Quantification of subjective information assessments in C2 decision option selection

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BACKGROUND

• In the past…
  – a major cause for a lack of consensus in a group decision making task was that all participants did not have the same information.

• Today…
  – A major cause is differing subjective assessments (importance, impact) of the same information.
    • Particularly true in multicultural/coalition groups

• Decision Making Constructs in a Distributed Environment (DCODE) is a decision support system for the elicitation, display, sharing and comparison of individual subjective information assessments.
Decision Making Constructs in a Distributed Environment (DCODE)

DCODE is a component of MIT’s Electronic Card Wall (EWall) project, and has been developed by SPAWAR Systems Center in San Diego.

**DCODE Overall Objective:** the development of a decision support tool for reducing the problems involved with **the storing, sharing and integration of subjective information assessments**.

The use of DCODE in the quantification and sharing of these subjective assessments can **improve the quality of group decision making** and significantly reduce the time devoted to **conflict resolution and team consensus building**.
EWall cards are small iconic representations of relevant information items and include a series of information parameters. They can be configured in a variety of formats.
EWall Card

Best ETA for SEALs is 1900 hrs, 10/14

Heading

Details

DCODE

Other options

Date & Originator

Fleming

ETA

Nov-21-05 11:33AM G
The use of DCODE as a decision support tool involves following sequential process for each decision relevant information item:

- Abstract
- Encapsulate
- Assess
- Integrate
- Share
- Decide

EWall processes

DCODE processes
Information Abstraction and Encapsulation

Mission: Rescue hostages from Islandia
Decision Options: Marines; SEALS; Army
Factors: Speed (ETA), Covertmess, Risk, etc

Situation Assessment:
Is Carlos still in Columbia?

Homeland Security email
To: joseph_donovan@dea.gov
From: william.kays@omb.gov
Subject: Re: acct. activity
Mr. Donovan
Fred Barnes in Finance Tracking informs me within the last 10 days, $27K was deposited in the referenced account (10/7) and $22K was withdrawn on 10/9. This is unusual activity for this account.
V/R
Bill Kays

Information is abstracted, encapsulated but **NOT** Assessed!
DCODE Information Assessment

EWall Information Card

Which option(s) is impacted?
How is it impacted?
How important is this item?
Quality of the information?
Timely?
Credible source?
Well documented?

Information Object (IOB)

This DCODE coding tells me that this information …

• Negatively impacts the viability of using the SEALS option.
• Is considered of high importance.
• There is some issue with the quality of this information.
Every time Carlos has left Columbia, there have been large deposits and withdrawals in his account.

This DCODE coding tells me that this information ...

• Very Negatively impacts the likelihood Carlos is in Columbia.
• Is considered of high importance.
• There is no question about the quality of the information.
Activating the DCODE Assessment Template
The Assessment Template

- Information Quality
- Information Importance & Impact

Drop-down menu for option selection
Scoring Impact and Importance

Item is of “High” importance (2 boxes) and has a “Negative” impact (yellow) on this option.
IMPACT: (color)

Very Positive
- Green

Positive
- Light Green

Negative
- Yellow

Very Negative
- Red

IMPORTANCE (# boxes filled):

AVERAGE (1)  HIGH (2)  VERY HIGH (3)

Average Importance
- Very Positive
  - Item W6

High Importance
- Very Positive
  - Item K8

Very High Importance
- Very Positive
  - Item F5

Average Importance
- Positive
  - Item J8

High Importance
- Positive
  - Item F1

Very High Importance
- Positive
  - Item L6

Average Importance
- Negative
  - Item S3

High Importance
- Negative
  - Item B8

Very High Importance
- Negative
  - Item W9

Average Importance
- Very Negative
  - Item T7

High Importance
- Very Negative
  - Item H6

Very High Importance
- Very Negative
  - Item D3
## Sample DCODE Assessments

### Selecting a House
- **Commute time**
  - 22 min.
  - 47 min.
- **Parking Lot**
  - Concord Blvd
  - Adams St.
- **View**
  - Fleming

### Selecting a Car
- **Gas Mileage**
  - 9.7 mpg
  - 28.1 MPG
- **Car Types**
  - Hummer
  - Civic
  - Wisconsin
  - Utah
- **5-yr avg. return**
  - 7.9%

### Selecting a College
- **Parties**
- **Broker rating**
- **Single Option:**
  - Buy stock “A”?
  - 87
  - P/E ratio
  - Dec-1-05 10:39 AM GMT... Fleming
  - "Hold"
Which is the BEST option?

<table>
<thead>
<tr>
<th>SEALs</th>
<th>SEALs</th>
<th>SEALs</th>
<th>SEALs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rebels have no night vision capability</td>
<td>SEALs have just returned from another mission</td>
<td>SEALs are very covert</td>
<td>There will be dense fog in the morning</td>
</tr>
<tr>
<td>SEALs are very covert</td>
<td>SEALs</td>
<td>SEALs</td>
<td>SEALs</td>
</tr>
<tr>
<td>Seal team can be activated immediately</td>
<td>SEALs</td>
<td>SEALs</td>
<td>SEALs</td>
</tr>
<tr>
<td>Seal team does not have a translator</td>
<td>SEALs</td>
<td>Seal team has a corpsman</td>
<td>SEALs</td>
</tr>
<tr>
<td>SEALs are especially trained in hostage rescue</td>
<td>SEALs</td>
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</tr>
<tr>
<td>SEALs should spend least time on the island</td>
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<tr>
<td>Very small time window for landing SEALs</td>
<td>Injured worker will have to spend 2 hours in Zodiac</td>
<td>SEALs</td>
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</tr>
<tr>
<td>Army will have the most firepower</td>
<td>Army</td>
<td>Army</td>
<td>Army</td>
</tr>
<tr>
<td>Off-road terrain difficult for Army vehicles</td>
<td>Army</td>
<td>Army</td>
<td>Army</td>
</tr>
<tr>
<td>Army team has corpsman and translator</td>
<td>Army</td>
<td>Army</td>
<td>Army</td>
</tr>
<tr>
<td>Army unit trained on island and knows terrain</td>
<td>Army</td>
<td>Army</td>
<td>Army</td>
</tr>
<tr>
<td>Army response will not be covert</td>
<td>Army</td>
<td>Army</td>
<td>Army</td>
</tr>
<tr>
<td>Army would have good public relations</td>
<td>Army</td>
<td>Army</td>
<td>Army</td>
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</tbody>
</table>

