



Information Exchange and Display in Asynchronous C2 Group Decision Making

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Collaborative Research Shows



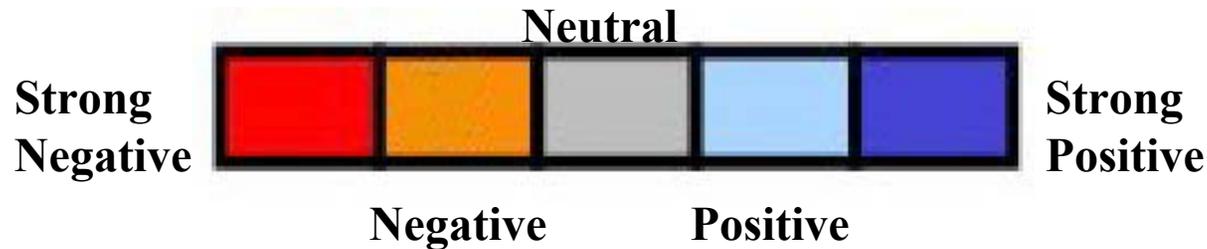
- Sharing of information is difficult:
 - Sender doesn't know:
 - Who knows what
 - Who needs what
- Processing shared information is difficult:
 - Recipient has significant cognitive burden just processing the information he finds
 - Information received from other participants is therefore often discounted/discarded



Sample Decision Task

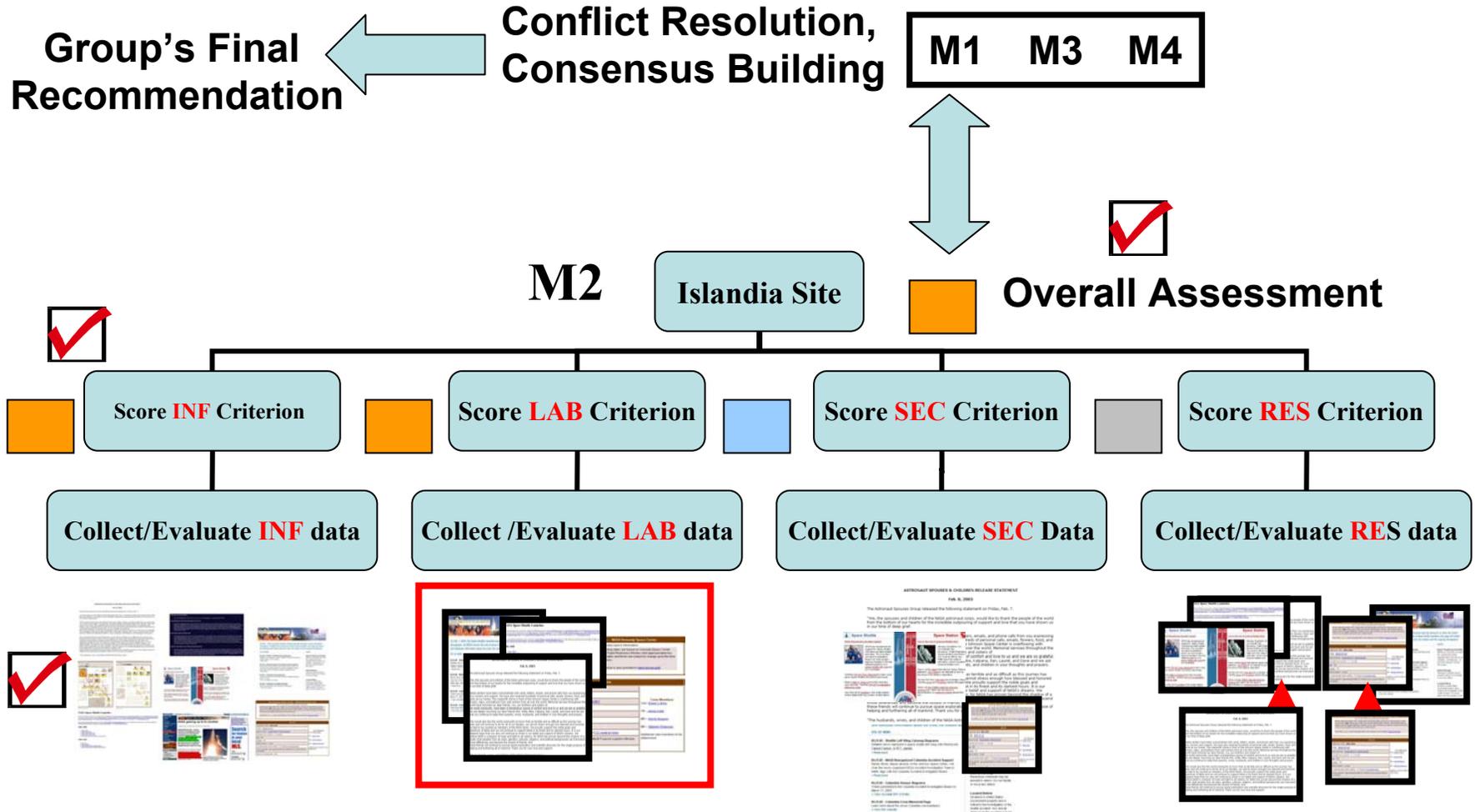


- Four staff/intelligence personnel asked to assess Islandia as site for a refugee camp. Make one of these recommendations:

