



NAC

**Advanced Collaborative Environments:
Vision + R&D + Services =
Critical Support to Army Programs**

**TARDEC's Advanced Collaborative
Environments (ACE) Laboratory**

Ken Ciarelli * Suzanne Shutes * Michael Cadieux * Bill Smith

The Foundation for the Army's Collaborative Environment



Advanced Collaborative Environments Lab

ACE Workshop Agenda

- The ACE Vision
- The Technology
- Applying ACE to the Army's Programs
- “Selfish Islands”
- Where Do We Go From Here?

Let's try to answer a few questions...

- What is Collaboration? What does it buy you?
- What's different, people have been collaborating for years?
 - What are these new meeting & Review ideas?
 - How can we use it to support M&S?
- What are the key technologies? How do you get started?
What are my choices?
- What is the best strategy for achieving success? What has worked for TACOM... for FCS?
- What are the limitations?
- Requires commitment by leadership, thinking out of the box, not afraid to try...
- Where can I get more information?



ACE...Focused on linking People
and Information

Provide timely, relevant Information...

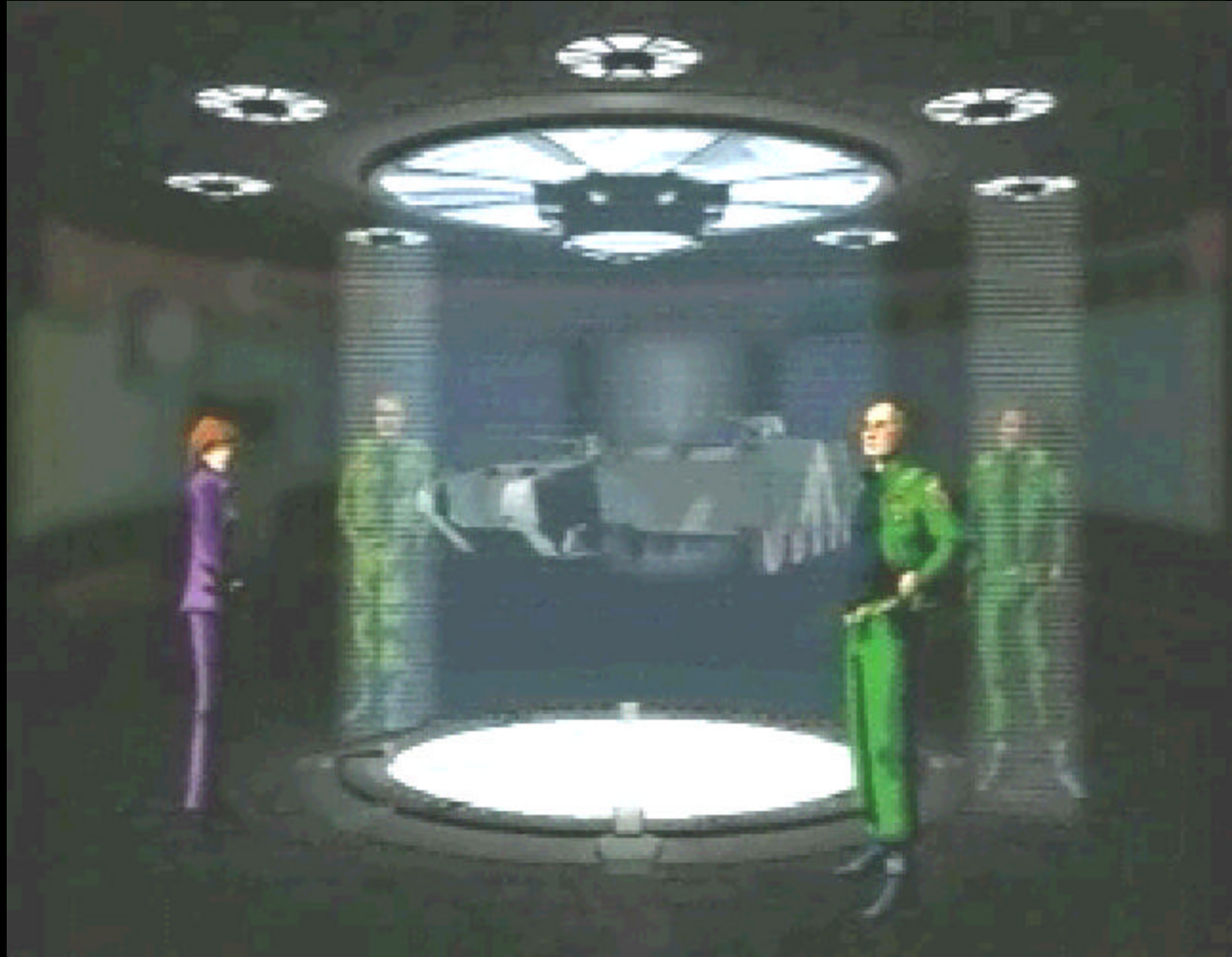
To all relevant people...

Receive timely, relevant Information...

Make Better Decisions...

Generate Quality Solutions

A Collaborative Environment Vision for the Army

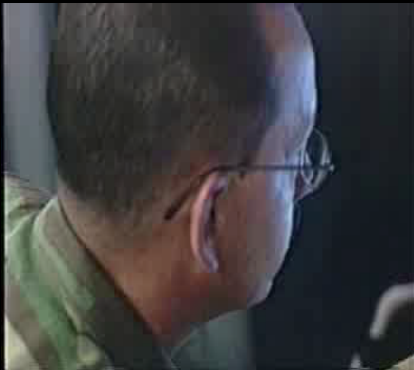


Developing Complex Systems Needs Many Voices



Army's Collaborative Environment

From the Desktop...



Connecting the nation's best...

To develop Future Combat Systems...

And equip our soldiers with the best.

ACE



...to the Virtual World



...at Multiple Sites...

