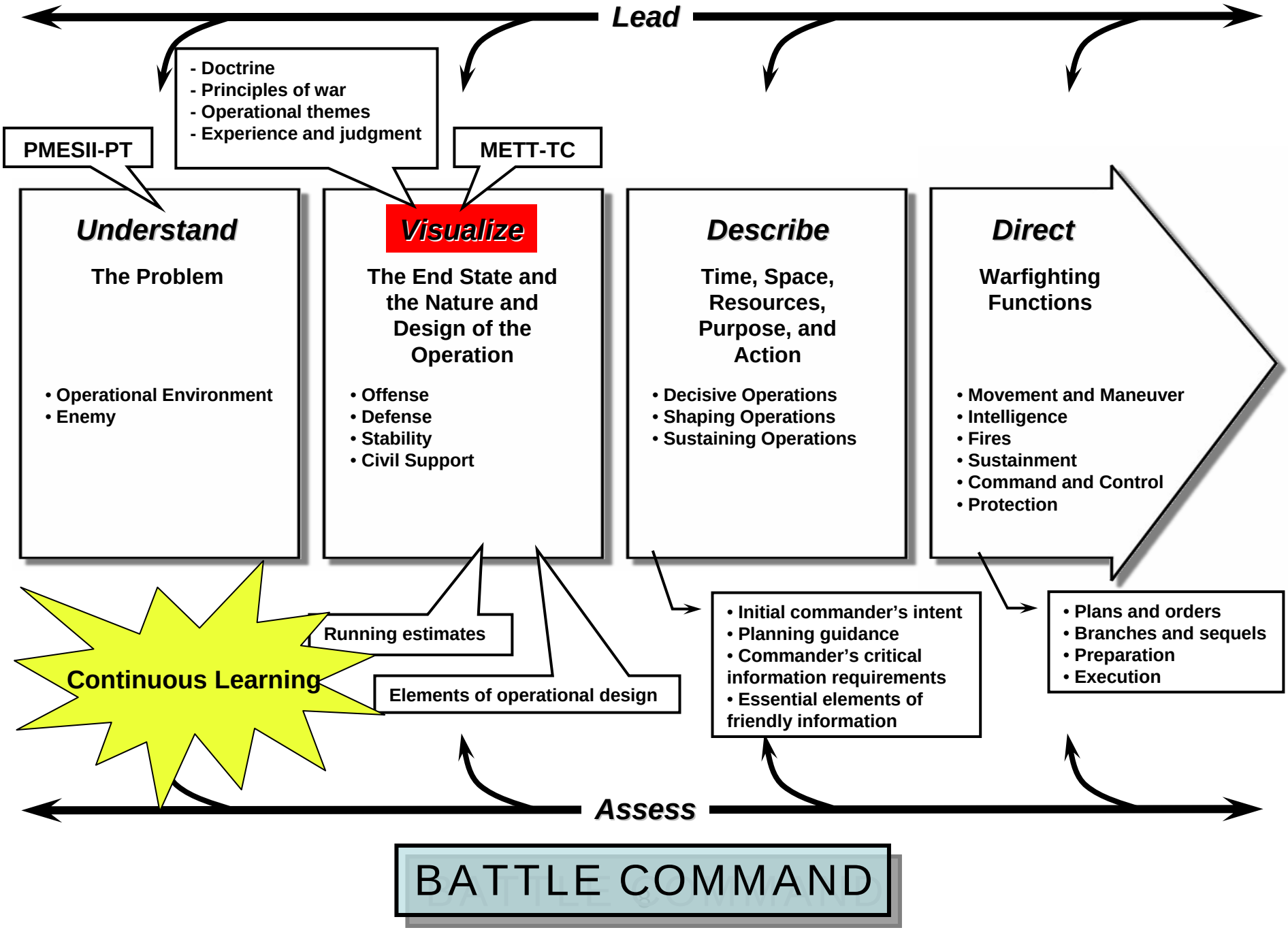
Training with abstractions



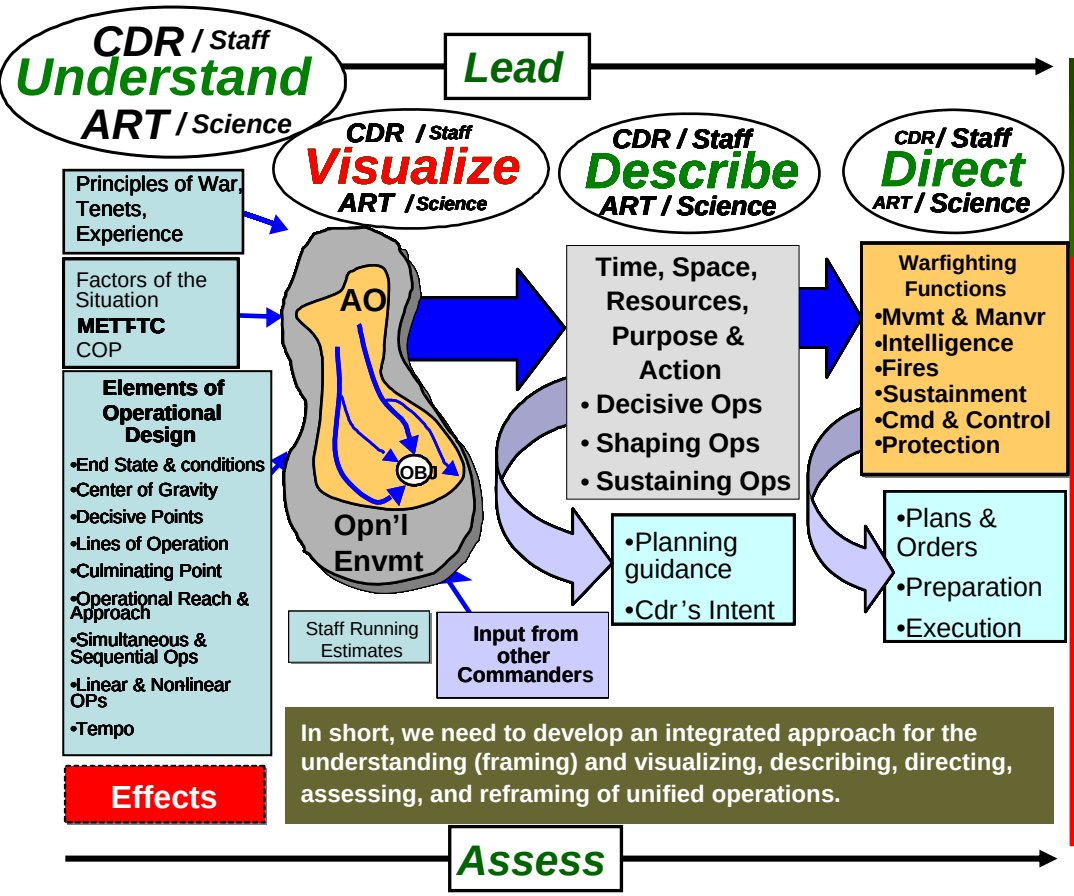
Team decision making at the TOC

Intelligent gathering

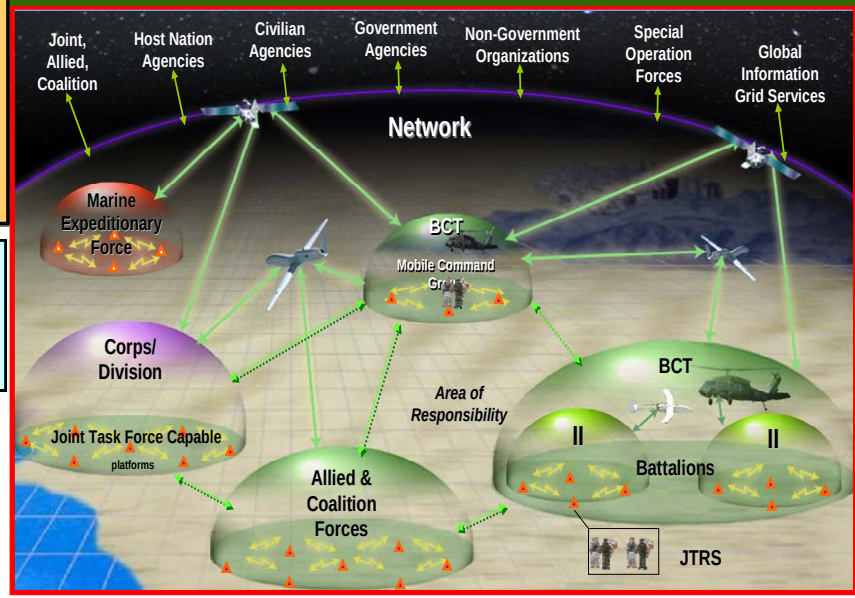
Civil affairs: Negotiation with local tribe leaders


Lead
- Doctrine
- Principles of war
- Operational themes
- Experience and judgment
PMESII-PT
METT-TC
Understand
The Problem
• Operational Environment
• Enemy
Visualize
The End State and the Nature and Design of the Operation
• Offense
• Defense
• Stability
• Civil Support
Describe
Time, Space, Resources, Purpose, and Action
• Decisive Operations
• Shaping Operations
• Sustaining Operations
Direct
Warfighting Functions
• Movement and Maneuver
• Intelligence
• Fires
• Sustainment
• Command and Control
• Protection
Continuous Learning
Running estimates
Elements of operational design
• Initial commander's intent
• Planning guidance
• Commander's critical information requirements
• Essential elements of friendly information
• Plans and orders
• Branches and sequels
• Preparation
• Execution
Assess
BATTLE COMMAND

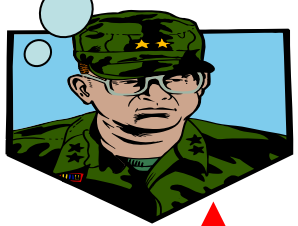
The *Art* and *Science* of **Battle Command**



LandWarNet provides the full spectrum of connectivity – from the deployed Soldier to Home Station Operations Centers, National/Strategic Intel Centers and Logistic Support & Sustainment locations – encompassing Joint, Interagency, and Multinational capabilities.



What is happening there?
What next?
When did (will) it happen ?
What should I know?