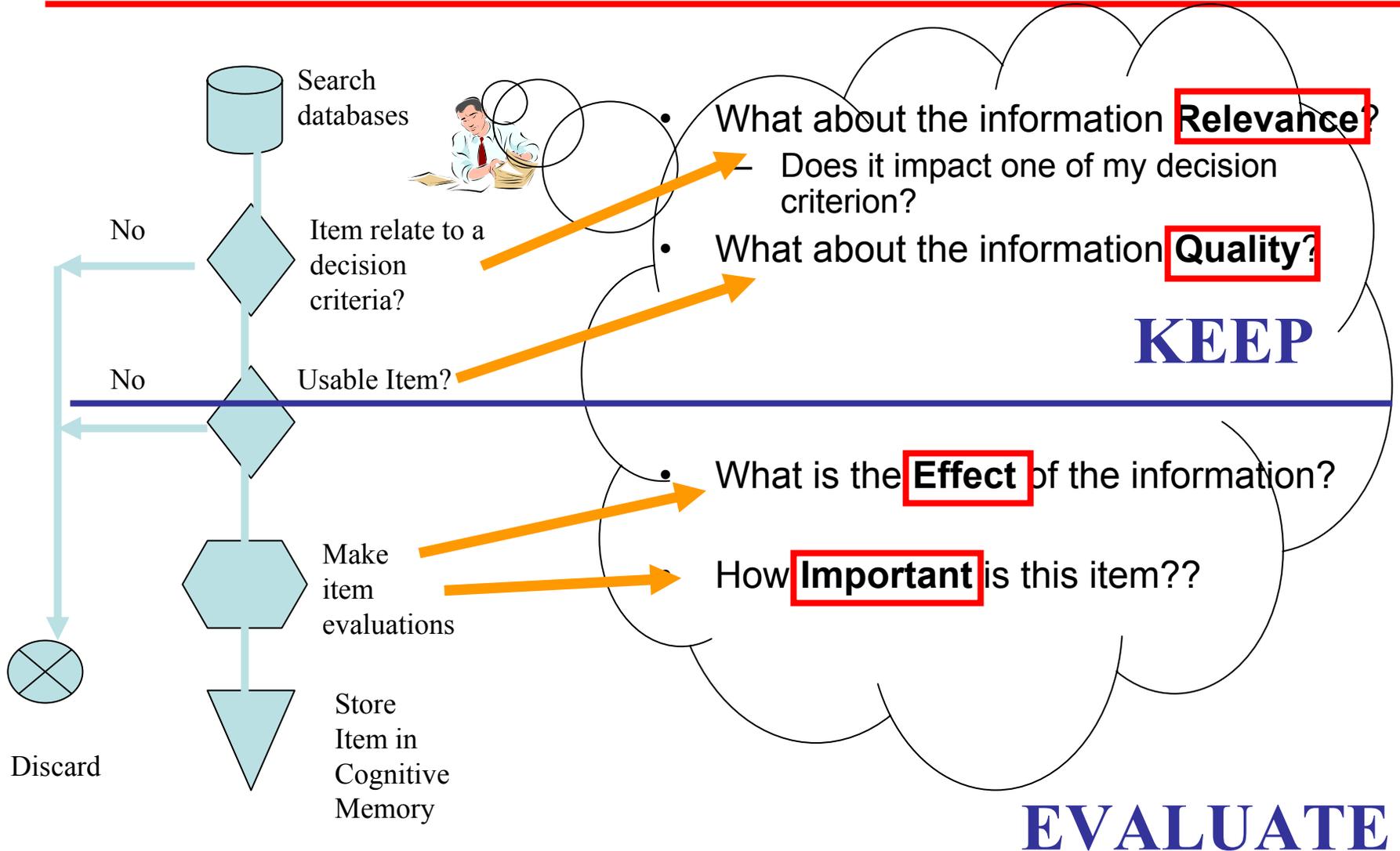


- Base recommendation upon these criteria:
 - Islandia's Infrastructure (INF)
 - Available Labor Pool (LAB)
 - Local Security Force (SEC)
 - Impact on our Resources (RES)
- Group is Distributed (D.C. to Japan)
- Recommendation needed by 1600 tomorrow

Decision Sequence (member M2)



An Analyst's Review & Selection of Information Items





Cognitive Abstractions



- The analyst has performed a set of cognitive information abstractions on each retained item.
- These abstractions are not formalized or made explicit but rather remain in cognitive memory.
 - They are **not** available for exchange between group members
 - **What is exchanged are the information items, not the information abstractions.**



