



# DCODE PROJECT



## Decision Making Constructs in a Distributed Environment

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### Improving Collaboration in Command and Control Environments: Creating and Exchanging Iconic Tags of Key Information

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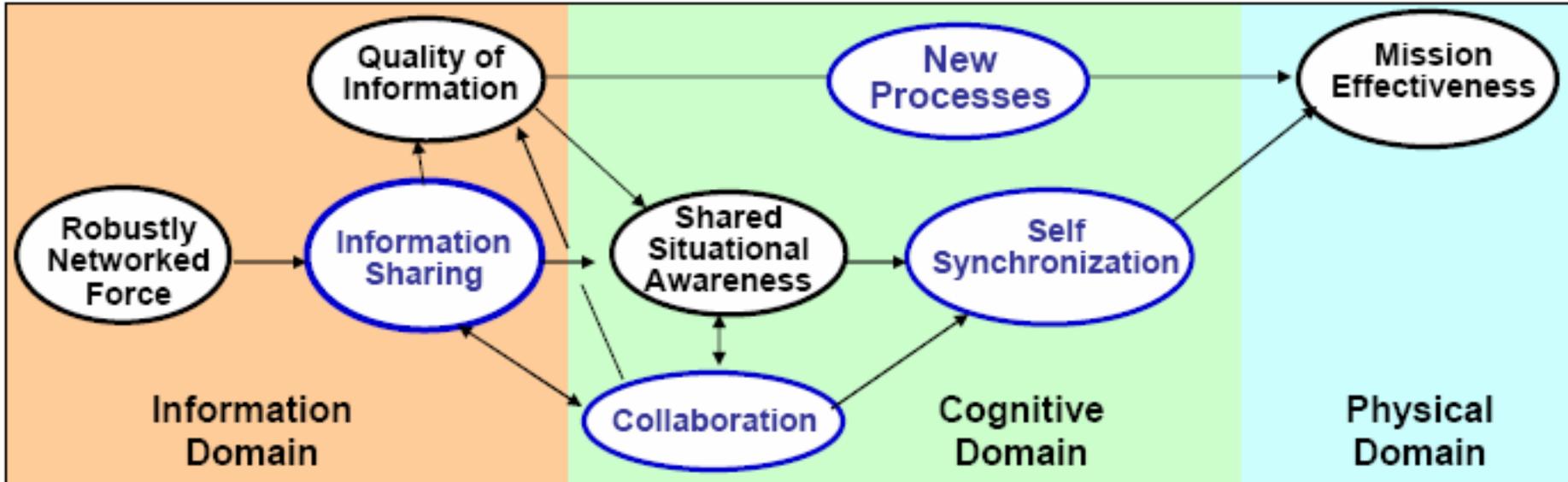
# Tenets of Network Centric Warfare



*...The New Value Chain*

Office of Force Transformation

- A robustly networked force improves information sharing
- Information sharing and collaboration enhances the quality of information and shared situational awareness
- Shared situational awareness enables collaboration and self synchronization, and enhances sustainability and speed of command
- These in turn dramatically increase mission effectiveness





# DCODE Objectives

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- The DCODE objectives are to:
  - improve the ability of both individual and distributed group decision makers to evaluate, share, and integrate decision-relevant information items and
  - to improve decision time by reducing the time and effort devoted to conflict resolution and consensus building in reaching an overall group decision



# DCODE



## Decision Making Application Areas

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- **Information Fusion, Analysis and Situation Assessment**
- **Option Generation/Selection**
- **Course of Action (COA) Recommendations**
- **Consensus Building**

**Multiple Options, Multiple Information Items About Each Option**

# Two Problem Areas Addressed



The most important, high impact items



#1 How do we improve the process of getting to here...

#2 How do we form an aggregate opinion from conflicting inputs.

1000's of possible decision relevant information items....

