Theater Battle Management Core Systems (TBMCS)  
Virtual University  
Proof-of-Concept Trade Study  

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10th ICCRTS  
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Systems & Solutions  
Colorado Springs, CO
Overview

• Problem Definition
• Solution – Trade Study
• Research Questions
• Proof-of-Concept Test Phases
• Methodology
• Findings
• Capability Summary
• Expected ROI
• Lessons Learned
• Summary
Problem Definition

- Electronic Systems Center (ESC)/ACF Theater Battle Management Core Systems (TBMCS) system program office training requirements continued to increase and training budget continued to decrease
- TBMCS end users dispersed world wide
- Approximately 50% of training budget for Mobile Training Team (MTT) travel costs
- High ops tempo for user base (military)
  - Need for anytime, anywhere training
- Compliance with DOD Advanced Distributed Learning (ADL) concept
  - Very little lessons learned /best practices amongst the DOD community
Solution – Proof-of-Concept Trade Study

• Requirements committee opened action item for TBMCS System Program Office to research feasibility of implementing alternative training to MTT.
• ESC/ACF conducted trade study Jun-Dec 03 to determine if a Virtual University (VU) is an effective alternative to MTTs. Key concepts included:
  – Asynchronous/Synchronous Training
  – Application Sharing
  – Collaborative Tools
  – Run over NIPRNet/Internet
Key Concepts Defined

• Synchronous Training
  – Instructors and students are in the classroom real time
  – Instructor and students are geographically separated but connected by computer network
  – Emulates a live classroom
  – Hands-On Practice with Instructor Over-the Shoulder

• Asynchronous Training
  – Recordings of Synchronous classes
  – Self-paced/web-Based training courses
  – Training materials
Research Questions

1. Can joint training requirements be effectively met via synchronous/asynchronous distance learning?

2. Can the current DOD infrastructure support synchronous distance learning technologies?

3. Is there a cost savings for a virtual course vs. MTTs?
VU Proof-of-Concept Test Phases

• Phase I – Request for Information
  – Select Vendor Candidates
• Phase II – Fly-off Between Vendor Finalists*

*Focus of report
Phase II

VU Fly-off Testing

Four Objectives

1. Assess the VU performance on DOD network and computing infrastructure
2. Assess the overall capability/functionality of VU SW to insure compatibility with TBMCS unique training solutions
3. Assess the ease of use of the VU by students and instructors
4. Assess the task-technology fit to determine if the VU is an appropriate technology for teaching TBMCS tasks
# Methodology

## Evaluation Types*

<table>
<thead>
<tr>
<th>Approach</th>
<th>Description</th>
<th>Collection Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective-oriented Approach</td>
<td>The focus of this approach is on specifying goals and objective and determining the extent to which they have been attained.</td>
<td>Type: Test Cards</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Who: Participants, Observers, Instructors</td>
</tr>
<tr>
<td>Participant-oriented Approach</td>
<td>This is dependent upon the involvement of the participants. Stakeholders are central in determining the values, criteria, needs and data for the evaluation.</td>
<td>Type: Test Cards/TAM Survey</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Who: Participants, Instructors</td>
</tr>
<tr>
<td>Experience-oriented Approach</td>
<td>This approach is dependent upon the direct application of professional expertise to judge the training objectives can be met in a virtual environment.</td>
<td>Type: Observation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Who: Subject Matter Experts</td>
</tr>
<tr>
<td>Management-oriented Approach</td>
<td>This approach is used when the central concern is on identifying and meeting the informational needs of managerial decision makers.</td>
<td>Type: Systems Evaluation Approach</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Who: Program Manager</td>
</tr>
</tbody>
</table>

Methodology
VU Test Collection Instruments

• Test Cards – Derived from Test Plan Objectives
  – Individual test cards to measure: ease of use for pre-class preparation, entering/exiting classroom, capability for student to receive lecture/demonstration of a learning objective, student attempts to complete exercises, independent practice, etc.

• Observer Field Notes – Log
  – Student reactions, voice/data quality, etc.