The Situation

Gun fire reported

Just after Friday prayer at Najaf

Most human endeavors are centered on human information processing with the aim of making sense of information available

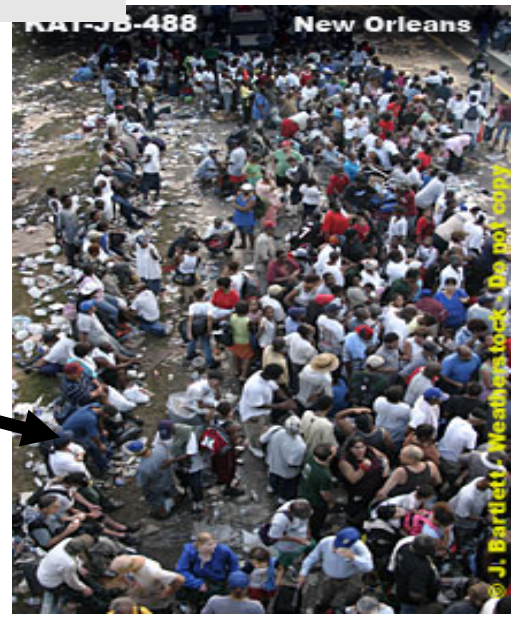
Sensemaking

Situation Awareness Enabled by Display & Visualization

Situation Understanding

1. Adversary characteristics identified
2. METTC-TC mapped to tasks
3. Actionable knowledge inserted into execution-monitoring loop

HURRICAN KATRINA



Transportation Modality
Emergency Routing
Location of facilities
Availability or resources

VICTIMS:
Food
Shelter
Medicine
Sanitation
Water
Communication

Most human endeavors requiring sensemaking behave like complex adaptive systems

Ambiguity and surprise.

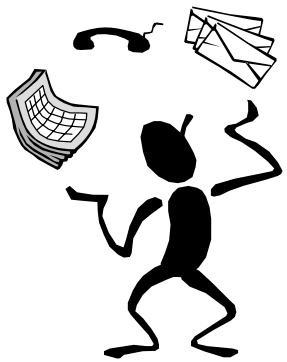
Uncertainty.

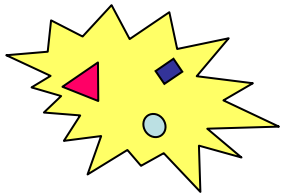
Equivocality.

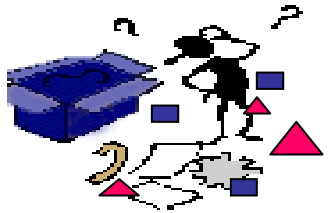
Limited rationality.

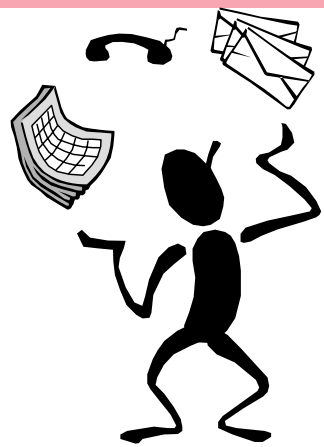
- "In a world that is complex and unknowable, sensemaking is all there is." (Reuben McDaniel)

Reality	Unexpected	Retrospection	Reality Creation



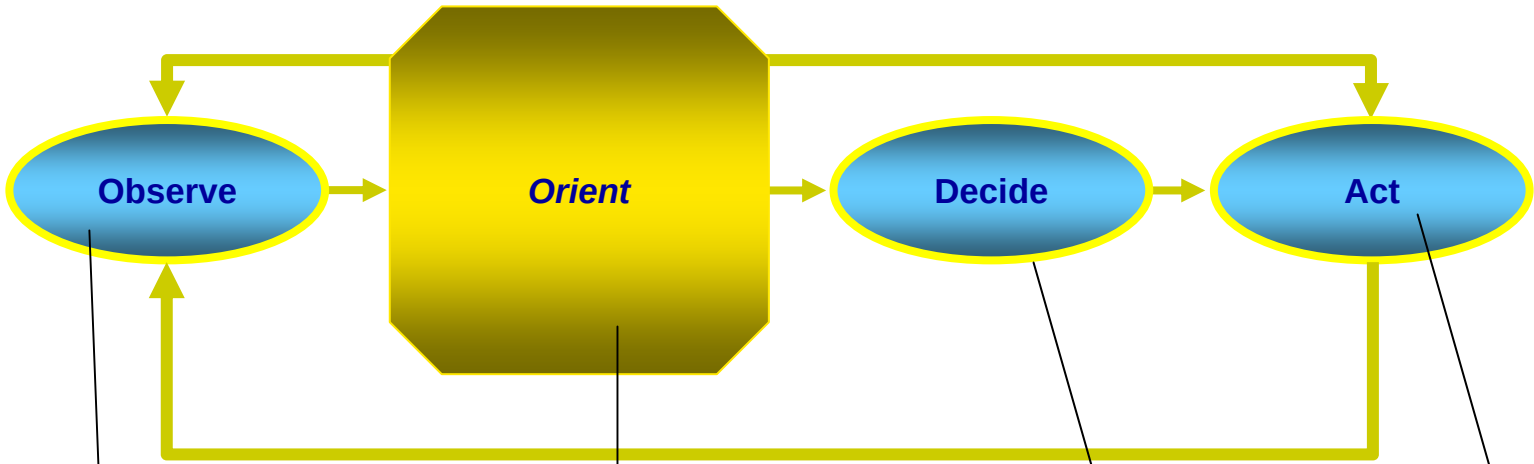






SOME MODELS OF THE SENSEMAKING PROCESS

OODA MODEL (BOYD, 1987)