Hypothesis:

- One approach to the reduction of this cognitive burden would be to:
translate the cognitive abstractions into a structured graphical representation.
- Expected Result:
 - Formalize/Standardize the abstraction process
 - The abstracted information could be encapsulated into readily understandable and transferable iconic symbology, resulting in:
 - **More Information being exchanged and used**
 - **Improved individual and group decision making**
 - **Faster conflict resolution/consensus building**

Group will have significantly improved **Shared Mental Model of the situation.**



“Moving abstractions from cognitive memory to computer memory”



Issues to be addressed:

- (1) What parameters need to be abstracted?**
- (2) How do we accomplish this formalized abstraction?**
- (3) How should we encapsulate (display) the results to optimize information exchange and integration?**



(1) Information Parameters

- Where does it belong?
 - Assign to a Decision **Criterion**.
- What about the **Quality** of the Information?
 - Credibility, Timeliness, Confidence/Uncertainty
- **Effect** of content on Criterion?
 - Positive/Negative, Major/Minor
- How **Important** is this item?
- **Administrative**



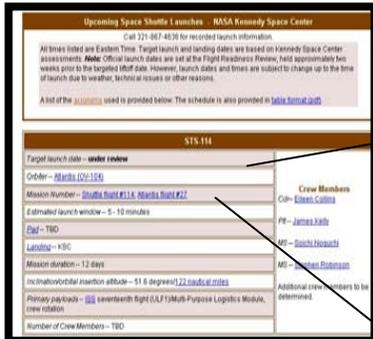
(2) The Abstraction Process



- **#1 REQUIREMENT: MINIMUM COGNITIVE BURDEN.**
- Right-hand mouse click presents abstraction template on screen.
- Required Parameters are listed sequentially
- Option selections are color-coded and selected by a radio-button click.

The abstraction process

This impacts Infrastructure, I wish to retain it.
(Right-hand mouse click)

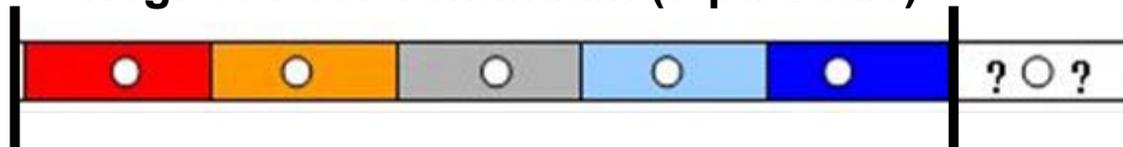


TITLE:

Criterion: INFR. LABOR SECURITY RESOURCES

Credibility	<input checked="" type="radio"/>	<input type="radio"/>	? ○ ?				
Timeliness	<input checked="" type="radio"/>	<input type="radio"/>	? ○ ?				
Confidence	<input checked="" type="radio"/>	<input type="radio"/>	? ○ ?				
EFFECT	<input checked="" type="radio"/>	<input type="radio"/>	? ○ ?				
IMPORTANCE	<input checked="" type="radio"/>	<input type="radio"/>	? ○ ?				

Neg. to Pos. Continuum (5-pt. Scale)



Importance (3-pt. Scale)



Discard

Average

High

Very High



Using the Abstraction Template



“The Asian Times reported yesterday that unidentified sources claim that the completion of the runway extension at Islandia’s main airport will be delayed at least one week.”

TITLE: **runway delay**

Criterion: INFR. LABOR SECURITY RESOURCES

Credibility	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	? <input type="radio"/> ?
Timeliness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	? <input type="radio"/> ?
Confidence	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	? <input type="radio"/> ?
EFFECT	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	? <input type="radio"/> ?
IMPORTANCE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	? <input type="radio"/> ?



(3) Encapsulating the Abstractions

Encapsulation Guidelines:

- For browsing/search, the title/keyword should be up front and readily visible.
- The most important parameters are:
 - The **Effect** on the criterion
 - Direction: Positive or Negative
 - Degree: Minor or major
 - The **Importance** of the item
 - Average, High or Very High
- Secondary parameters are:
 - Quality of Information
 - Administrative tags

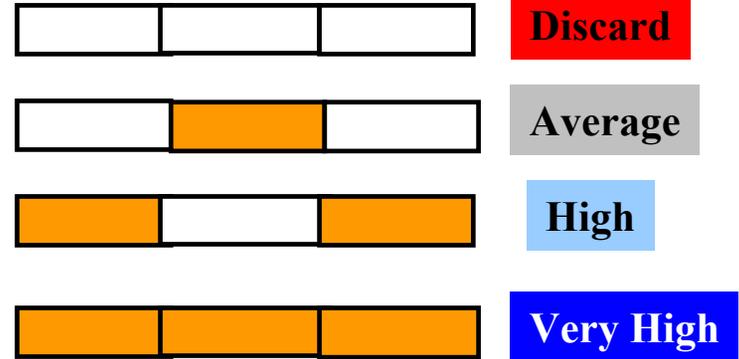


Creating an Information Object (IOB)



TITLE: runway delay						
Criterion: <input checked="" type="radio"/> INFR. <input type="radio"/> LABOR <input type="radio"/> SECURITY <input type="radio"/> RESOURCES						
Credibility	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	? ○ ?
Timeliness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	? ○ ?
Confidence	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	? ○ ?
EFFECT	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	? ○ ?
IMPORTANCE	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	? ○ ?