• Technology Acceptance Model Survey* – Captured Qualitative, Overall Impressions
  – Perceived usability & ease of use

• Performance Monitoring – System Metrics
  – Topaz Prism/Mercury Interactive tool

*Technology Acceptance Model Defined -- http://www.absoluteastronomy.com/encyclopedia/T/Te/Technology_acceptance_model.htm
Methodology

VU Test Activities

• Student logs-in and enrolls
• Student takes pre-test
• Student downloads needed worksheets and handouts
• Class in session*
  – Instructor explains and demonstrates TBMCS operation
  – Students practice using real application
  – Instructor provides individual over-the-shoulder help as needed
  – Student takes post test and completes critique

*system performance metrics collected

Activities emulate a traditional classroom environment
## Methodology

### VU Test Participants

<table>
<thead>
<tr>
<th>Organization</th>
<th>Location</th>
<th>Number of Testers</th>
<th>Number of Tests They Participated In</th>
</tr>
</thead>
<tbody>
<tr>
<td>12AF</td>
<td>Davis-Monthan</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>7AF</td>
<td>Osan</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>8AF</td>
<td>Barksdale</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>9AF</td>
<td>Shaw</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>ACC/DOY</td>
<td>Langley</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>CENTAF</td>
<td>Al Udeid</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>ESC/ACF</td>
<td>Hanscom</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>NORAD</td>
<td>CMOC</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>PACAF/DOQ</td>
<td>Hickam</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>USAFE</td>
<td>Ramstein</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>USMC</td>
<td>Hanscom/Hurlburt</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>USN</td>
<td>St. Juliens Creek</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Representative of target audience
Methodology

Limitations

• Paradigm Change
  – Perceptions/attitudes that on-line environments are not as efficient (both instructors and students)
  – A new way of teaching/learning for everyone
  – Determining non-verbal feedback from students
• Bandwidth at Selected DoD Installations
• Program Level Security
Findings

Data Results – Test Cards

- Tests
  - One Connectivity Test
  - Two Informal Tests
  - Four Formal Tests
- Seven Test Cards
  - Class Prep
  - Classroom Entry
  - Intro to Class
  - Instructor Demo
  - Supervised Practice
  - Independent Practice
  - Close Class
- Participants
  - 42 total participants
  - 28 returned surveys
  - 66% response rate

<table>
<thead>
<tr>
<th></th>
<th>N/A</th>
<th>Fail</th>
<th>Some Problems</th>
<th>Pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Responses*</td>
<td>79</td>
<td>11</td>
<td>49</td>
<td>1011</td>
</tr>
</tbody>
</table>

*frequency count
Findings

Data Results – TAM Survey

• Test
  – Surveys conducted simultaneously with the test cards and were turned in at the conclusion of each test

• Survey focus
  – Perceived usefulness – “The degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989).
  – Perceived ease-of-use – “The degree to which a person believes that using a particular system would be free from effort” (Davis, 1989).

• Participants
  – 51 total participants
  – 14 returned surveys
  – 27% response rate

Total Responses

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
<td>21</td>
<td>67</td>
</tr>
</tbody>
</table>

TAM Survey

- Frequency count


06/13/05
Findings

Data Results – Observations

• Test
  – Observations were conducted simultaneously with formal tests

• Observer Log
  – Detailed notes to annotate observations as they occur.

• Focus Group
  – Facilitate discussions through posing initial questions to obtain reactions from others in the group.

“Just wanted to give you my two-cents worth of impressions about Virtual University. It's great! 'Nuff said!” Bill Smith/46 Test Squadron

“Great product. Good tool for collaborative training” Sherry Robinson/ESC Langley AFB

“Product is easy to use and captured interests/needs of testers. Excellent choice for on-line application sharing”

Meredith Briscollino/AOC Training Manager
Capability Summary
(At End of Testing)

• VU can emulate live classroom
  – Delays in audio and video negligible
  – Instructor able to demonstrate as live classroom
  – Q&A interactions as effective as live classroom
  – Students easily able to operate actual TBMCS applications
  – Over-the-Shoulder Help as effective as live classroom
    • Once users participated, the attitudes were quickly changed
ROI Expectations