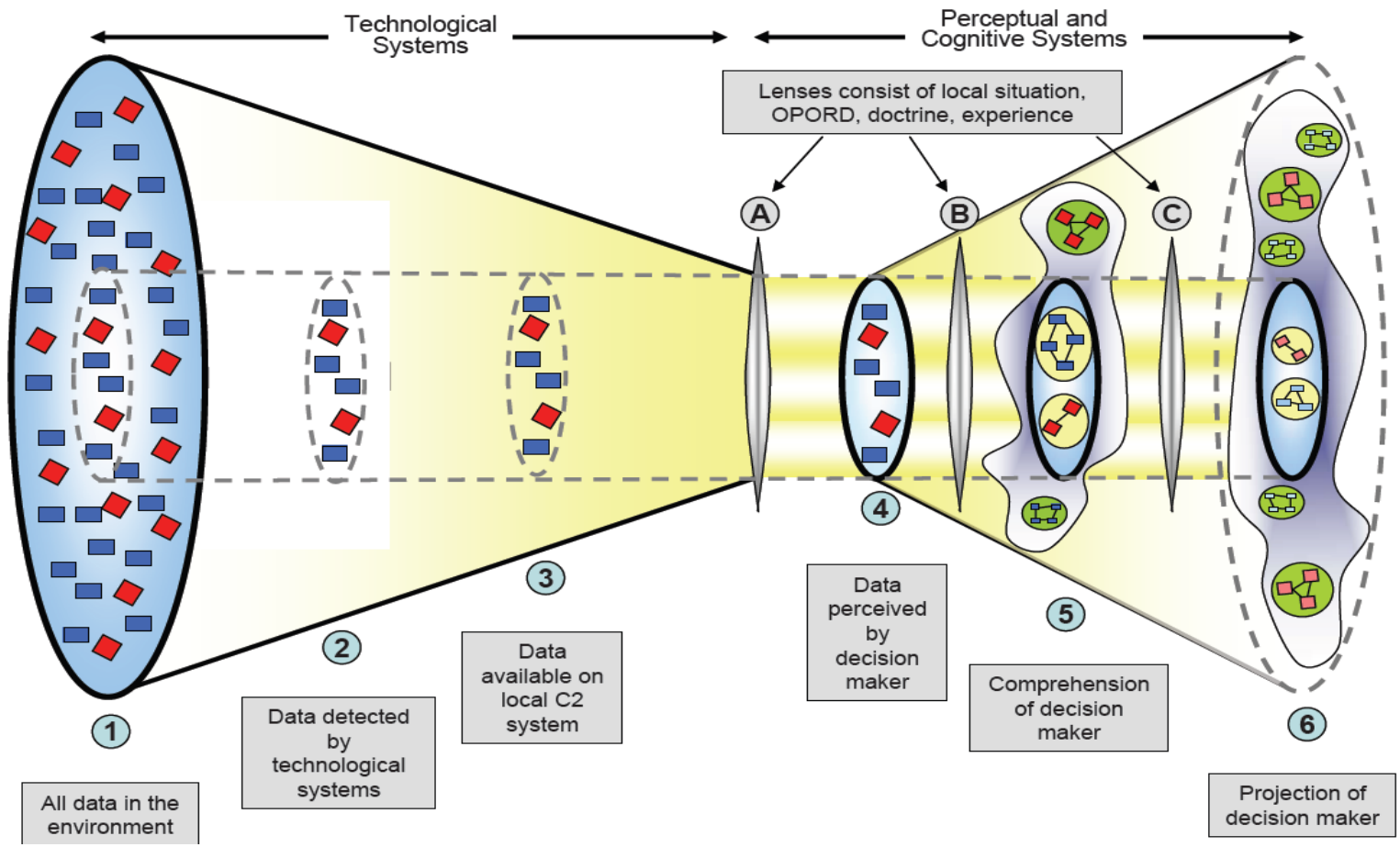


Observation: Data/information collection

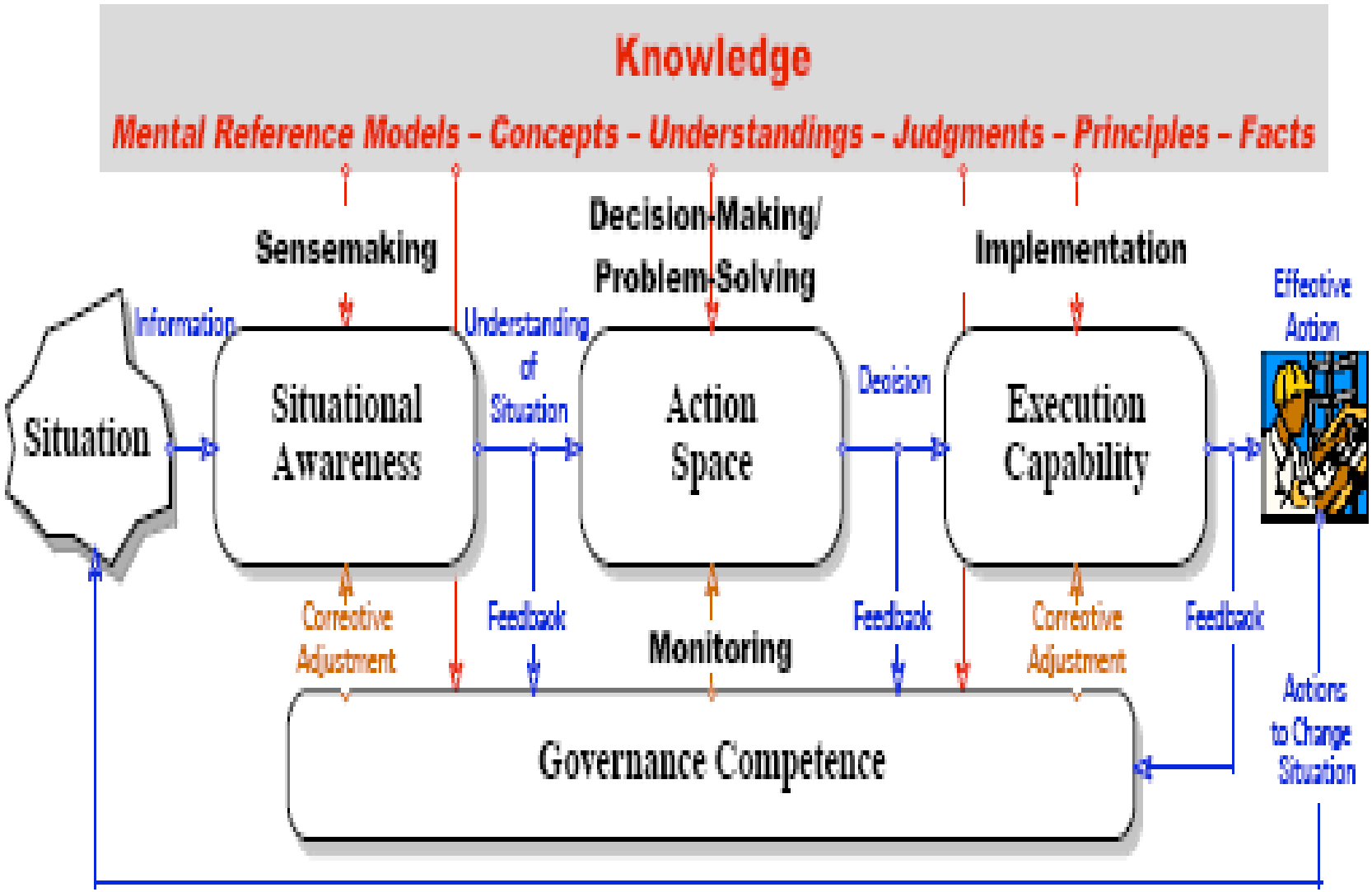
Orient: Data-Information-Knowledge-Wisdom Most Sensemaking Process here

Decide: Select COA Nominate execution

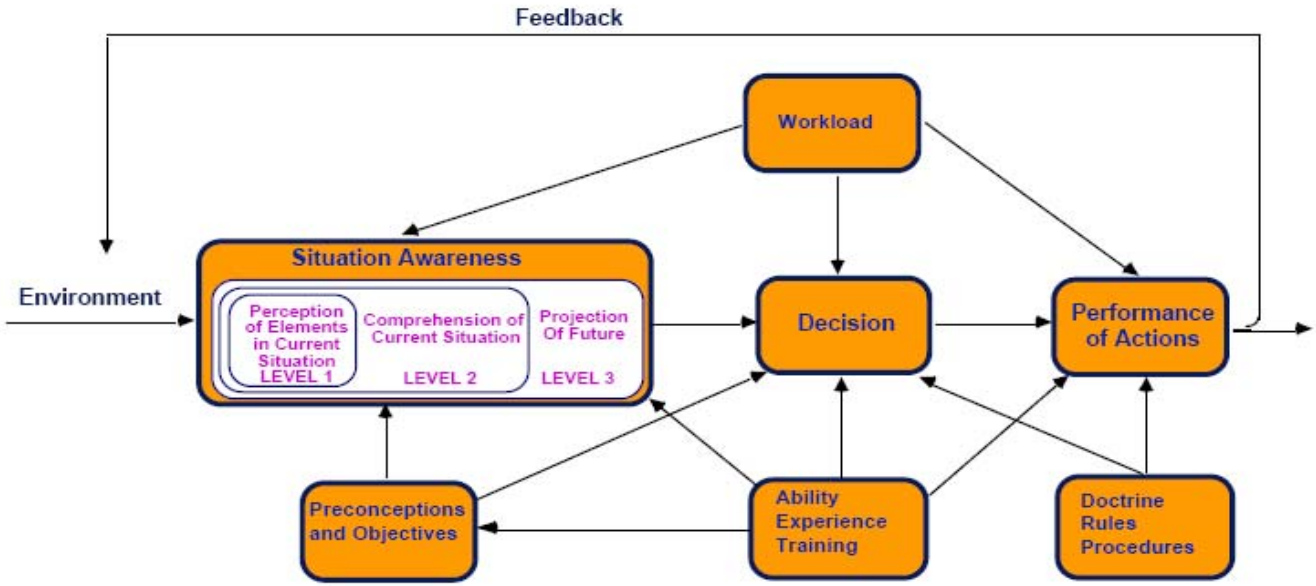
Act: Execution/ Evaluation



Dynamic Model of Situated Cognition (Shattuck/ Miller , 2004)



Situation handling Model (Wiig, 2002)



Situation Awareness is the Perception of the Elements in the Environment within a Volume of Time and Space, the Comprehension of their Meaning, and the Projection of their Status in the Near Future. (Endsley, 1988)