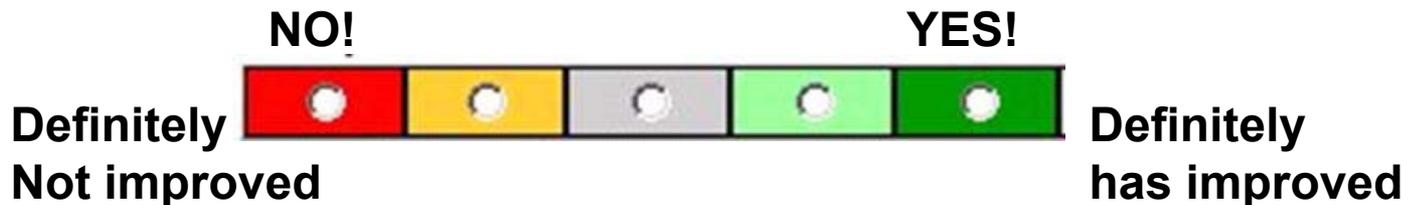




# Sample Decision Making Task



- We have spent a lot of money over the last two years on improving airport security.
- Has Airport Security significantly improved?
  - Review reports and assign an overall effect/impact score to the results:



## Airport Security Gets Another 'F'

LOS ANGELES, Sept. 3, 2002

**VIDE**  
**Screener's Flunk CBS Test**



(Photo: CBS/AP)

**QUOTE**

(CBS) In January and February, I went undercover to test security at American airports. We took lead-bags, which block X-rays, through checkpoints.

Steve Elson, who used to test ch security for the Federal Aviation Administration, helped us with or

"When the bag goes through the there's a big black blob," says El "They're impossible to miss and just continually let it go."

Screener's could not clearly see in our carry-ons and should have

**Screener's in Atlanta and Washington**

US airport security under fire  
 didn't check bags six mc again they n this time.



Security on US domestic flights i  
 By BBC News Online's SI Matthews

US airline security has suff breach in history.  
 At least four separate tear boarded planes and hijack hours of each other.  
 But security experts say the terrorists had been presented with virtually an open goal.  
 Security on US domestic flights is so relaxed that

September 24 2002

**GAO**  
 U.S. GOVERNMENT ACCOUNTING OFFICE

### Highlights

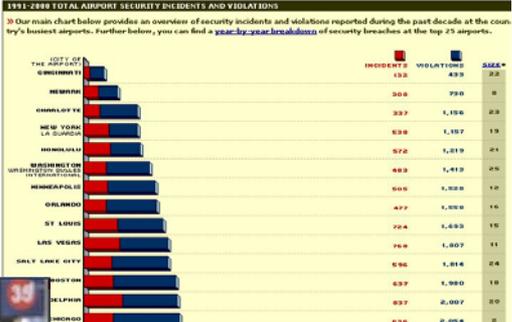
**Why GAO Did This Study**  
 Passenger screening is critical to the security of our nation's aviation system, particularly in the aftermath of the September 11, 2001, terrorist attacks. The Transportation Security Administration (TSA) is tasked with securing all modes of transportation, including the screening of airline passengers. TSA has not met minimum requirements in this regard, such as deploying more than 50,000 federal screeners over 400 commercial airports nationwide. To determine if the TSA's passenger screeners are having the intended effect, GAO has conducted an initial evaluation of TSA's effe

September 24 2002

### AIRPORT PASSENGER SCREENING

#### Preliminary Observations on Progress Made and Challenges Remaining

**What GAO Found**  
 The Transportation Security Administration (TSA) was tasked with the tremendous challenge of building a large federal agency responsible for securing all modes of transportation, while simultaneously meeting ambitious deadlines to enhance the security of the nation's aviation system. Although TSA has made significant progress related to its passenger screening program, challenges remain.  
 TSA recognized that ongoing training of screeners on a frequent basis and effective supervisory training is critical to maintaining and enhancing skills. However, TSA has not fully developed or deployed recurrent or supervisory training programs. Although TSA has not yet deployed these programs, it has taken steps in establishing recurrent and supervisory training, including developing site assessment training modules that will soon be launched to all



### Airport Security Issues

of 11 September 2001, has made security an extremely high priority around the world. Although there has been an increase in the level of the advice on this page should provide an overview of what to do going through many of the world's airports.

## Guest Comment

On NRO

### Security, Smith's Way

The cyber model.

By James D. Miller, assistant professor of economics, Smith College  
 October 30, 2001 9:45 a.m.

**U**nleash the marketplace to strengthen airport security. The socialistic solution of federalizing airport-security workers will deny us the creativity we need to fight terrorists. Only by utilizing the constant competition that the free market provides can we protect America's skies.