Research & Engineering Development, Inc. (RED-Inc)
Integration of IOBs
### Sorted by Importance:

**Very High – High -- Average**

<table>
<thead>
<tr>
<th>Most Important (size)</th>
</tr>
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<tbody>
<tr>
<td>SEALs are very covert</td>
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<td>Use of Army will have least impact on our reserve</td>
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<tr>
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<tbody>
<tr>
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<tr>
<td>Army team predicted to have least casualties</td>
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<tr>
<td>Use of Army would have good public relations</td>
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<p>| | | |</p>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>SEALs should spend least time on the island</td>
<td>Reef is only passable at high tide</td>
<td>Injured worker will have to spend 2 hours in Zodiac</td>
</tr>
<tr>
<td>Army unit fresh and at full strength</td>
<td>Off-road terrain difficult for Army vehicles</td>
<td>Army will have the slowest response time</td>
</tr>
<tr>
<td>SEALs have just returned from another mission</td>
<td>Army will be the most expensive option</td>
<td>Army will not be covert</td>
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**Very High**
- SEALs are very covert
- SEAL team does not have a translator
- Army unit trained on island and knows terrain

**High**
- SEALs are especially trained in hostage rescue
- SEAL team has a corpsman
- There will be dense fog in the morning
- Army team has corpsman and translator
- Army team predicted to have least casualties
- Use of Army would have good public relations

**Average**
- SEALs should spend least time on the island
- Reef is only passable at high tide
- Injured worker will have to spend 2 hours in Zodiac
- Army unit fresh and at full strength
- Off-road terrain difficult for Army vehicles
- Army will have the slowest response time
- Army will be the most expensive option
- Army will not be covert
**Sorted by Impact:**

**Very Positive, Positive, Negative, Very Negative**

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Smith’s Display (EWall workspace + Exchange view)
Making Decisions with DCODE
(the weighting matrix)
Summary Score Bar Chart

Algebraic sum of all IOBs for each option.
Sample DCODE Summary Results

Multiple Options

Single Option
(Yes-NO, Act-Don’t Act)

Two Options
Use of DCODE in the Intelligence Community

“Is Carlos still in Columbia?”

“Where is Carlos?”
DCODE Process

• Abstract
• Encapsulate
• Assess
  • Option
  • Importance
  • Impact
  • Quality
• Integrate/Sort
• Share
• Decide
Recent DCODE Developments
Does DCODE Work?

DCODE Experiment

- 123 College Students
- Task: Rank order three cities (A, B and C) in terms of expansion sites for a new plant
- 12 items of information about each city
- Items had been rated on importance (three levels) and impact (4 levels)
- Given 30 min. for task (most took 10-15 min.)
- Text vs DCODE COLOR coding
- Male vs Female
Text versus Color Condition

Two Text Item Examples

<table>
<thead>
<tr>
<th>OPTION A</th>
<th>OPTION B</th>
<th>OPTION C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High Importance Very Positive Impact</td>
<td>Very High Importance Very Positive Impact</td>
<td>Very High Importance Very Positive Impact</td>
</tr>
<tr>
<td>Item 17</td>
<td>Item 17</td>
<td>Item 29</td>
</tr>
</tbody>
</table>

Color Equivalent

<table>
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<tr>
<th>OPTION A</th>
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<th>OPTION C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 17</td>
<td>Item 17</td>
<td>Item 29</td>
</tr>
</tbody>
</table>

36 Item Display
Text Condition

36 Item Display
Color Condition
Response Sheet

- Write your choice as Best option on the “100” line.
- Write your choice as Worst option on the “0” line.
- Circle the number that best represents where you would assign the remaining option.

<table>
<thead>
<tr>
<th>100</th>
<th>Option C</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Option B
Results

• Color condition had significantly fewer errors
• Color condition had significantly more people get all 3 rankings correct
• Color condition was significantly better at assigning position to the Middle rank
• Text condition had more people select the Best option—but then performed significantly worst than chance on the last two rankings
• Males had significantly more confidence in their rankings
DCODE Small business Technology Transfer Program (STTR) Awarded

- N06-T025 Decision Making Constructs for a Distributed Environment (DCODE)

- OBJECTIVE: Enable quick-response knowledge interoperability in coalition operations decision making.

- PHASE I: Develop a cognitive processing-based concept, tool or methodology 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.

Three Phase I proposals accepted by ONR 6/06
More Information

• DCODE contacts:
  – bobfleming@gmail.com
  – Mike.cowen@navy.mil

• DCODE documentation, updates:
  – http://www.dcode-onr.net/

• EWall information:
  – Paul Keel, keel@mit.edu

• ONR Sponsor
  – Mike Letsky letskym@onr.navy.mil