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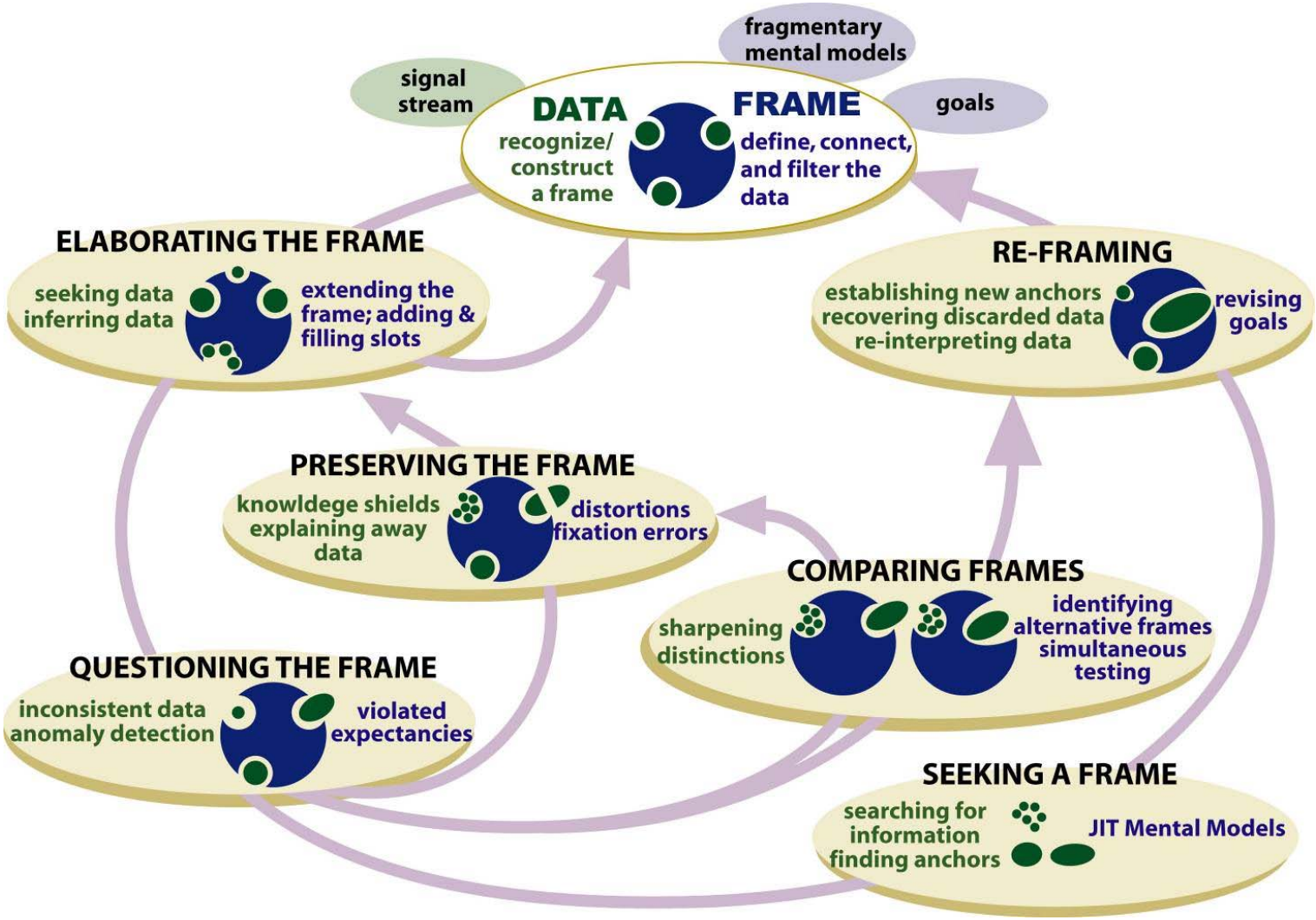
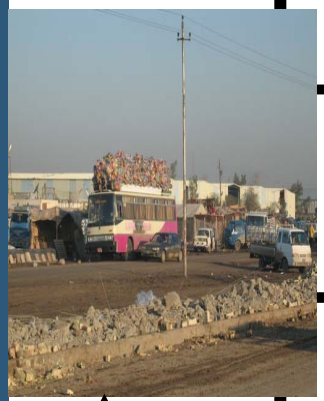
Situation Awareness, Endsley, 1995)



Data / Frame Model, Sieck, et al., 2004)