Computer networks have to endure incessant attacks from hackers. Network providers have to continually strengthen their defenses to ward off new types of assaults. Hackers have consequently increased computer security and have made the U.S. more resistant to terrorist cyber-attacks. Computer security is not provided by the government, but rather by a marketplace that punishes any firm that can't protect its electronic assets. America's airplanes should be protected by a similar free market approach.

## SPECIAL REPORT THE STERILE AIRPORT

Canadian

Authority (to open four...  
 0 items below included sciss



Illustration by Jameson Simpson

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Near-total airport security is possible. Technologies are in sight to seal the leaks, spot the bad guys, find the bombs.

By Dan Tynan

1 | 2 | 3 | 4

### AIRPORT SECURITY FOR THE 9/11 AGE

Recent dummy-weapon tests at airports show it's still possible to get guns through security, here's how a super-secure airport would work.

We asked Isotec Inc., a Denver-based security systems design firm, to help us engineer an airport that would target terrorists without gumming up passenger traffic. We also sought input from CompuDyne Corp., Visage Technology, General Defense Systems, and other companies that make and install security equipment. In this exercise, money was no object; safety was our only concern.

We set a target date of five years from now. But much of the technology is available, or will be very soon. The goal: Every person, every bag, and all supplies and equipment in an airport will be tagged, tracked, and instantly locatable.

#### 1. CHECK-IN AND SECURE ID

Initial safeguards appear a mile outside the airport. Scanners at tollbooth-like structures along access roads aim their laser scanners at



# Background:

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- Research has shown that in a group decision making environment, members usually discount any uniquely held information that gets shared with the group.\*
- This shared, uniquely held information typically does **not** impact the final decision.
  - “You can lead a group to information, but you can’t make it think.”
  - **Why is this true?**

\*Stasser et al



# Hypothesis

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- (1) A group member already has a high cognitive burden in processing the information he has found.
- (2) Shared information from other members usually arrives in an unprocessed form:
  - “Here’s a relevant report you should read”
- (3) The new information is not integrated into the decision process because it causes too great of a cognitive burden.



# Challenges

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- Improve the quality of group decision making by
  - (1) enhancing the ability of each participant to **assess/evaluate** their pool of disparate information findings
  - (2) simplifying the process by which participants **share** uniquely held information
  - (3) improving the process for **integrating** this shared information into the on-going decision process and
  - (4) developing information “drill down” capabilities so that participants can quickly focus on the differing subjective assessments that are causing lack of **decision consensus**.



# Approach

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- Exchange processed, subjective assessment information:
  - “Read this report” vs.
  - “The originator of this report has high credibility, the information is timely, backed up by facts, is of high importance and has a strong negative effect on use of option C”
    - How do we encapsulate these subjective assessments?

# Subjective conclusions from each of the reports

## Vulnerabilities and Potential Improvements for the Air Cargo Security Gets Another 'F'

### What GAO Found

Numerous government and industry studies have identified vulnerabilities in the air cargo system. These vulnerabilities occur in the security of some air carriers and freight forwarders and in possible tampering with freight at various handoffs that occur from the point when cargo is shipped to the point when it is loaded onto an aircraft. As a result, weaknesses in this program could create security risks.

FAA or the TSA responsibility key recomm since 1990 by this site.

### US airport security under fire



Security on US domestic flights is under fire. By BBC News Online's St Matthews

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Special Report

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We asked Irotec Inc., a Denver-based security systems design firm, to help us engineer an airport that would target terrorists without gumming up passenger traffic. We also sought input from Comsec, a security technology company; Genetec, a video surveillance technology, Genetec's security systems, and other companies that make and sell security equipment. In this exercise, money was no object; safety was our only concern.

We set a target date of five years from now, but much of the technology is available, or will be very soon. The goal: Every person, every bag, and all supplies and equipment in an airport will be tagged, tracked, and instantly locatable.

I. CHECK-IN AND SECURE ID

Initial safeguards appear a mile outside the airport. Scanners at tollbooth-like structures along arrival roads aim their laser scanners at

Illustration by Jameson Simpson

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No

Yes

## Guest Comment

On NRO

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The cyber model.