U.S. Army - National Automotive Center - Warren, Michigan

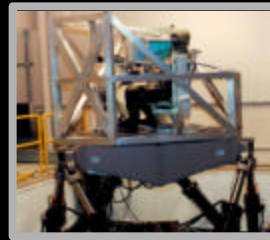
NAC

Systems Integration Using High Tech Collaboration Tools

In the
Office



In the Lab



In the Field



**Quickly Finding,
Viewing,
Understanding,
and Using
Information**

World Wide Web

IDE

On the Road



On the
Shelf



In the Virtual World

**Leverage Commercial Tools with
Industry and Government Partners**

Managed by
PTC
WINDCHILL

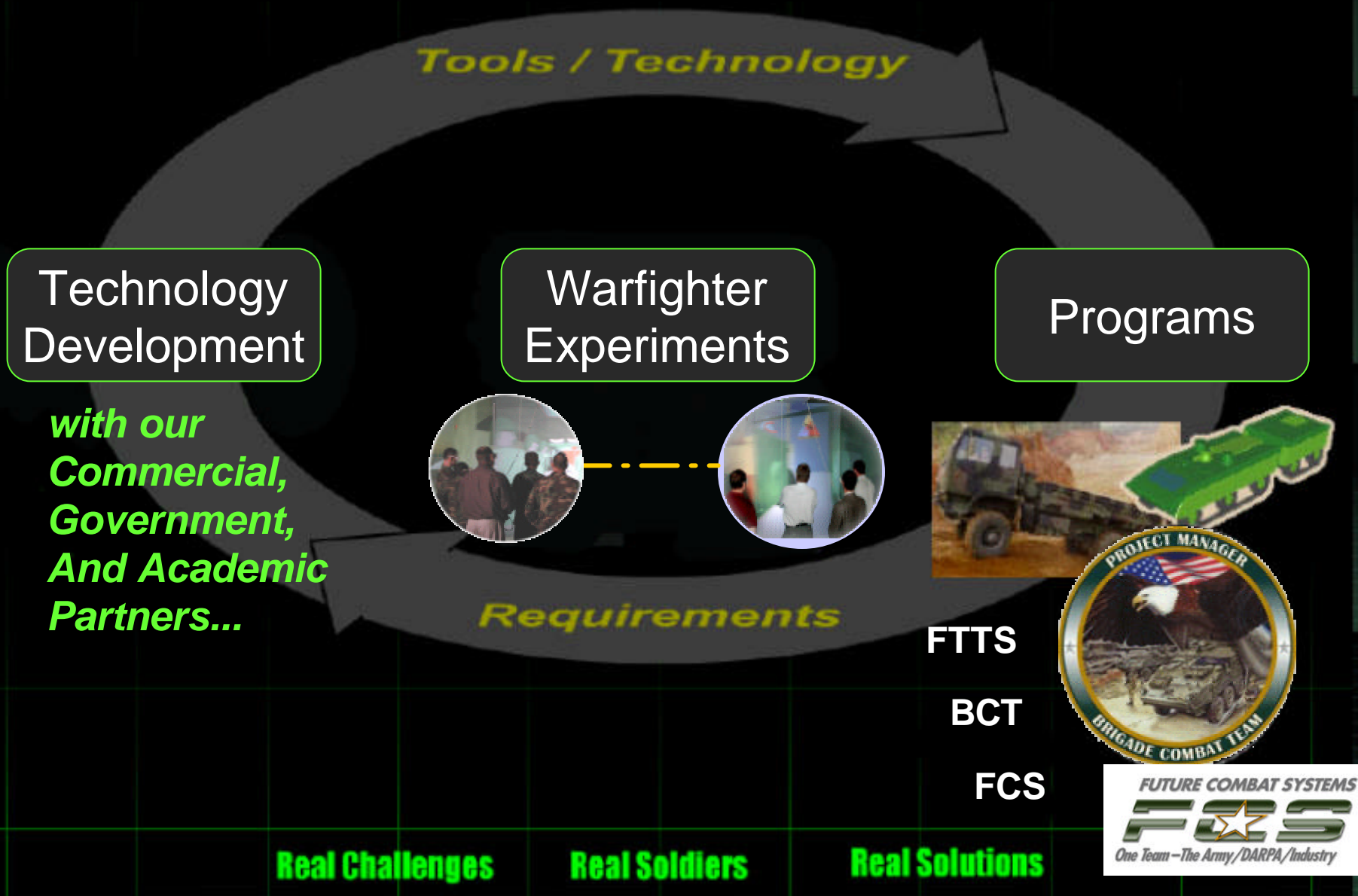
Successes in Advanced Collaborative Environments

- Established the Army ACE Vision
 - Interconnected Distributed Enterprise
 - Improved Communication, Issue Identification-Resolution, Brainstorming
 - Reduced “Waiting for Information”
 - Faster Consensus and Decisions
- Developed a Commercial-based ACE Framework
- Verified ACE Functionality in Army Stryker-Brigade Combat Team Program
- ACE Adopted by Army Future Combat Systems Program and its LSI - Boeing
 - FCS CTD and SDD Phases
- ACE Adopted by Industry



ACE... key to FTTS Success.

Our Approach



Who have we partnered with?

- Boeing
- PTC
- Fakespace Systems
- GDLS
- GM Defense
- UDLP
- LMC
- SGI
- EDS
- Multigen Paradigm
- TASC-Litton
- UoA MBL
- TARDEC Adv. Concepts
- SLAD
- PM BCT
- PM FCS
- PM Small Arms
- NASA
- DOE
- U of Ill-Chicago
- Iowa State
- U of Mich
- Clemson U
- U of Tenn
- U of Central Florida
- U of Iowa

The Enabling Technologies



Collaborative Engineering Environments

Key Enabling Technologies

People-Information Integration

-Web-based Information Technology

-Flexible Workflow Manager

-Immersive Virtual Environments



***Tailoring Technologies for Army
People, Processes, Tools & Data***

Technology View of the ACE

- ? Industrial strength information management system
- ? Web based access, viewing, and interaction with people and information
- ? Display technologies – desktop, PDA, VR, etc.
- ? Network connectivity using various technologies between multiple central sites, distributed users, and to the actual systems being developed
- ? Integrated development, assessment, review, and support tools
- ? Process and workflow facilitation toolsets
- ? Interfaces to existing information sources and related tools
(based on commercial and defacto standards and best practices)

What is Windchill? ?

- **Web-based Enterprise Information Management Foundation**
- **Out of the box - Configuration Management, Document Management, Workflow & Lifecycle Management, Visualization, Data Acquisition**
- **Incorporates a best in class architecture, utilizing tools such as JAVA and XML.**