SUGGESTED STAGES OF THE SENSEMAKING PROCESS

Preamble to defining sensemaking tasks



Situation framing based on dynamic goals

Search for relevant information cues

Map or cluster information based on similarity or variations

Search for meaning in the pattern

Determine conditions For information comprehension

Interprete information relevance to goals

Create a subset of situation understanding

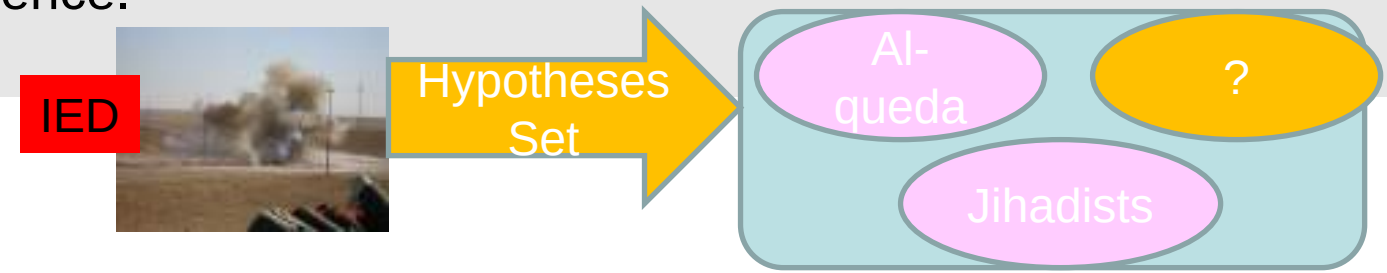
Connect understanding models to action

8 steps to sensemaking process

1.Situation Framing

- To conceive information structure about the problem context.
- Form hypotheses and guesses.
- Impose beliefs on situational information.
  - Retrospective cognition
  - Arguments
- In both cases, sensemaking is an effort to tie beliefs and actions more closely together as when arguments lead to consensus action during team problem solving.

- Problems: Failures in framing a set of hypotheses about a context can be attributable to atypical beliefs, bias, and stereotypes. These attributes can block our ability to see things in the same fixed frame of reference.



2. Searching for Cues

- A signal, symbol, or sign used to prompt information on events.
- A cue is used to contextualize clues about a problem, such as:
  - Linkages, patterns, relations, characteristics.
- A cue can be used to inform through noticing, alarms, warnings, etc.
- A cue-guided search can be used--a bottom-up search which uses information cues as an initial data frame.
- A recognition-primed decision relies on the decision maker's ability to recognize cues or familiar objects (Klein, 1989).
- Problems: (1) confirmation failure—information processing state whereby the existing information space does not match or correlate with the information in our memory; (2) wrong assumptions or hypotheses which are contradictory to the existing evidence,

3. Information Mapping

- Matching information available to clusters or hypotheses sets.
  - The mapping process can include link maps, conceptual maps, free body diagrams, decision trees, and semantic diagrams
- Can use several analytical techniques:
  - Pattern recognition
  - Dynamic conceptual maps
  - Mental model (high level cognition)
- Problems: (1) miss classifications and false alarms; (2) wrong and/or incomplete conceptual lists; (3) poor associations and relationship assignments

- See example in the next slide

Gun fire reported

Just after Friday prayer at Najaf

Insurgents inside the Mosque

Insurgents at the roof top of the Mosque

Insurgents embedded in the crowd

Attention to draw Coalition forces

Coalition force engaged with insurgents

Most likely Based on history

Civilians are combatants

Deception, there is a plan to attack

An ongoing operation

Ignore

Respond

Ignore/ Talk to Emir

Ignore

Respond

Sample cognitive map of reported event

4. Search for Meaning in Information Pattern

- Meaning is tied to a specific context and search of how one concept relates to, influences, or allows sensemakers to gain a first level interpretation of the big picture.
- As an epistemological construct, meaning is a subtle, loose, and diverse assignment of definition to a knowledge token, object, or artifact. In this respect.
- Berkeley (1710) notes that meaning exists in one's mind, and is often difficult to explain it.
- Meanings are embedded in language through description (Macdonald, 1995)--implying that meaning cannot be absolute or objective in the positivist sense (Ambrosini, 1998).

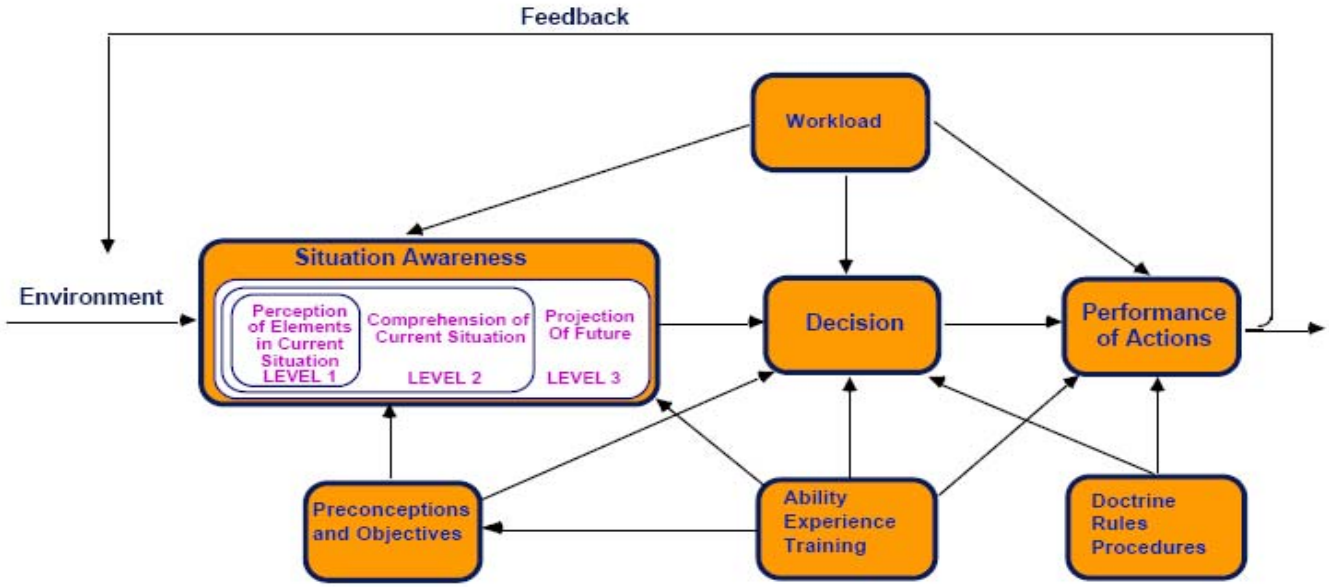
4. Search for Meaning in Information Pattern

•Problems: When patterns are irregular in form, or when we can not predict the conditions when and where an information pattern repeats itself;

• We can encounter gestalt type errors leading to sensemaking failures.