By James D. Miller, assistant professor of economics, Smith College, October 30, 2001 9:45 a.m.

Unleash the marketplace to strengthen airport security. The socialistic solution of federalizing airport-security workers will deny us the creativity we need to fight terrorists. Only by utilizing the constant competition that the free market provides can we protect America's skies.

Computer networks have to endure incessant attacks from hackers. Network providers have to continually strengthen their defenses to ward off new types of assaults. Hackers have consequently increased computer security and have made the U.S. more resistant to terrorist cyber-attacks. Computer security is provided by the government, but rather by a marketplace that punishes any firm that can't protect its electronic assets. America's airplanes should be protected by a similar free market approach.

No!

Yes

No

Yes

No

Yes

No

Yes

...but other subjective estimates have also been made..

**NO! Difficult Task! YES!**



Highly Reliable Source

Old Data

Good documentation

Very recent info.

Most Important

High level of uncertainty

Least Important

Source Credibility?

and Potential for the Air Cargo Security Gets Another 'F'

LOS ANGELES, Sept. 3, 2002

GAO Highlights

AIRPORT PASSENGER SCREENING

Preliminary Observations on Progress Made and Challenges Remaining

What GAO Found

The Transportation Security Administration (TSA) has taken steps to improve the screening of passengers at airports, but more work is needed to ensure the security of the air cargo system.

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GAO found that TSA has made progress in improving the screening of passengers at airports, but more work is needed to ensure the security of the air cargo system.

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THE STERILE AIRPORT

AIRPORT SECURITY FOR THE 9/11 AGE

Recent damage to airport security is a sobering reminder that we must have a superior system design to protect the nation's airports.

We asked Isotek to design a system that would eliminate the need for gunning up passengers from Customs and Border Protection. Isotek's solution was a system that would allow passengers to pass through the airport with their luggage in their own vehicles.

We set a target date of 2005 for the completion of the system. The goal was to have the system in place and all equipment and infrastructure to be tested, tracked, and maintained.

Initial safeguards appear to be in place at the airport. Standards for the system are being established.



# What are the key Essential Elements that need to be Abstracted from an Information Item?

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- Where does it **Fit?**
  - i.e. which decision criteria/factor (e.g. cost, risk, etc.)?
- How good is the information **Quality?**
  - What is the Credibility of the source?
  - How Timely is this information?
  - How much Confidence do I have in the information?
- What is the **Effect/impact** of the information on the criterion?
  - **Positive or Negative?**
  - **Strong or Weak?**
- What is the **Importance** of this item relative to other items?

# DCODE Solution: Convert IMPLICIT subjective estimates into EXPLICIT estimates.



Credibility?



Effect/Impact?



Importance?



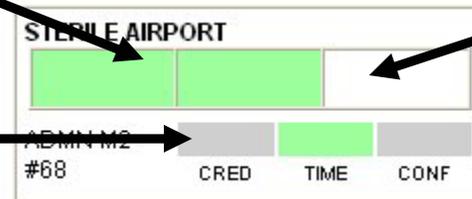
Timeliness?



Encapsulate the scores into an icon (called an Information Object, IOB) that displays information quality, impact and importance

Effect/Impact: **Color**

**Quality** of information



IOB

Information **Importance:**  
**Size of color bar (1, 2 or 3 sections filled)**



# DCODE Approach

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- Improve the ability of both individual and group decision makers to:
    - Abstract
    - Encapsulate
    - Assess
    - Share
- ...all decision relevant information items.

# Information Tagging

**The EWall program is a highly efficient method of displaying, organizing and sorting diverse information.**



**Critical concept is translating each information item into an EWall card, also called an Information Object (IOB)**



# DCODE



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**DCODE enhances EWall capabilities by adding the ability to:**

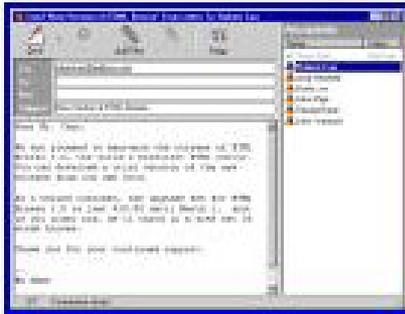
**assess, store and display a user's  
cognitive interpretation of the information,**

**specifically, the impact, importance and  
quality of any decision-relevant information  
item**

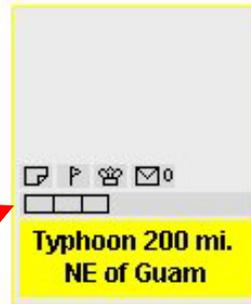
# EWall & DCODE

- **EWall**: Architecture for the Abstraction, Encapsulation and Sharing of information.