IMPORTANCE Coding



Effect:

: runway delay

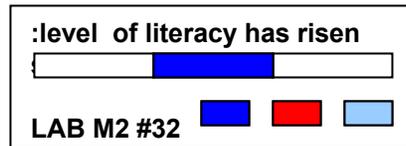
INF M2 #31

INFORMATION OBJECT (IOB)

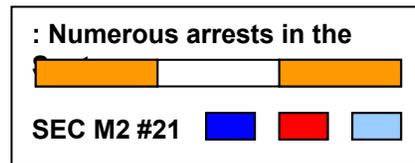
Decoding the IOB



Positive
Very High Importance (3)



Very Positive
Average Importance (1)



Negative
High Importance (2)

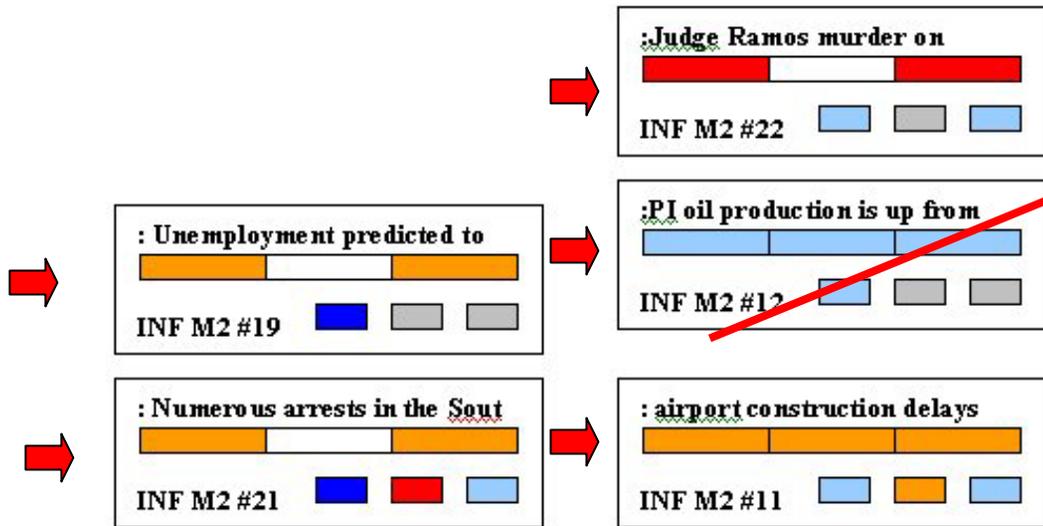


Very Negative
Very High importance (3)



Use of IOBs: Infrastructure has these 8 retained items. What is the criterion assessment?

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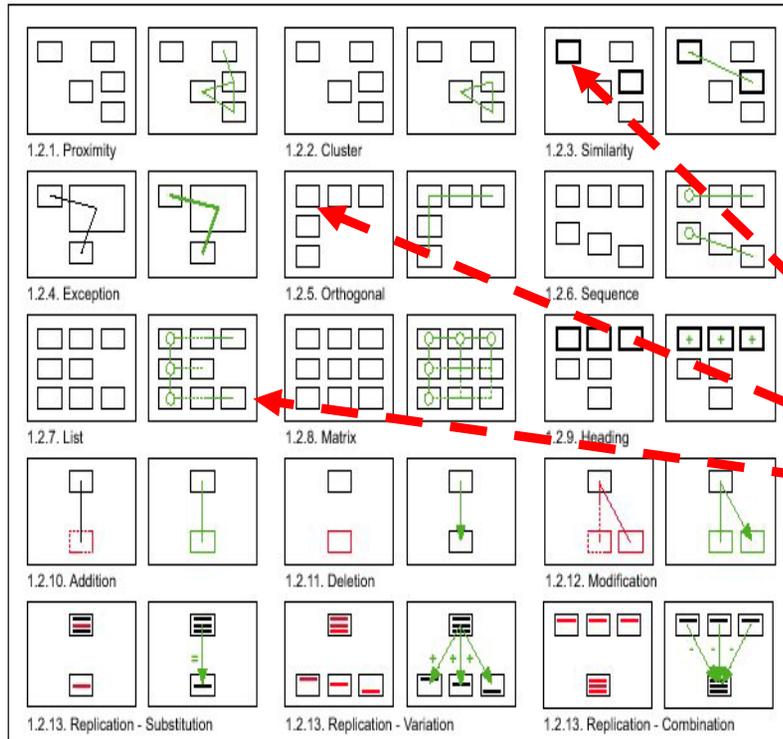


What is the assessment?