Native Web Approach



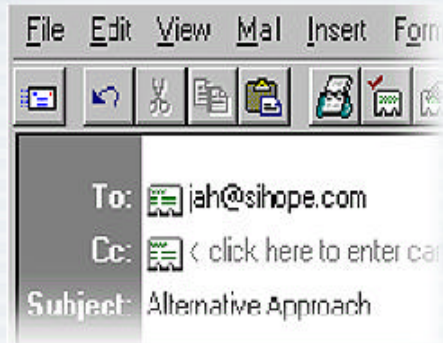
Applets



Search Engines



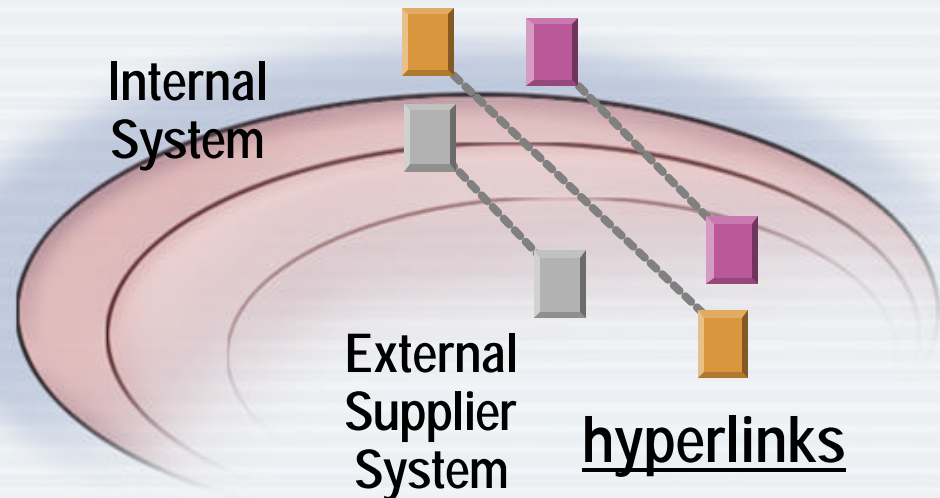
Push



Email

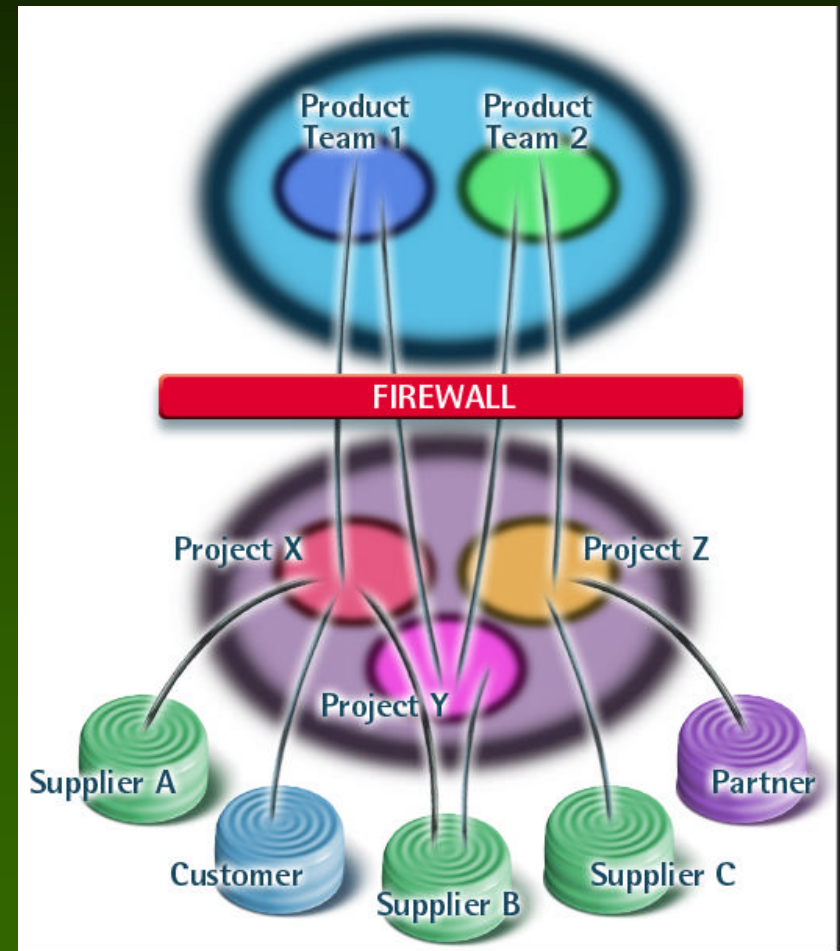


URL's



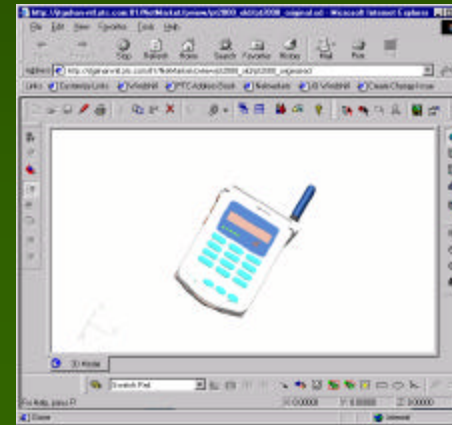
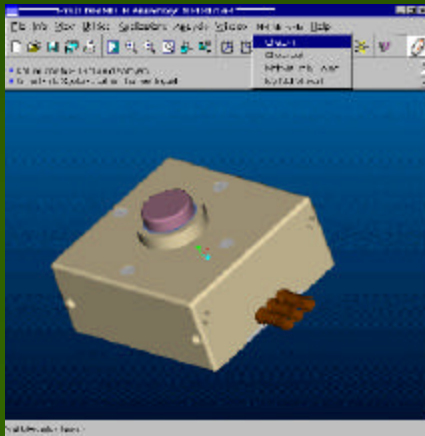
Collaborative Product Design Space & Tools

- Project-Based Approach
 - Document Management
 - Project Milestones
 - Deliverables
 - Meetings and Project Events
- Tools to support a virtual team
 - On-line Meetings
 - Discussion Forums
 - Workflow Processes
 - Subscriptions and Notifications
- Developed for Manufacturers
 - Product Structure Management
 - 3D Visualization and Markup
 - Integrated CAD Interfaces



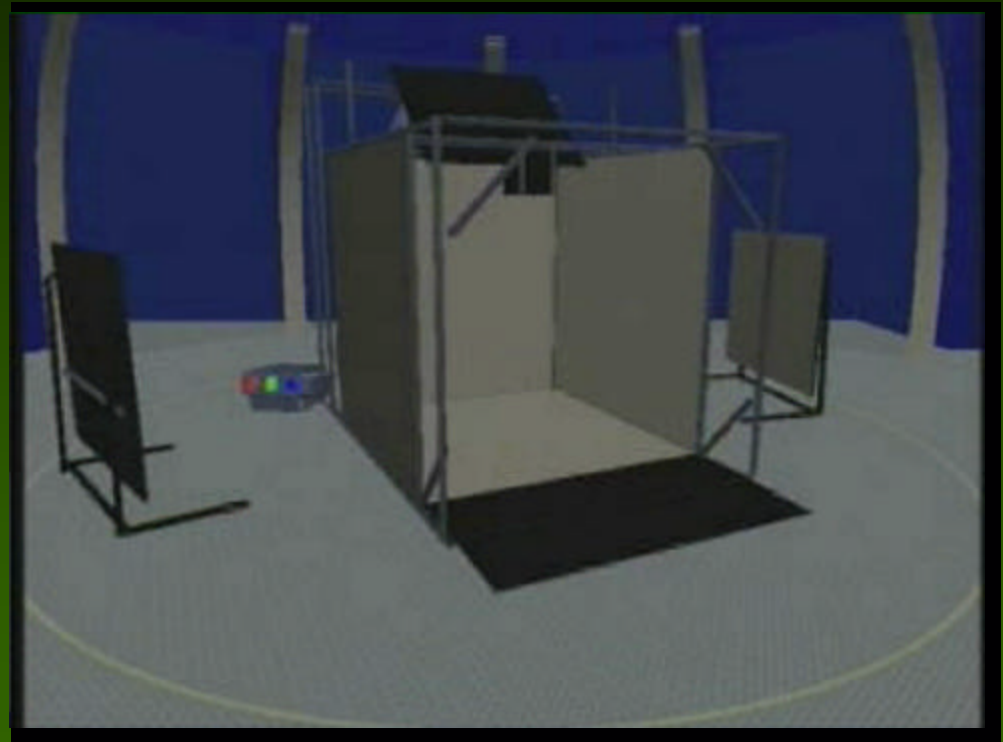
Integrated CAD/Visualization & Markup

- Direct CAD Support
 - Pro/ENGINEER, Catia, AutoCAD, UG
- Simple installation
 - Plug-in downloaded to CAD client
- CAD files vaulting:
 - Integrated check in/check out of sets of CAD files: parts, assemblies and drawings
- Visualization
 - Automatically creates thumbnails
 - Automatically creates viewables
- Product Structure
 - Automatically creates BOM links



Immersive VE – CAVE Device

- Multi-user environment
- One-to-One Scale
- Real-time interaction
- Provides sense of *being inside* e.g. Like a cockpit, or tank crew compartment



Immersive VE

Seeing, touching, interacting...improving understanding - - even without hardware