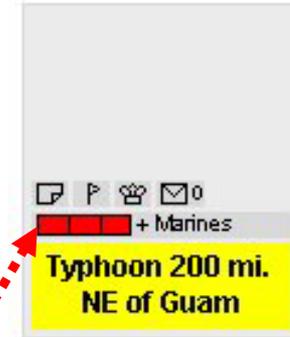
## Original Document



## EWall Icon



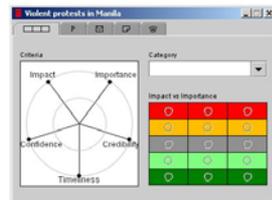
(1.5 x 2.0 in.)



## Information Object (IOB)

**DCODE**: Process for capturing and displaying the cognitive **assessments** of each information item (“what does this mean?”)

The DCODE assessment “bar”



The DCODE assessment template



# DCODE/EWALL Example

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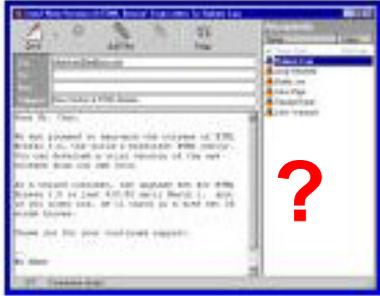
**Scenario: Rescue 3 Red Cross workers  
from the Island of Drapo (insurrections)**

**Options: Use SEALs, Marines or the Army**

**Analysts: Baker, Jones, Smith**

**This is Jones, looking at the viability of the Seals option**

# Information Abstraction, Encapsulation and Assessment



“Typhoon has serious and very negative effect on using the Seals”



Perform DCODE assmt. on IOBs that are retained for use/sharing in final decision making. **(Assessment)**



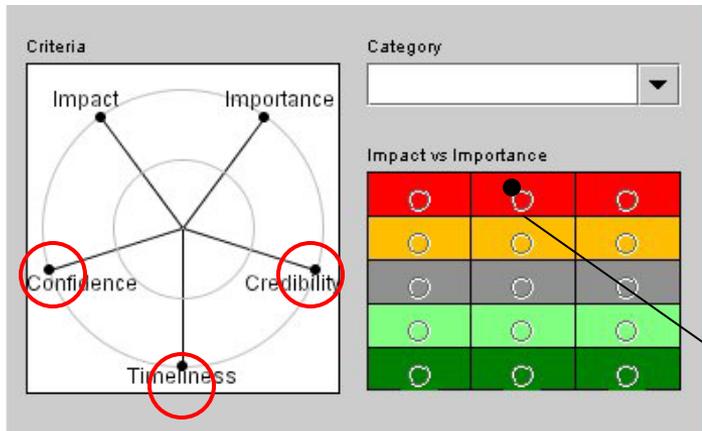
Convert candidates from original format into EWall IOBs **(Abstraction, Encapsulation)**





# Cognitive Assessment

The subjective assessments of each IOB are converted into size and color coded icons.



**3 Slider-bar adjustments for Information Quality**

Very negative impact on SEALs, High Importance

0  
■ ■ ■ ■ ■ SEALs  
**Rebels have land mines**

## Impact on a COA

- Very Negative
- Negative
- Neutral
- Positive
- Very Positive

## Importance

- Average
- High
- Very High

# IOB Designs

IOB design can be tailored to meet specific decision making requirements.