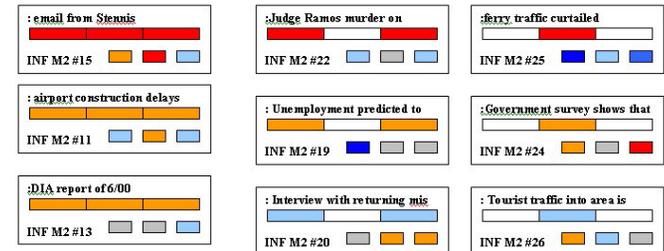
- Sort by Importance:
4 out of 5 items rated as having High Importance have a negative impact on this decision criterion .

IOB Arrangement Analysis

We are integrated with the Electronic Card Wall [EWall] project at MIT's AI Lab. (Patrick Winston, William Porter, Paul Keel)



17 Algorithms under development for sorting, analysis and assessment of grouped IOBs.





The INTEGRATION of Arriving Information (**Text**)



Quality is an encompassing term comprising utility, objectivity, and integrity. Therefore, these four statutory terms, collectively, are referred to as "quality."

Utility refers to the confidence of the information to its intended users. The agency determines the uses of the information not only from its own perspective, but also from the perspective of the public. NOAA takes care to ensure that transparency of information is relevant for assessing the information's usefulness from the public's perspective. NOAA takes care to ensure that transparency has been addressed in its review of the information.

Objectivity consists of two distinct elements: presentation and substance. The presentation element includes whether the information is presented in an accurate, clear, complete, and unbiased manner. The substance element involves a focus on ensuring accurate, reliable, and unbiased information. In a scientific, financial, or statistical context, the original and supporting data shall be generated, and the analytic results shall be developed, using sound statistical and research methods.

Integrity refers to security - the protection of information from unauthorized access or revision, to ensure that the information is not compromised through corruption or falsification.

Examples are:

Title	Purpose	Audience	Genre
Parents' Choice	inform	parents & teachers	policy document
Parents' Choice	report an event	roby fans	news story
Microsoft Excel	explain	software users	software manual
Microsoft Excel	sell shares	general public	general public
Microsoft Excel	presentations of teach	students	students

b. Information qualities

Information tends to be either:

- Analytic
 - Examples:
 - financial figures
 - news from about what's happening
 - preparation of reports of research
 - Characteristics:
 - contains data or facts only
- Objective
 - Examples:
 - news from about what's happening
 - preparation of reports of research
 - Characteristics:
 - based on facts which can be verified

MAINE CORPS GAZETTE ARTICLE # 4, COMMANDER'S CRITICAL INFORMATION REQUIREMENTS

All information management should focus on critical information requirements. This demands review on the part of the commander and understanding on the part of subordinates in order to recognize critical information when they see it.

MCCIP is Command/Control

Commanders have always required critical elements of information to make sound, timely, and effective decisions on the battlefield. Determining the information needed to make these decisions is a commander's ability to act decisively on the fog and friction of war. The commander's critical information requirements (CCIRs), issued as a subset of the commander's intelligence area evaluation, is a leader's method for focusing his staff on the information he needs for critical decision-making. The commander is reducing information needs to a manageable set. MCRP 3-12C, "Marine Corps Information Management: Intelligence, Planning, and Reporting," defines the CCIRs as "information regarding the enemy and friendly activities and the environment identified by the commander as critical to maintaining situational awareness, planning future activities, and facilitating decision-making." Despite their importance, MCRP commonly sees units encountering difficulty with CCIRs by establishing too many, naming CCIRs that are not properly focused on the information needed, and not tracking current CCIRs.

The three broad categories of CCIRs identified above: terrain, friendly, and environment are normally assessed for the commander via the development of priority intelligence requirements (PIR). Friendly focus information requirements (FFIR), and essential elements of friendly information (EEFI). PIRs are those information requirements related to the enemy and the environment. FFIRs relate to the status of friendly forces, and EEFIs concern information about friendly forces and plans that must be kept from the enemy.

CCIRs help focus information management and drive the intelligence collection plan. CCIRs are primarily a decision-making tool that links critical decisions or decision points the commander must make with the information required to make those decisions. For example, suppose a battalion commander is trying to decide where and when to breach an enemy material. To make this decision he may establish the following CCIRs:

Likelihood of getting integrated?

Give me all the items I am missing...