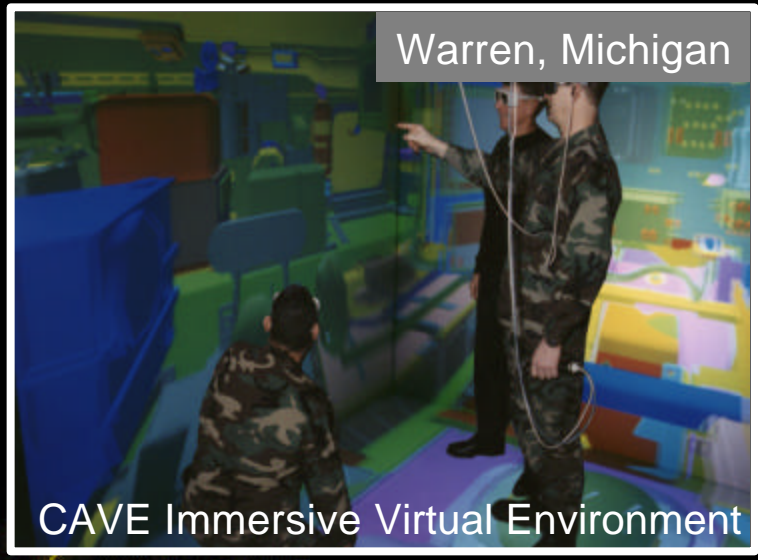
Ft. Knox, Kentucky



CAVE Immersive Virtual Environment

Connecting to the Virtual World

Warren, Michigan



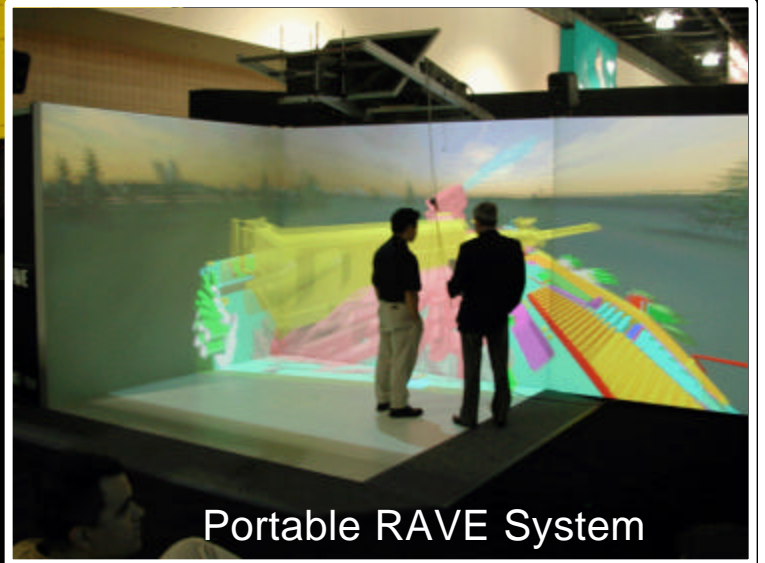
CAVE Immersive Virtual Environment



PowerWall



Warren, Michigan



Portable RAVE System



Impacting the Army's Acquisition Programs



Supporting the Brigade Combat Team

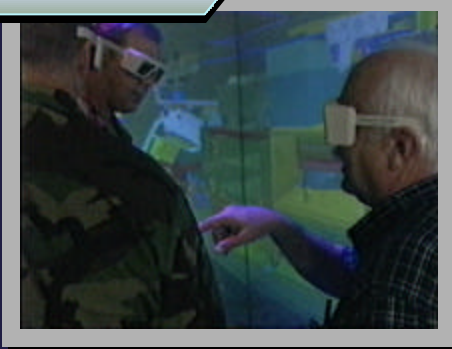


Army's Virtual BCT System Mockups & Collaborative Evaluations

From the Desktop...



IDE



- **20K+ TIR & FACAR Processing in T&E**

...to the Virtual World

Meeting BCT's Aggressive Schedule

Supporting the Future Combat Systems

Manned Systems



The Soldier (2145-2245)



C2V (78)



ICV (54)

Mounted Combat System (54)



Reconnaissance & Surveillance (27)



NLOS Cannon (18)



NLOS Mortar (24)

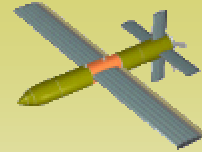


Maintenance & Recovery (9)



Medical Treatment & Evacuation (36)

Unmanned Air Platforms



SUAV (384)



OAV -M (36)
OAV-L (69)

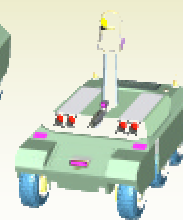


TUAV (16)

Unmanned Ground Vehicles



Armed Robotic Vehicle (27)



Small
Manpackable
UGV (45)



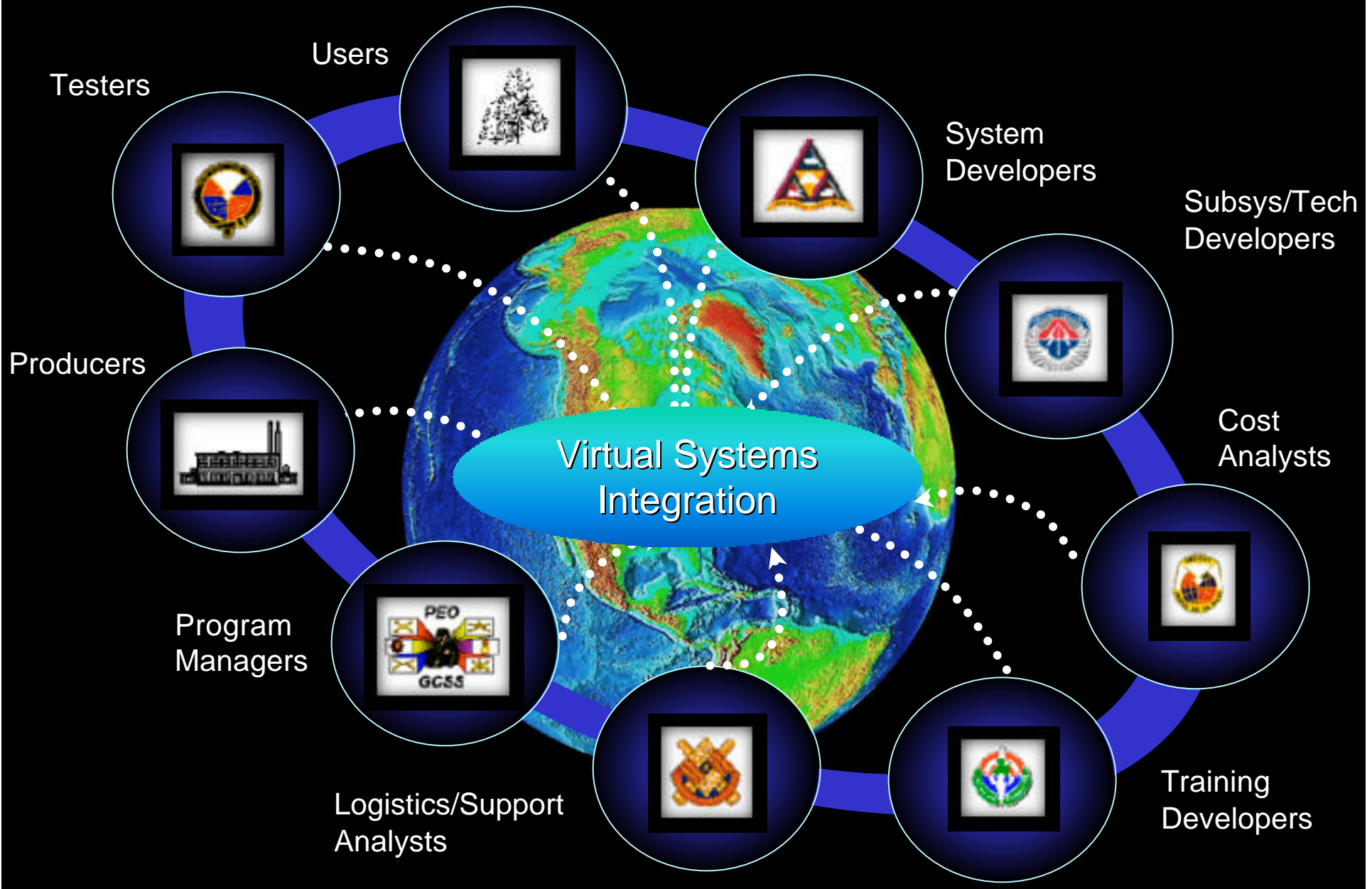
Mule (59)