Picture/text



Information Bar



Assessment

SEALS

Date

Aug-17-04 2:23 PM PST

Author

Jones

Keyword

SH-60





# IOB Sorting

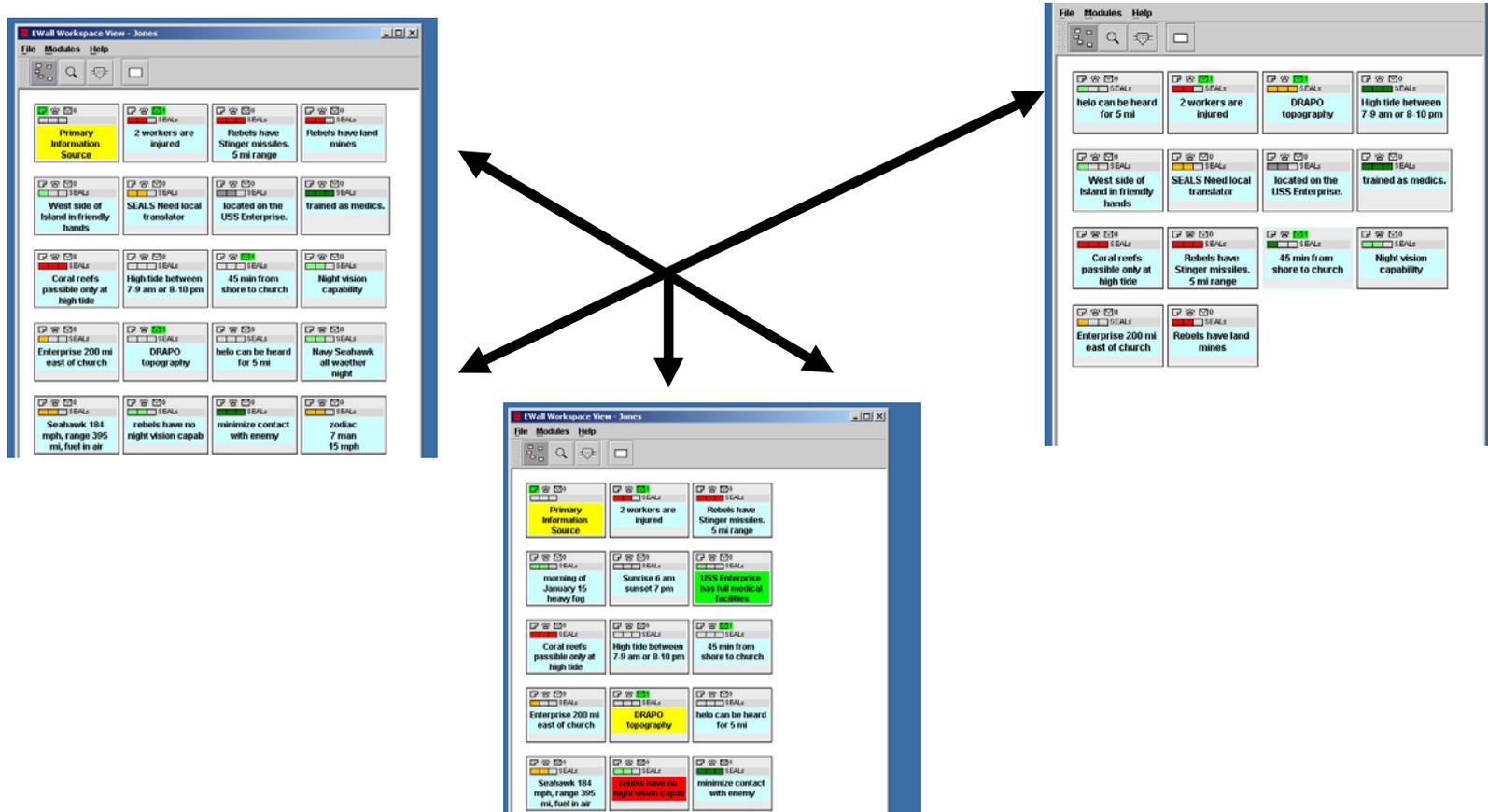
Sorting/organizing of completed IOBs are used to evaluate each COA

The screenshot displays a software interface titled "EWall Workspace View - Jones". It features a menu bar with "File", "Modules", and "Help". Below the menu is a toolbar with icons for home, search, and refresh. The main area is labeled "Work Space" and contains a grid of IOB (Intelligence Observation Briefing) cards. Each card includes a header with a crown icon, a status indicator (a bar with red and green segments), and a title. The IOBs are as follows:

<b>Coral reefs possible only at high tide</b>	<b>Rebels have Stinger missiles. 5 mi range</b>	<b>trained as medics.</b>	<b>minimize contact with enemy</b>
<b>Rebels have land mines</b>	<b>2 workers are injured</b>	<b>SEALs are very covert</b>	<b>morning of January 15 heavy fog</b>
<b>High tide between 7-9 am or 8-10 pm</b>	<b>SEALs Need local translator</b>	<b>45 min from shore to church</b>	<b>Night vision capability</b>
<b>Enterprise 200 mi east of church</b>	<b>zodiac 7 man 15 mph</b>	<b>Navy Seahawk all waether night</b>	<b>rebels have no night vision capab</b>
		<b>USS Enterprise has full medical facilities</b>	<b>DRAPO topography</b>
		<b>Sunrise 6 am sunset 7 pm</b>	<b>located on the USS Enterprise.</b>
		<b>West side of Island in friendly hands</b>	

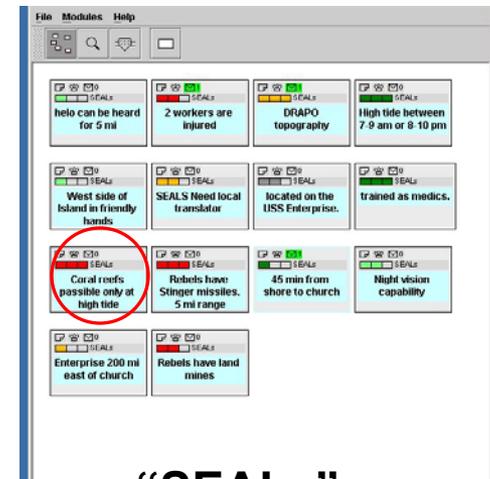
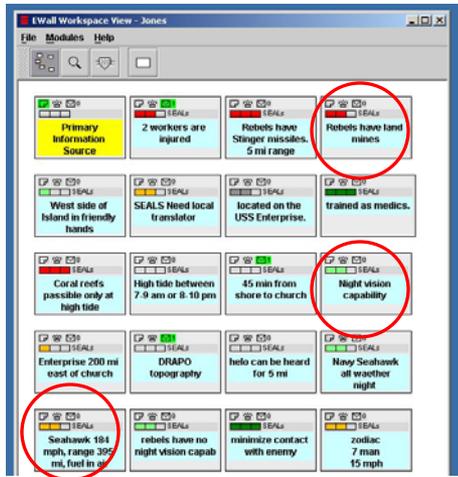
# IOB Exchange

Group participants can exchange, incorporate or modify each other's IOBs (drag & drop)



# Conflict Resolution/ Consensus Building

Exchange/evaluation of the IOB pool permits focused discussion on differing COA selections and results in quicker/better group decisions.



# CSU Experiment

- 36 Subjects at Colorado State
- Rank Order 3 companies in terms of a good stock investment
  - Standardized test used in other studies
- Compare decision performance of subjects who used IOB subjective assessment color bar (Effect and Importance) vs. those that did not.



Used Subjective assessment

Did not use Subjective assessment





# Task

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- Select the best company to invest in out of a group of three.
- Read a report about each company
  - Profits, work force, CEO, new markets, etc.
- Create IOBs about each company
  - Watched AVI videos on how to create and use IOBs and the DCODE options.
  - Creation, layout, contents, DCODE options totally under subjects control.
- Make a final Rank Ordering of the 3 companies.
- \$ incentive for best performance



