Decision-support Infosphere Services for Collaborative Operations and Virtual Environment Requirements (DISCOVER)

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**Decision-support Infosphere Services for Collaborative Operations and Virtual Environment Requirements (DISCOVER)**

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The original document contains color images.
Briefing Outline/Purpose

• Introduction
  – What is DISCOVER and why are we doing it
  – Background (Joint Battlespace Infosphere and Fuselet Information Transformation Services)
  – Goals and objectives

• Experimentation Process
• System Architecture
• Project Status
• Preliminary Findings
• Next Steps
What is DISCOVER?

- DISCOVER is an AFRL project centered on the design and execution of an experiment
  - Goal is to measure the value and performance impact of a combination of technologies
    - Joint Battlespace Infosphere (JBI)
    - JBI fuselets
    - Collaboration and Visualization Software
  - Operational context focuses on the dynamic mission re-planning processes within an Air Operations Center (AOC)
Joint Battlespace Infosphere (JBI)

- A vision for an orchestrated information management system whose services adapt to the operational needs of users and the enterprise for universal access to tailorable, actionable information
  - Information sharing services (publish, subscribe, query)
  - Control services (policy, security, authentication, access control, authorization, QoS)
  - “Service contract” services (force templates to facilitate the effective plug-and-play-and-go of operational entities with an instance of an infosphere)
  - Information transformation services (fuselets which tailor the information space to the needs of the warfighter)

Realizing the Air Force Scientific Advisory Board (SAB) vision as delineated in two SAB summer study reports, Information Management to Support the Warrior (1998), and Building the Joint Battlespace Infosphere (1999)
Some Related ICCRTS Papers and Presentations from AFRL this Week

• Joint Battlespace Infosphere: Information Management within a C2 Enterprise
  – Combs, Hillman, Muccio, McKeel
  – Information Operations/Assurance Track
  – Consulate
  – Day 3, Wednesday, 3:15-3:45

• A Reference Model for Information Management to Support Coalition Information Sharing Needs
  – Linderman, Siegel, Ouellet, Brichacek, Hains, Chase, O’May
  – Coalition Interoperability Track
  – Old Dominion
  – Day 4, Thursday, 1:30-2:00
Motivation for Information Transformation:
Lessons Learned from Kosovo, Afghanistan, and Operation Iraqi Freedom

- More intelligence data leads to information overload
- Decision time has become the “long pole in the tent”
- Warfighters lack actionable information
Problems to be Addressed by Information Transformation

- **Multiple information systems and sources** can produce duplicate or inconsistent information that requires significant human effort to correlate, integrate and understand
  - Information overload and confusion
  - Inefficient and ineffective decision-making
  - Cumbersome and error-prone migration of information from one system to another (manual data entry often required)

- **Current information systems** are difficult to change to produce information that is tailored to the specific needs and context of end users
  - The information they produce is generally static
  - Application reengineering can be complex, costly and time consuming, potentially leading to significant downtimes
Information Transformation Objectives

• Augment information systems with a flexible information production capability that is dynamically responsive to the changing needs of end users and imposes minimal impact to legacy systems

• Improve the efficiency and effectiveness of decision-making by correlating duplicative information, resolving inconsistent information, mediating between information sources, and fusing information together into comprehensible information products
Fuselet Definition

- A fuselet is a light-weight, special-purpose JBI client program that provides value-added information processing functions that are under the control of the JBI platform
  - These information processing functions take existing information objects as input and manipulate them in some way to produce new information objects
  - Light-weight means that they are intended to be easy to build and deploy, relatively modular, usually small in terms of lines of code, amenable to reuse, and utilize a low level of system runtime resources
• We recognized the need to visualize (present) the information produced by fuselets to human operators within an AOC and the need for teams of operators to collaborate over this information
  
  – DISCOVER utilizes portal, messaging, and chat technology to support presentation and collaboration requirements
AOC Collaborative Decision-Making Support

Air Operations Center

- AOC Director
  - Combat Plans Division (CPD)
    - Campaign Plans
    - Air Tasking Order (ATO) Production
    - Airspace Control
  - Combat Ops Division (COD)
    - Offensive Operations
    - Defensive Operations
    - Airspace Control
    - Weather Support
    - Rescue Coordination Center
  - Combat Intel Division (CID)
    - Operations Intelligence
    - Plans Intelligence
    - Sensitive Compartmented Information Facility (SCIF)
  - Airlift Control Center (ALCC)
    - Airlift Ops
    - Airlift Plans
    - ALCC Support
    - Aeromedical Control Center

Lines of Collaborative Peer Communication

JBI Infospace

Legacy Data

P2P Decision Support

Decision Logic

Joint Movement Control Center (JMCC)

Air Mobility Command (ACC)
Why DISCOVER?