Unmanned
Payloads

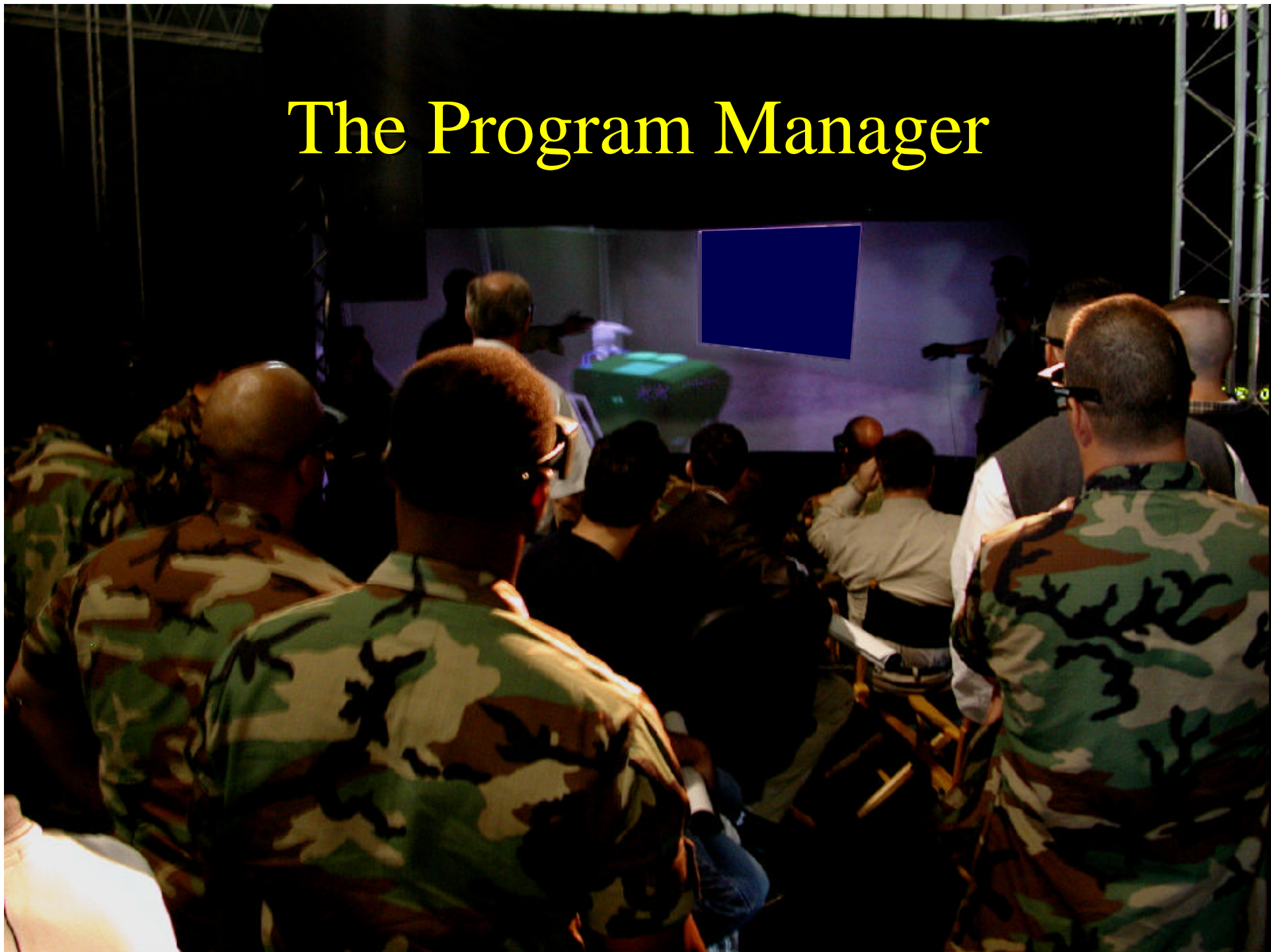
Unattended
Ground
Sensors

Unattended
Munitions
• NLOS LS
• Intelligent
Munitions

Developing Complex Systems Needs Many Voices



The Program Manager



Conducting Virtual Design Walk-throughs & Reviews



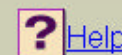
- ? Familiarization with designs and operational scenarios
- ? Two Way Street of Sharing Information and Jointly Making Decisions
- ? Lower Risk...Fewer Hidden Issues
- ? Make Better Quality Decisions
- ? Early Consensus
- ? Brainstorm new ideas

Information Available and Accessible On-demand

- Support a global business environment
- Information and data easily located and accessible
- Types of information - product, program, M&S and analysis. SME, technology
- Access to “live” information - like a helpdesk or information/expert on-call
- Threaded discussions - get related opinions and background information

Support Meetings with Live Information

- Real-time information access
- Support Review, Decision or Status Meetings
- Pulling in other resources when needed
- Eliminate information related action items
- Make the decision now
- Support sidebar/off-line discussions



PM Approve

- [*Home](#)
- [*Personal Cabinet](#)
- [*Checked Out Folder](#)
- [*Search](#)
- [*Worklist](#)
- [*Create Document](#)

Instructions: Comments from Chief Engineer

Rave Ballistics Threat and Crew Capsule Solutions:
Crew Protection issue needs your attention, to meet ORD requirement takes us outside C130 envelope. Recommend frontal protection (bulkhead) only. Need to change ORD to remove side protection. Should we proceed and initiate resolution?

Process:	Rave Issue Resolution
Process Initiator:	Chief Engineer
Due Date:	
Role:	Assignee
Assignee:	Chief Engineer

CEtoPM:

Rave Ballistics Threat and Crew Capsule Solutions:
Crew Protection issue needs your attention, to meet ORD requirement takes us outside C130 envelope. Recommend frontal protection (bulkhead) only. Need to change ORD to remove side protection. Should we proceed and initiate resolution?

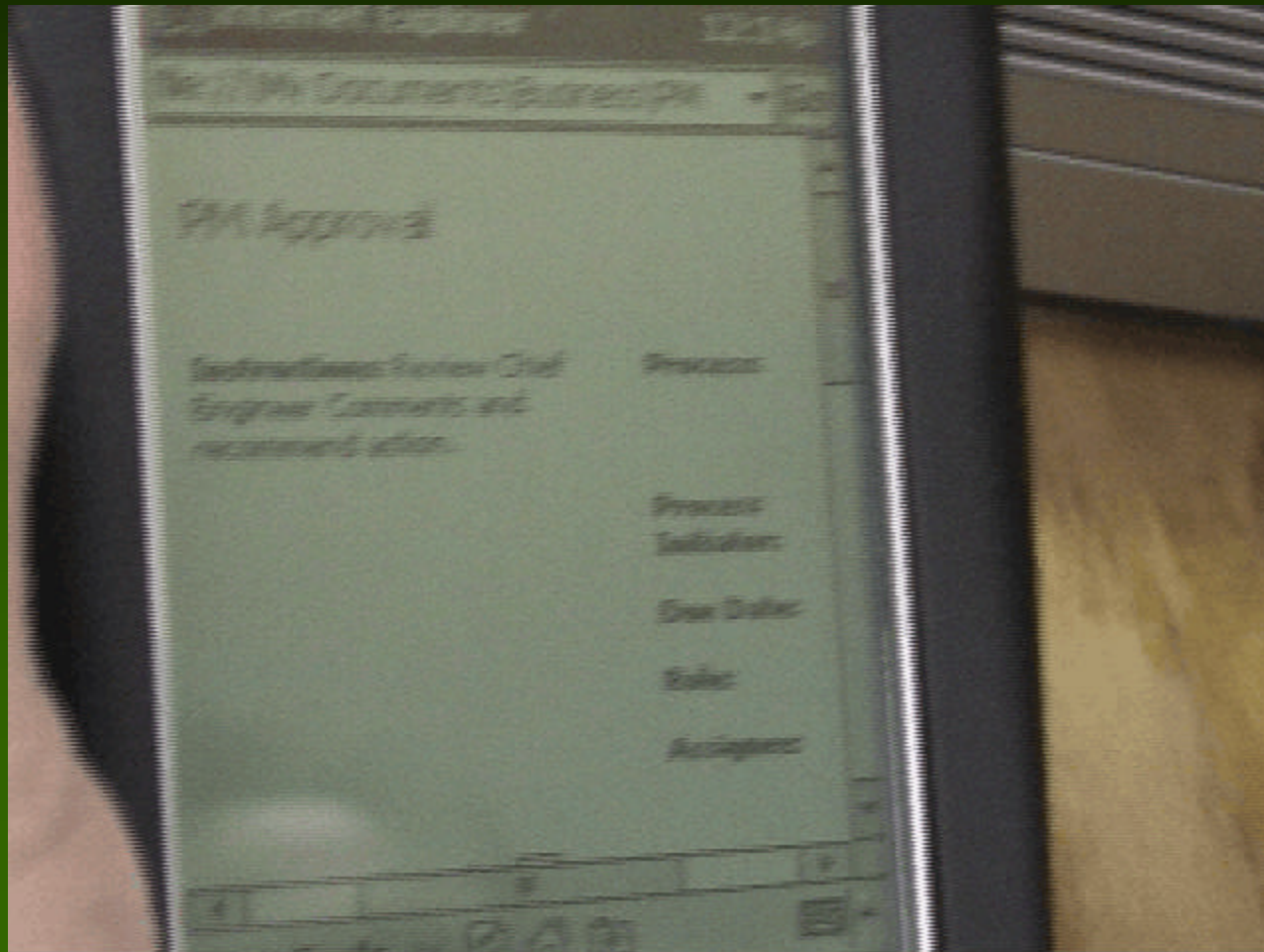
- Yes
- No
- Conduct Further Analysis

Task Complete

[Update Rave Issue Resolution Content](#)