- Decreased travel expenses for students or instructors
- Decreased physical classroom space
- Increased productivity because instructors can stay on task and continue to get part of their day job accomplished
- Lower course distribution costs
- A wider student populace is trained because individuals may not have the time or budget to attend a traditional class
- The best instructors can be made available worldwide at the same time to support user needs


Return On Investment (ROI) – Projected Estimates

• Cost Per Student Training Hour

• MTT Specific Costs (Travel)

  Year 1                      Year 2
  – 240 Students – $24.68     $26.41
  – 480 Students – $12.34     $13.20

• VU Specific Costs (Setup/Sustainment)

  Year 1                      Year 2
  – 240 Students – $25.87     $6.45
  – 480 Students – $12.94     $3.23
Research Questions – Concluded

1. Can joint training requirements be met via synchronous distance learning?
   – Yes

2. Can the current DOD infrastructure support synchronous distance learning technologies?
   – Yes

3. Is there a cost savings for a virtual course vs. MTTs?
   – Yes (projected)
Lessons Learned

• Limit Class Size to 10-15
• Provide “101” class separate from course
• Provide clearer registration and enrollment instructions
• Early sign-in required
• Local NIPRNet workstations security lockdowns problematic
Summary

- VU Proof-of-Concept trade study was an effective means to identify, assess and select a vendor that would best meet the Government needs.
- Final vendor demonstrated on-line synchronous/asynchronous, application sharing capability which is beneficial to the Government in solving training problems.
- VU product is a viable solution as an alternative to MTTs.
Back Ups
Network Architecture

TBMCS Training Virtual University Configuration

https://vu.tbmcstrain.com
ELMS/Colaborative Virtual Classroom (LM-MS Extra Net)

Cisco Router 16 Port

TBMCS Training System

Weblogic (Sun 420)
(TBMCS Web Application Server)

Oracle Server (Sun 420)

Sybase Server (Sun 420)
(TBMCS CAOC Central Webhost)

https://vu.tbmcstrain.com
ELMS/Colaborative Virtual Classroom (LM-MS Extra Net)

CheckPoint Firewall by CheckPoint
Stateful Inspection System with Protocol Inspection Implemented

TBMCS Training System
Weblogic (Sun 420)
(TBMCS Web Application Server)

Oracle Server (Sun 420)

Sybase Server (Sun 420)
(TBMCS CAOC Central Webhost)

Centra Server
Centra Collaboration Server
(Windows 2000 with IIS)

Centra Server
Centra Knowledge Center ELMS
(Windows 2000 with IIS)

Virtual University Instructors

HTTPS Port 443 Open

Internet

NIPRNET

TBMCS Student Clients (Public Access)
Browser based interface to ELMS via HTTPS

TBMCS Student Clients (Base Access)
Browser based interface to ELMS via HTTPS on Base

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VU Test Suite Hardware

- Windows PC with Headset or Microphone and Speakers
  - 2 Instructor Workstations
  - 1 Moderator Workstation
  - 1 Support (Help Desk) Workstation
  - Multiple Student Workstations
- TBMCS Lite Application Suite (Unclassified)
  - ORASVR (Fictional Dataset)
  - SYBSVR (Fictional Dataset)
  - WebLogic (Enhanced Web Applications)
VU Test Suite Software

• Software Plugin (Automatically downloaded)
  – Collaboration Software and Web Browser
• Certificate (Verisign) for Secure Connection
• Asynchronous Downloads of Course Materials
• Communicates Via the Internet and NIPRNET
  – Viable Voice Over IP (VOIP) Performance Via Connections As Low As 28Kbps Dial-Up
  – All Communication Transferred Via HTTP and HTTPS Ports 80, and 443
Phase I – Request for Information
Select Vendor Candidates

• RFI sent to 8 vendors – 4 responded
  – ATC – Intranet U
  – Centra
  – Click2Learn
  – LearnLinc (NS Software)

• VU Team researched all 4 vendors for current customer satisfaction
  – Centra and LearnLinc customers – Highly Satisfied