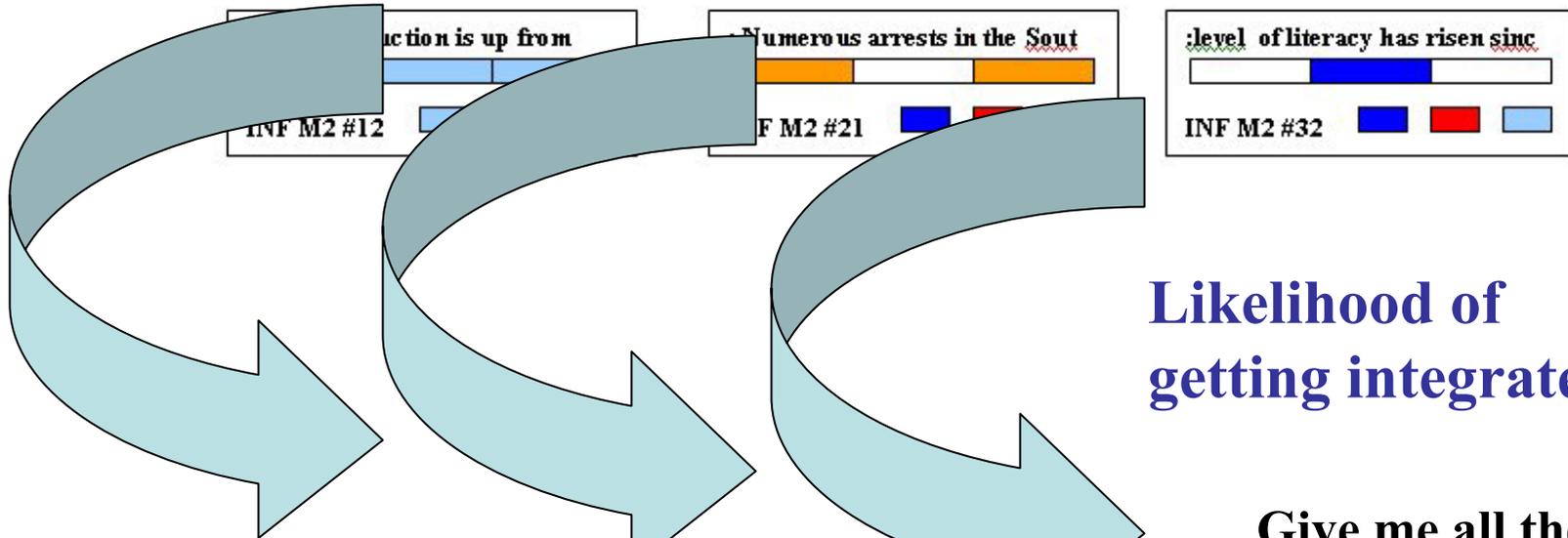


My items

The collage contains several documents and tables:

- A document titled "Quality is an encompassing term..." with red boxes around the definitions of Quality, Utility, Objectivity, and Integrity.
- A table with columns "Title", "Purpose", "Audience", and "Genre" containing examples like "Parents' Choice", "Microsoft Excel", etc.
- A document titled "MAINE CORPS GAZETTE ARTICLE # 4, COMMANDER'S CRITICAL INFORMATION REQUIREMENTS" with red boxes around key paragraphs.
- A document titled "Quality is an encompassing term..." with red boxes around the definitions of Quality, Utility, Objectivity, and Integrity.
- A document titled "The Admiral Robert Group released the following statement on Feb. 7..." with red boxes around the text.
- A document titled "The husbands, wives, and children of the NASA Astronaut Corps..." with red boxes around the text.

The INTEGRATION of Arriving Information (IOBs)



Likelihood of getting integrated?