“Live” Information at your fingertips

Staying connected even while out of the office...Quickly responding



The Warfighter



Collaborative Evaluation Process



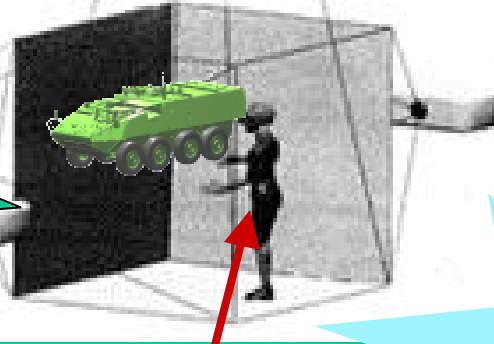
Variant Requirements



Develop Evaluation Plan

Evaluations in CAVE

Conduct Supporting Analysis



Refine Requirements

Analyze Results



Variant Design

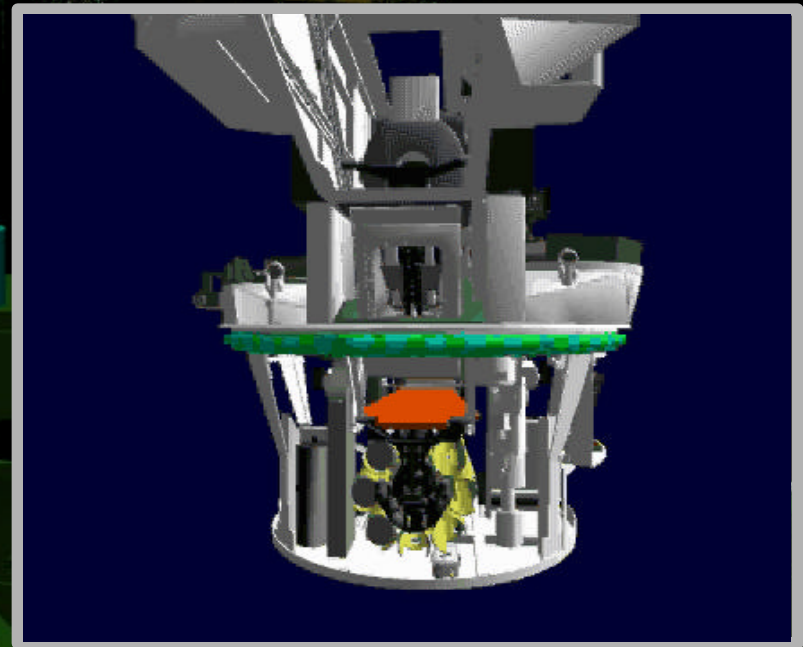
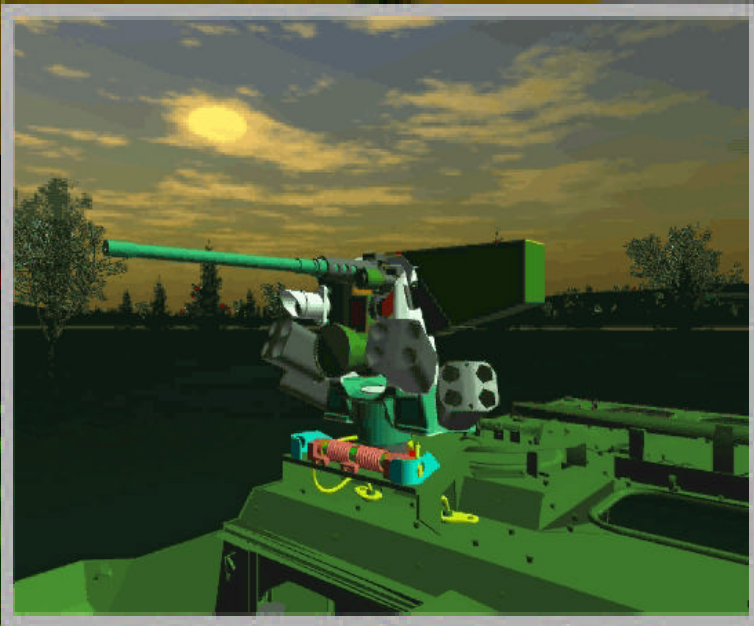
Evaluation Teams
Environment Integrated Data



Refine Base Design



Connecting the Warfighter with Stryker Variants



Connecting in the Virtual World



- Bringing soldiers into the development environment
- Early Evaluations
- Early Operational and Support Considerations
- Rapid and Inexpensive Trade-offs

Capturing & Managing Relevant Feedback

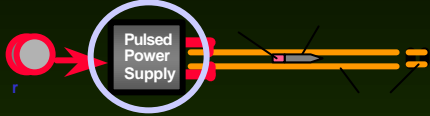


Technology Developer





Wireless Comms & Sensors

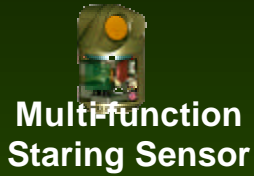


Electromagnetic Gun

Signature Management



Multi-Role Cannon (LOS, BLOS, and NLOS)



Multi-function Staring Sensor

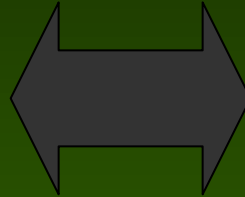
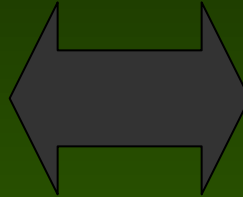
Fuel Cells



A
C
E



Future Combat Systems

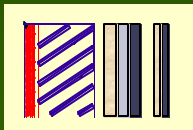


Robotics



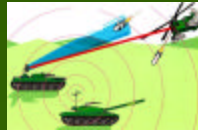
Active Protection

"Missile in a Box"



Advanced Armor

Directed Energy



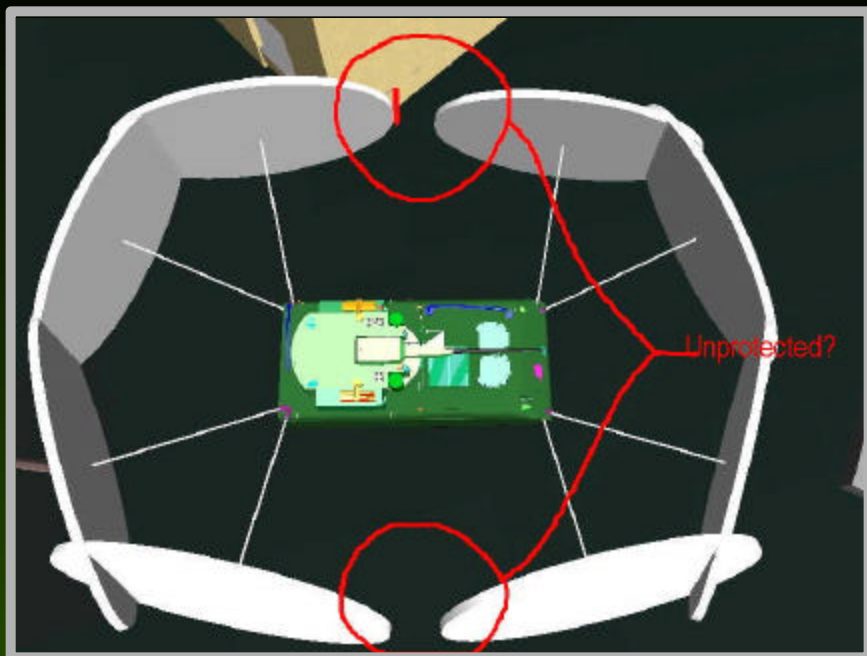
Pulsed Power



CKEM



Using Haptic feedback to
develop Crewstation
Concepts in the virtual
world



Original
Location

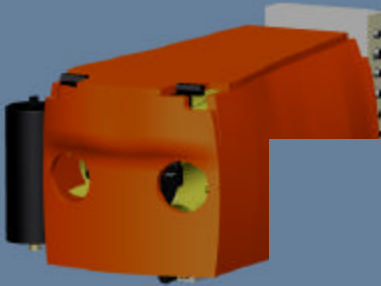
Refined
Locations



Platform Integrator

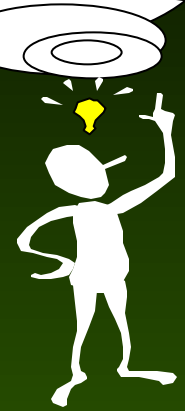
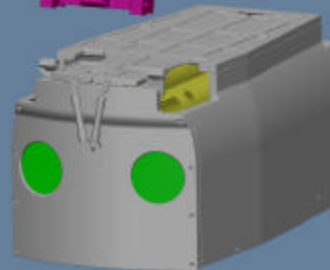