- **Provide objective experimental evidence** on the value of information management technologies (JBI, fuselets, collaboration)

- **Quantitatively demonstrate** how JBI and fuselets can improve the efficiency and effectiveness of dynamic mission re-planning process in an AOC

- **Identify areas for future R&D** to improve and advance these and other information management, interoperability, and transformation capabilities
DISCOVER – Project Goals

• **Reduce the Footprint [Less People]**
  – Demonstrate how fuselets can perform tedious manpower intensive data collection and processing tasks that are currently done by military personnel
  – Allows the warfighter to focus on warfighting

• **Improve Efficiency [Faster]**
  – Demonstrate how fuselets can increase the speed of decision-making through the production of quality information

• **Improve Effectiveness [Better]**
  – Demonstrate how fuselets can improve the warfighters ability to make better, more optimized decisions
DISCOVER Team

Jim Milligan
AFRL
Project Manager
and Fuselet Development

JBI In-House
AFRL
JBI
Tech Support

John Beyerle
C3I Associates
Subject Matter Expert
and TBMCS Database Bridge

Naomi Dyer
AFRL
TBMCS
Tech Support

Andy Chruscicki
SBS, Inc.
Experimentation and Process
Rqt’s and Design

Gail Raynus
InfoDynamics, Inc.
Collaboration
and Information Visualization

Syracuse Air National Guard
AOC Operator Support for
Experimentation
Experimentation Process

1. Findings & Recommendations
2. Project Strategy & Goals
3. Model “As-Is” Process
4. Problem & Solution Analysis
5. Scope Scenario
6. Model “To-Be” Process
7. System Rqt’s & Design
8. Implement
9. Experimentation & Assessment
10. “As-Is” Process
11. “To-Be” Process
12. Project Strategy & Goals
13. Findings & Recommendations
14. Experimentation & Assessment
15. “As-Is” Process
16. Problem & Solution Analysis
Dynamic Collaborative Mission Replanning Scenario (page 3)

ODO Assigns MDS or BDO:
1. Reviews TBMCS status display
2. Selects the F16E Fighter Duty Officer (FIDO) to further plan mission

FIDO Review & Resource Selection:
1. Reviews Base and Unit Status Reports, to select resources to execute attack
2. Selects a mission to re-roll, and determines the proper munitions that need to be uploaded by the unit possessing the platform
3. Checks with Unit Status Technician to be assured the unit is qualified to upload the selected munitions

Post Mission Re-roll:
1. Posts the re-planned mission shell with its planned Time on Target, take off time, landing time.
2. Based on the mission distance, fills out an air refueling request in the mission shell
3. Sends alert to Air Refueling Technician and Weather Duty Officer

Confirm Unit Qualified:
1. Responds with Unit qualification answer

Unit Status Technician

FIDO Alert

Selection is based on the weaponry suggestions, the target area threat to re-roll an asset as shown on the Common Relative Operational Picture (CROP), the requirement for a daylight attack, the requirement for guided munitions, the target DMPI, and his experience.

Target Nomination Message

Weather Alert

Offensive Duty Officer

TBMCS CROP

TBMCS EMC

TBMCS AAT

Weapon Selection

Base Status Report

ATO Mission Marquee

Air Refueling Request

Alert

No

Yes

Re-planned Mission Shell

Confirm Unit Qualified

TBMCS EMR

ARCT Alert
Problem & Solution Analysis

- Subject Matter Expert (SME) interaction
- Operational briefings
- Legacy AOC system demonstrations
- Documentation review
- Legacy system capability analysis and data modeling
- As-is scenario analysis
F15E Fighter Duty Officer (FIDO)
Collaborative Decision Making (“As-Is”)

TBMCS EMC
Base and Unit Status Reports

FIDO Review & Resource Selection

TBMCS AAT
ATO Mission Marquee

FIDO

Air Refueling Request

Re-planned Mission Shell

TBMCS EMR
Takeoff, Target and Landing Forecasts

FIDO

Proposed Re-plan

TBMCS EMC

Weather Officer

Weather Analysis

FIDO

Rework Mission Events for Re-plan of Targeting

TBMCS AAT
Air Refueling Request

FIDO

Adjust ARCT for Supportability

TBMCS EMR
Adjust Air Refueling Request

FIDO

Proposed Re-plan

OVO
Approve / Disapprove

Air Refueling Request

TBMCS EMC
Planned Receivers Marquee

Air Refueling Technician

Assess ARCT Supportability

FIDO

Air Refueling Technician

FIDO

Confirm Unit Qualified

Unit Status Technician

Post Mission Re-Roll

FIDO

FIDO

FIDO

FIDO

Approve

FIDO

Rework Mission Events for Re-plan of Targeting
F15E Fighter Duty Officer (FIDO) Collaborative Decision Making (“To-Be”)

- **Unit Status Technician**
  - Enter Unit Qualifications

- **UST Client**

- **Weather Officer**
  - Furnish Target Criteria Information
  - Assess ARCT Supportability

- **JBI**
  - Pub/Sub/Qry
  - Instant Messaging

- **Database Bridge**
  - Subscribe
  - Query
  - Result

- **MIDB**
  - AODB

- **TBMCS**

- **FIDO Review & Resource Selection**

- **FIDO**
  - Post Mission Re-Roll
  - Rework Mission Events for Re-plan of Targeting

- **Approve / Disapprove**

- **Fuselets**

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*Images and icons representing various components and connections.*
Requirements and Design