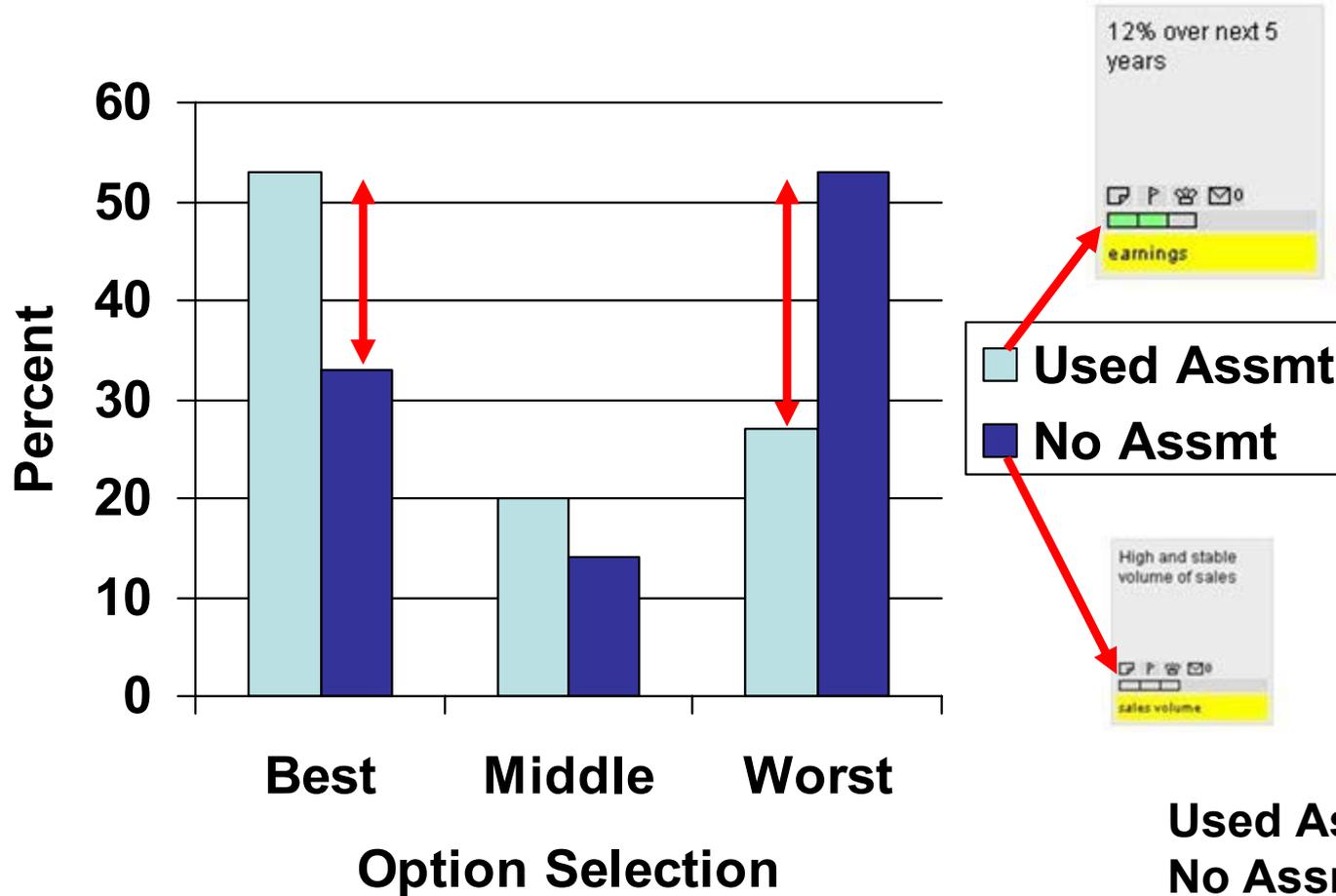
# Overview

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- 36 subjects participated
  - 14 Females
  - 22 Males
- 15 of the subjects used the DCODE color bar option

# Use of Subjective Assessments



Experiment at Colorado State



# DCODE



## Concept of Operations:

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DCODE works with MIT's Electronic Card Wall (Ewall) Program, which provides a strong framework for the abstraction, encapsulation and sharing of of decision relevant information items.

DCODE expands/enhances this capability by capturing, displaying and sharing the **subjective assessments** a team member attaches to each item. An Ewall card, with the attached DCODE assessments is referred to as an **Information Object (IOB)**

IOBs compactly display physical **data** (reference link, originator, abstract, time tag, etc.) as well as **meta data** (credibility of source, importance, option impacted, timeliness, etc). This combination of information helps individuals and teams consider the full range of pooled assessments available on a topic, and to balance the diversity of viewpoints.

**The critical feature of DCODE is its ability to capture, display and share these subjective assessments.**