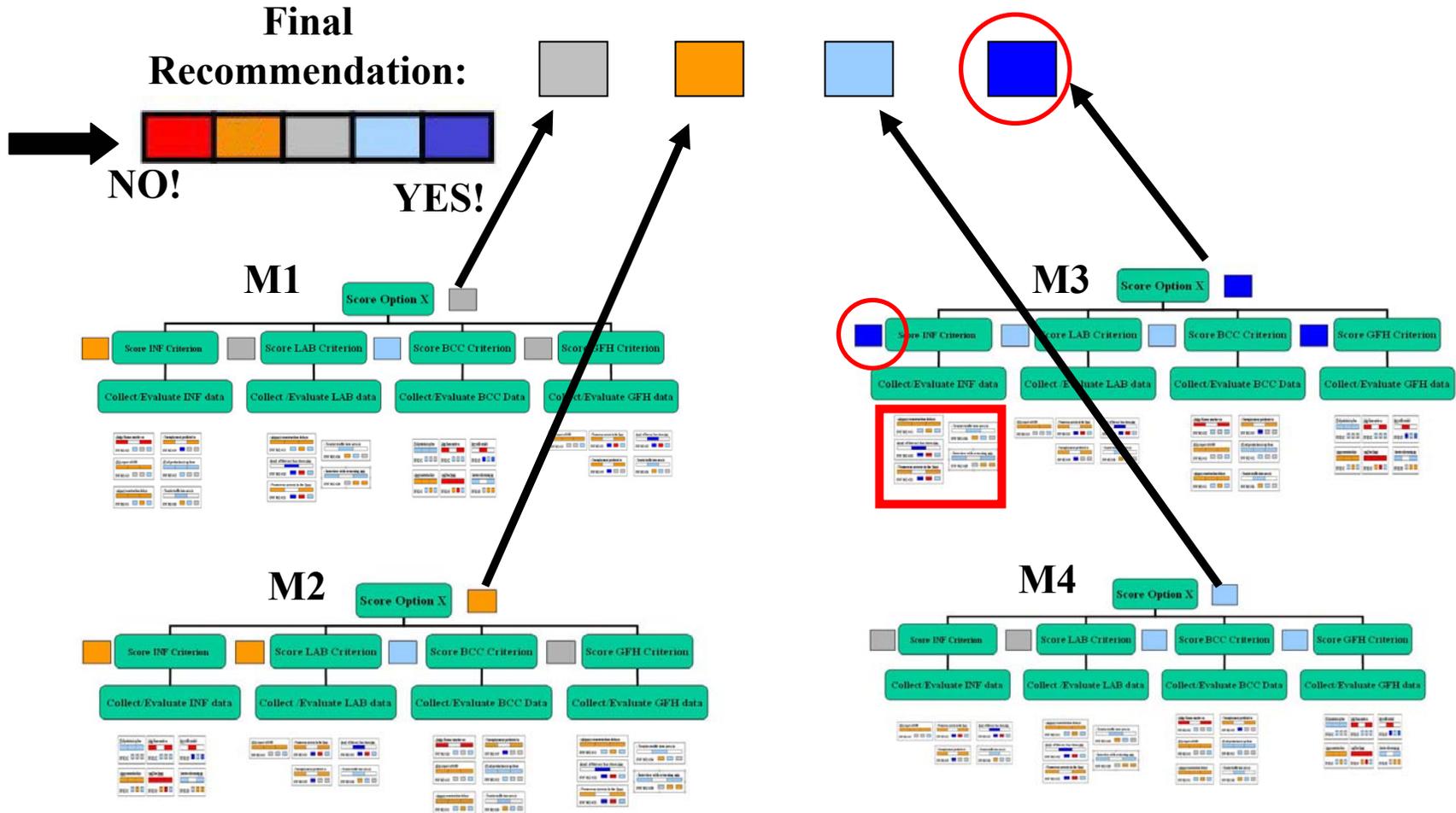
Give me all the objects I am missing...

<p>: email from Stennis</p> <p>INF M2 #15</p>	<p>: Judge Ramos murder on</p> <p>INF M2 #22</p>	<p>: ferry traffic curta</p> <p>INF M2 #25</p>
<p>: airport construction delays</p> <p>INF M2 #11</p>	<p>: Unemployment predicted to</p> <p>INF M2 #19</p>	<p>: Government survey shows that</p> <p>INF M2 #24</p>
<p>: DIA report of 6/00</p> <p>INF M2 #13</p>	<p>: Interview with returning mis</p> <p>INF M2 #20</p>	<p>: Tourist traffic into area is</p> <p>INF M2 #26</p>
<p>: Oil production is up from</p> <p>INF M2 #12</p>	<p>: Numerous arrests in the Sout</p> <p>INF M2 #21</p>	<p>: level of literacy has risen sinc</p> <p>INF M2 #32</p>



My items

Another IOB Advantage: Remember....this is Group Decision Making



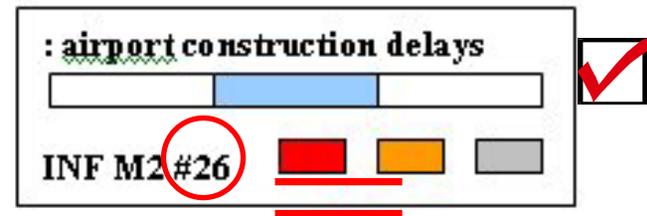
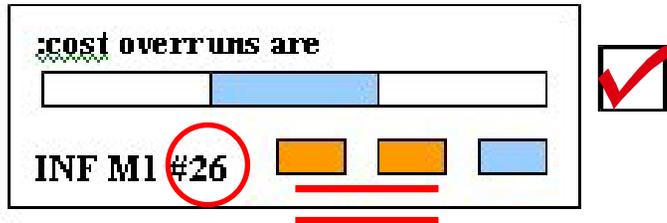
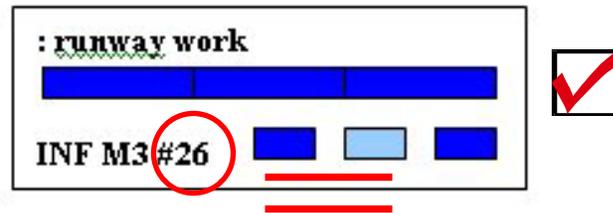
Need for Conflict Resolution/Consensus Building

Focused Discussion of Differences

IOBs permit **FOCUSED** discussion, e.g.