- Information object engineering (XML Schema)
- GUI storyboarding (Visio)
- Scenario-based use cases (UML)
- Sequence diagrams (UML)
- Architecture context diagram (UML)
- Textual capability requirements specification
System Architecture

- UST Client
- Portal Client
- Presentation
- Special Requirements
- Chat
- Messaging
- DISCOVER

- TBMCS Applications
- AODB
- MIDB
- JBI Database Bridge

- JBI
- Fuselets
Project Status

- UST Client
- Portal Client
- JBI
- TBMCS
- Applications
- JBI Database Bridge
- AODB
- MIDB
- Fuselets
- DISCOVER
- Chat
- Messaging
- Presentation
- JWIS
- Special
- Requirements
- Implemented
- Partially
- Not Implemented
- Legacy / Other
## UST Client

**DISCOVER Convergence Portal**

Logged in as: jsmler

### UST Client

**UST Client**

### USTclient

<table>
<thead>
<tr>
<th>Base Name</th>
<th>Unit</th>
<th>Munition Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Griffiss</td>
<td>AFRL</td>
<td>Tool the munitions display</td>
</tr>
<tr>
<td>Otis AFB</td>
<td>522nd Bomber Wing</td>
<td>Tool the munitions display</td>
</tr>
<tr>
<td>Otis AFB</td>
<td>15th Fighter Bomber Wing</td>
<td>Tool the munitions display</td>
</tr>
</tbody>
</table>

Show all munitions | Hide all munitions

### Add/Remove Unit Munition Qualifications

- Select Operation (Add/Remove)
- Select Unit
- Select Munition

Update

Filter by Base: No Filter
Filter by Unit: No Filter
Database Bridge

- Modified to produce the “raw” TBMCS information objects required by the DISCOVER project
Fuselets
Shared Updatable Knowledge Object (SUOKO)
SUKO Publishes Internal State Upon Receipt of a Trigger

[ {'baseid': 525, 'basename': 'Otis', 'unit': '7th Fighter Wing', 'munition': 'MK82' },
 {'baseid': 525, 'basename': 'Otis', 'unit': '7th Fighter Wing', 'munition': 'AGM65' },
 {'baseid': 525, 'basename': 'Otis', 'unit': '102nd Fighter Wing', 'munition': 'GBU52' } ]
### Portal Client

![Portal Client Interface](image)

#### Target Information

<table>
<thead>
<tr>
<th>Target DMPI</th>
<th>Target Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATK23</td>
<td>ENEMY HEADQUARTERS</td>
</tr>
</tbody>
</table>
Preliminary Findings

Issues

• Narrowing the gap between the SME and software developers
  – A great deal of application domain knowledge needs to be assimilated before an understanding of problems and the development of potential solutions can be embarked upon

• It seems there will always be is a fairly steep learning curve, either for the fuselet/software developer to understand the problem domain, or for the subject matter expert to learn how to build fuselets and companion clients

• Until we can empower the typical SME in this way, we will always have to employ a problem solving methodology such as we have under DISCOVER to understand and derive solutions to customer problems
Preliminary Findings
Reducing the footprint

• It is evident that we can accomplish this by eliminating the need for a Unit Status Technician (UST) to report unit qualifications by capturing this information in the JBI and associating it with the information captured from TBMCS

• This in turn leads to better decision-making efficiency and effectiveness…
  – Allows the UST to perform other mission-critical tasks
  – Makes target-platform-munition-unit-qualification correlation possible by fuselets to provide operators valid options to choose from promoting more efficient and effective decision making
Preliminary Findings
Improving efficiency

• Augmenting legacy systems with fuselet technology
  — One of the problems that we identified is that TBMCS is largely a sophisticated database query-response system
  — Evidence suggests that fuselets can increase the decision-making speed of AOC duty officers by automatically correlating a given target to valid mission re-roll options
  — Fuselets would provide a proactive decision-support capability, as opposed to a reactive one where there is a high potential for no-go decisions where replanning has to back up and repeat itself

• Distributed collaboration for distributed operations and improved communications
  — Today, much of the person-to-person communication is done by “tennis shoe” interfaces, which makes distributed AOC operations difficult and centralized operations vulnerable to attack
  — Therefore, automation for collaborative capabilities provided by chat, instant messaging, and portal technology would in theory be beneficial to speeding up communication between operators and enable it to be done in a distributed way
Preliminary Findings

Improving effectiveness

• Through controlled experimentation we can demonstrate how fuselets improve the warfighters ability to make better, more optimized decisions
  — Measure % improvement in missions re-rolled successfully (best selections) in a laboratory setting using realistic data sets
  • Do so first without our technology
  • Do so second with it
  • Compare the results
Next Steps

- Complete system/fuselet development
- Complete experiment design plan
- Execute phased experimentation
- Perform data analysis
- Document results and provide recommendations
- Initiate fuselet security study
  - Investigate and report on the operational security implications of JBI fuselet technology, particularly within the operational context of the DISCOVER experiment
  - Demonstrate in the DISCOVER prototype a role-based approach for addressing some of the security concerns uncovered by the study
That’s all for now…

• Thank you.

— Questions?