Start with an idea,
sketch in virtual space



Brainstorm alternatives in a shared
virtual space...where many ideas can be
explored & evaluated

Mature the Idea



Add System Functionality



Add all the stakeholders to
enrich the design and
get buy-in

Supporting PM Brigade Combat Team

Design Reviews - a better way

**OLD WAY - Death
by PowerPoint**

**NEW WAY -
Interactive, Engaged**

ICV

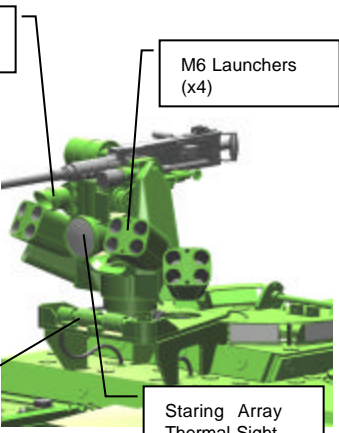
- Weapon
 - KDA Remote Weapon Station
 - M2HB .50 cal
 - Mk19 mod 3 40mm
 - M240 7.62mm MG
 - Defeat light armored targets at 1500m
 - -20° depression to + 60° elevation
 - Targets acquired and engaged from under armor

Day Camera
Target Acq Sight

M6 Launchers
(x4)

Staring Array
Thermal Sight

Height reduction for
air transport



GM GDLS
Defense Group

Z-1AV-025-14 49
2-3 May 2001

**V
E
R
S
U
S**



The way we do it NOW



The IDEAL way to do it <https://ace1.tacom.army.mil/Windchill>

M & S



M&S Plan Execution



- On-line tasking, monitoring, synchronizing
- Streamline data preparation
- CM on Input/Models for VV&A
- Package input/output and related data for on-line review
- Fast delivery of output in useful form
- Traceability from requirements to decisions made

The background image shows three soldiers in camouflage uniforms wearing VR headsets. They are in a virtual environment with various colored platforms and structures. One soldier is pointing towards a virtual object. The scene is dimly lit, with the primary light source being the virtual environment's colors.

Seeing it from the eyes of the Program Office

- Truly manage all M&S efforts
- Keeping M&S relevant...updated information...access results when needed
- “See” understandable results
- On-line archive of entire process

Bigger Bang for the Program's M&S Buck

Seeing it from the eyes of the M&S Provider

- View of the bigger picture & why M&S
- Continuous access of current system information
- Better planning of M&S activities
- Better way to communicate the results and get feedback

Better informed, more visible,
a true part of the program

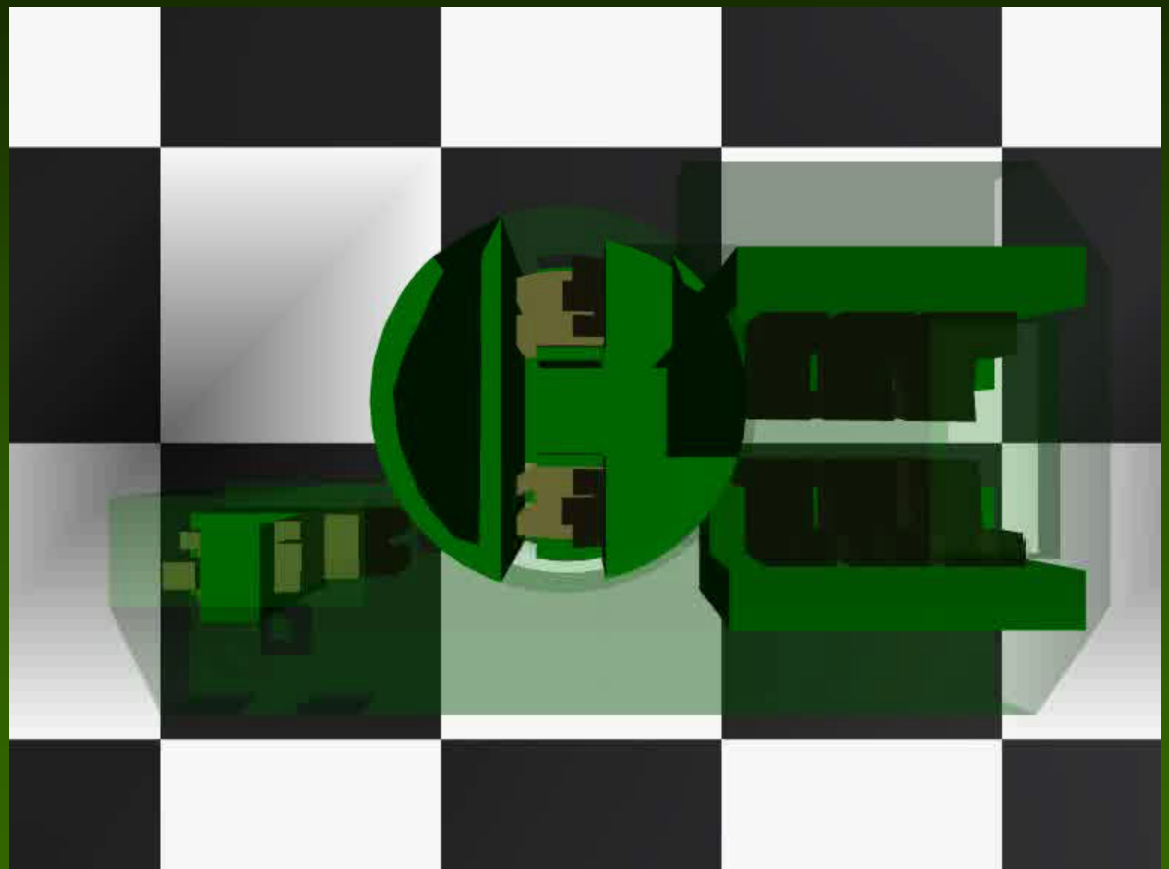
Enriching the Decision Making Further

- Linking other simulations, analytical tools, & testing
- Putting results into understandable views to support decision making



Enriching the Decision Making Further

- BFVS Fire Suppression System Assessment



Executive Management



The Army's Mid-Course Review



FCS Infantry Carrier Vehicle Carrying Capacity Study

FCS Capstone Demonstration

“Clearly show that the FCS program is ready for transition from the Concept and Technology Demonstration (CTD) phase to the System Development and Demonstration (SDD) phase now”