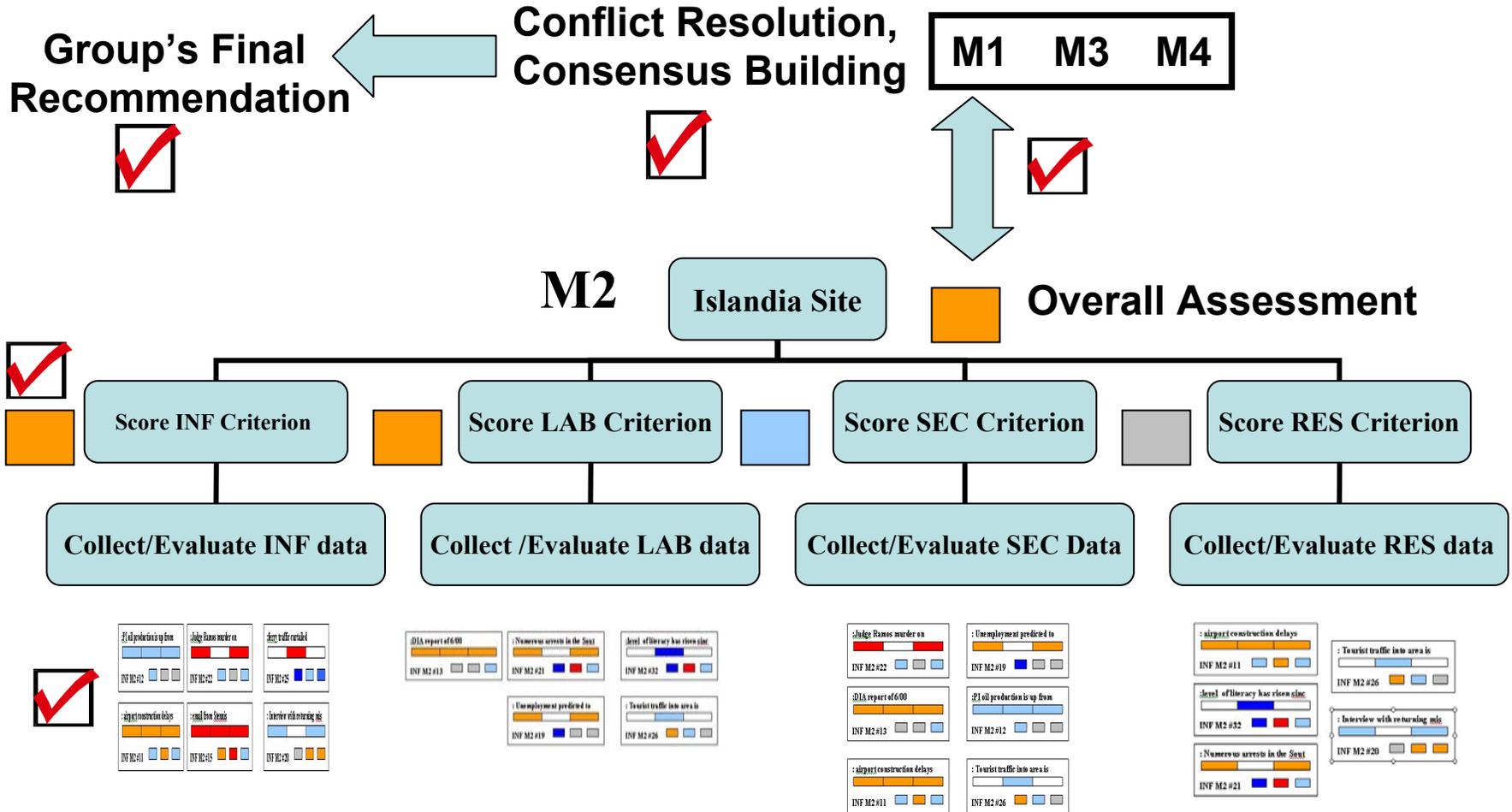
“Let’s discuss the credibility and timeliness of Item #26”

vs. an open-ended “Why did M3 score criterion INF so high?”



Focused discussions are essential in the austere (email, chat box, etc.) environment of asynchronous collaboration

Collaborative Decision Sequence using IOBs





Summary



- Our Current Research is directed at:
 - Methodologies for transferring implicit cognitive assessments into explicit graphical representation.
 - Experimental evaluation of their effect upon the sharing and integration of decision-relevant information in a collaborative, asynchronous group environment.
 - Do we get better quality decision making?



On-line Demo of Information Abstraction & Encapsulation



<http://2000.nehsalumni.com/dcode>