•An example may be arresting a wrong person in the IED bombing case and latter exonerating the person with better evidence from DNA analysis.

5. Information Comprehension



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5. Information Comprehension

- Comprehension is a meta-cognition task explicated in the context of a work domain.
- In a sensemaking task, comprehending a situation is synonymous to "being aware" of the situation.
- During a comprehension task, *"changes in the environment will often be met by an updating of the current schema by a subconscious reaction to cues or a consciously expressed intention (Rasmussen, 1986; pp.151)."*
- Problems: Kelly (1955) defined this phenomenon in terms of personal constructs, an individual's organization of unique mental models (in the form of rules) of the world that are both shaped by prior experience and are used to interpret new experiences. It is the main source of cognitive dissonance in collaborative sensemaking situations

6. Interpreting Information Relevance to Goals

- Interpretation reflects an approximation of these individual opinions.
- Interpretation can lead the sensemakers to discover the possible knowledge states required for intended actions.
- Feldman (1989) views sensemaking as an interpretive process that is necessary for *"organizational members to understand and to share understandings about such features of the organization as what it is about, what it does well and poorly, what the problems it faces are and how it should resolve them*."
- The act of interpretation may take the form of explicit sensemaking through communication; it may also take place through the transformation and integration of representation of selected information within the defined context (Suthers, 2005).

- Problems: The key challenge is, however, is minimizing the variance in a diversity of meanings accorded the object of interest with its different interpretative viewpoints (Malhotra, 2001).
  - all forms of subjectivity—opinions, estimates, guess, and so on; leading to the so called problem of equivocality or diversity of viewpoints.

Iraqi invasion: jubilation or protest?

7. Creating a Subset of Situation Understanding

Situation Understanding: Is the application of human intuition, judgment, and cognitive aided models to comprehend a dynamic information space with different scales of complexity with the goal of

(a)determining the center of gravity of the problem (e.g., identifying adversaries),

(b) being aware of the significance of information relevant to mission, and

(c) adapting the available information and experience to new and evolving problems

7. Creating a Subset of Situation Understanding

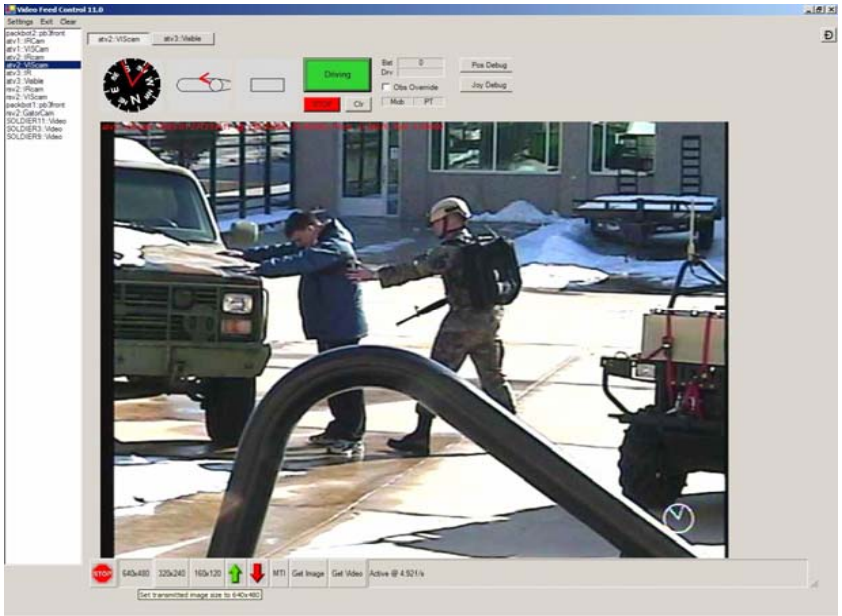
•If a certain pattern of information has been encountered previously the sensemaker will likely recognize that pattern and make the connection quickly.

•Accordingly, Polanyi's (1967) definition of focal knowledge can be used to infer how individuals assign meanings to what the see and feel.

•As echoed by Malhorta (2001), *by understanding a situation, we can form the conceptual link between information available and the expected result or anticipation of task outcomes. It could also help us to understand the gap between performance expectations based on information in context (Malhorta, 2001; pp. 120).*

8. The State of Actionable Knowledge

•Connecting situation understanding to task executions required to deliver effects.



SUMMARY AND CONCLISIONS

1. Sensemaking is a cognitive task and a complex human endeavor.
2. It is a knowledge intensive process that involves many multivariate activities such as data mining, diagnostic reasoning with approximate/ plausible explanations, etc.

3. Usually lacks any formal procedure.

4. A sensemaking process is an attempt to provide a procedure to help in:
   - (a) A computational representation & a recipe
   - (b) A common ontology framework
   - (c) Modeling and simulation of sensemaking contexts

SENSEMAKING

It would sure be nice if we had some clear idea what it was we were trying to do first