• Based on a Weighted Rating Scale two vendors – Centra and LearnLinc products – received the highest score
  – Centra and LearnLinc met all of the requirements

• Proceed with Phase II – VU Testing
Example Test Instruments

Test Card #2, Classroom Entry

Student enters classroom and receives an introduction to the class

<table>
<thead>
<tr>
<th></th>
<th>N/A</th>
<th>Fail</th>
<th>Some Problems</th>
<th>Pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2</td>
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<td>3</td>
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<td>7</td>
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</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test Card Example

1. You access TBMCS Website
2. You log into the TBMCS-Centra VU Homepage
3. You enter the VU classroom within 30 minutes of class start time
4. Voice communication established between tester (you) and instructor
5. You observe introduction slides
6. You can easily identify each slide
7. Instructor can easily display an earlier slide in response to a student's question
8. Screen and audio stay in sync

TAM Example

Technology Acceptance Model Survey

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>I would encourage my unit to use the VU for TBMCS training.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.2</td>
<td>If I’m unable to get live TBMCS training, I will make time to attend VU TBMCS classes.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.3</td>
<td>The VU technology provides a suitable alternative to live training.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.4</td>
<td>I would recommend the VU system to others for training.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>If I couldn’t have a live instructor, I would want to attend the VU.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.6</td>
<td>The VU interactions between instructor and students closely emulated the interactions in a live classroom.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Methodology

## Test Schedule

<table>
<thead>
<tr>
<th>Event</th>
<th>Type Test</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor 1</td>
<td>Informal</td>
<td>Oct 03</td>
</tr>
<tr>
<td>Vendor 1</td>
<td>Formal/User Community</td>
<td>Oct 03</td>
</tr>
<tr>
<td>Vendor 2</td>
<td>Informal</td>
<td>Nov 03</td>
</tr>
<tr>
<td>Vendor 2</td>
<td>Formal/User Community</td>
<td>Nov 03</td>
</tr>
<tr>
<td>Vendor 1</td>
<td>Informal</td>
<td>Nov 03</td>
</tr>
<tr>
<td>Vendor 1</td>
<td>Formal/User Community*</td>
<td>Dec 04</td>
</tr>
<tr>
<td>Vendor 1</td>
<td>Formal/User Community*</td>
<td>Dec 04</td>
</tr>
<tr>
<td>Vendor 1</td>
<td>Formal/User Community*</td>
<td>Dec 04</td>
</tr>
</tbody>
</table>

*Multiple time zones*
## Test Results

<table>
<thead>
<tr>
<th>Event</th>
<th>Type Test</th>
<th>Dates</th>
<th>Results#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor 1</td>
<td>Informal</td>
<td>14 Oct 03</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Vendor 1</td>
<td>Formal/User Community</td>
<td>23 Oct 03</td>
<td>Unsatisfactory*</td>
</tr>
<tr>
<td>Vendor 2</td>
<td>Informal</td>
<td>17 Nov 03</td>
<td>Unsatisfactory</td>
</tr>
<tr>
<td>Vendor 2</td>
<td>Comparative Connection Test*</td>
<td>17 Nov 03</td>
<td>Elimination of Vendor #2</td>
</tr>
<tr>
<td></td>
<td>Satisfactory (2 hr connection)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vendor 1</td>
<td>Stress Test*</td>
<td>20 Nov 03</td>
<td></td>
</tr>
<tr>
<td>Vendor 2</td>
<td>Formal/User Community</td>
<td>4 Dec 04</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Vendor 2</td>
<td>Formal/User Community</td>
<td>4 Dec 04</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Vendor 2</td>
<td>Formal/User Community</td>
<td>5 Dec 04</td>
<td>Satisfactory</td>
</tr>
</tbody>
</table>

* 23 Oct test resulted in an unknown loss in connectivity. Performance metrics did not show loss in bandwidth…required additional connection/stress testing to determine cause

# Total results included system capabilities, overall user reaction, and the notation of any significant problems encountered

06/13/05 Not sure if I like this slide