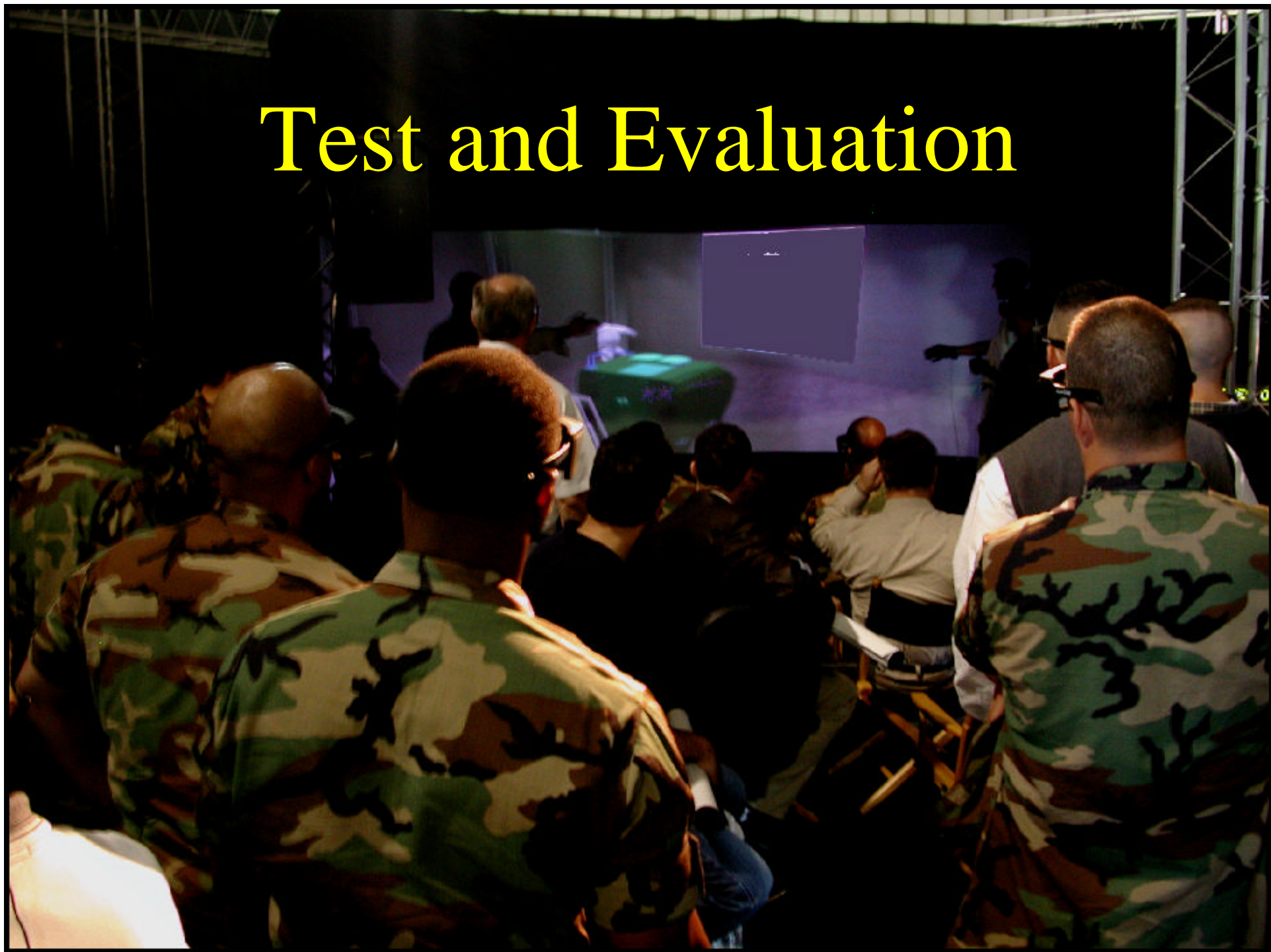


“Live” ACE Data

<http://www>

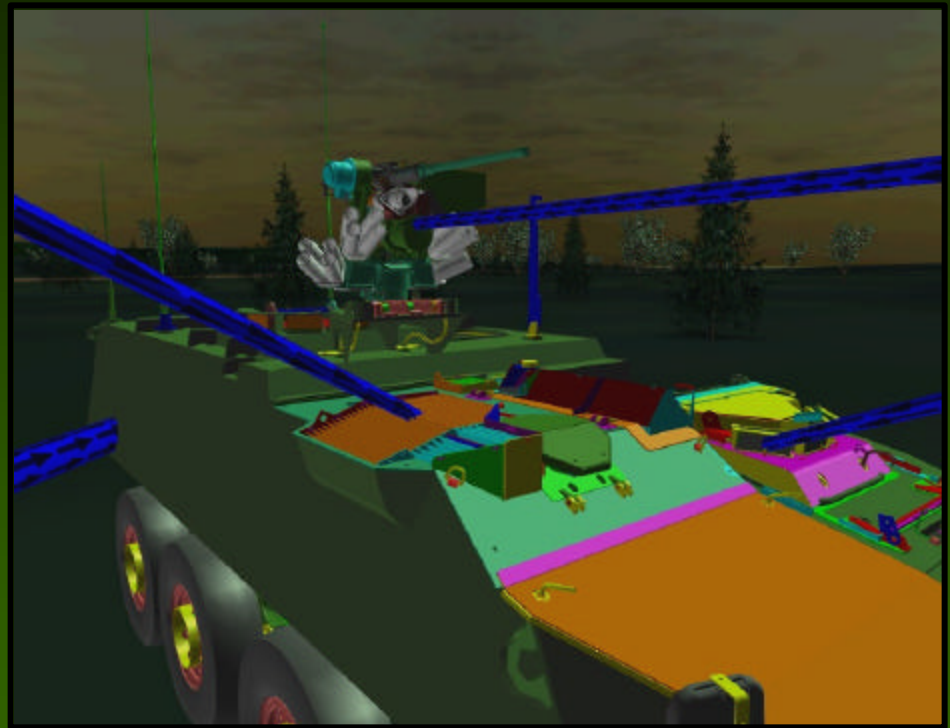


Test and Evaluation

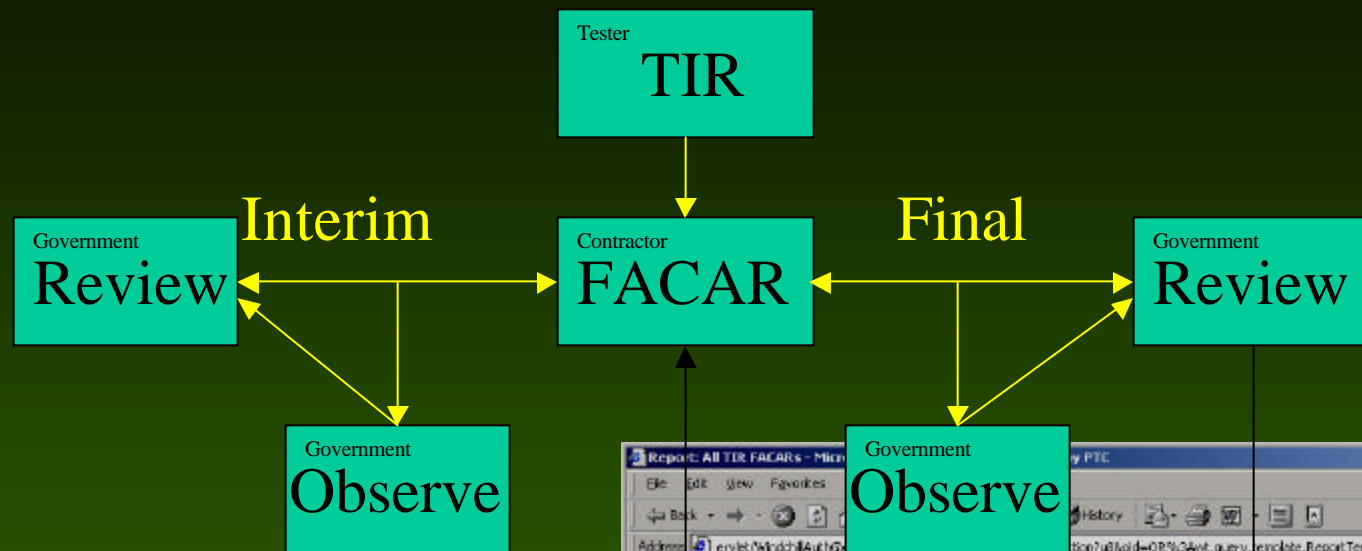


Test & Evaluation

- Test the test plan on the virtual system
- Multidisciplinary review of tests and results
- Fast familiarization of new systems
- Communicate identified issues more accurately and fix them faster
- Kill the rumors and see the test results



TIR & FACAR Process



Report: All TIR FACARs

TIR/FACAR Number	Name	Description	Incident Class
Y2-B000463	QMD OUTSTANDING ISSUES	General M... Outstandi... Styker IC	MAJOR
15-A000026	BILL BOX MOUNT BRACKET BENT	Bill box lid lift cylinder mounting bracket bent, recommendation for	MINOR
15-A000031	HOSE COUPLERS INCORRECT	Hyd hose couplers incorrect; swapped conn; recommend labeling pr	MINOR
15-A000031R1	HOSE COUPLERS INCORRECT	Hyd hose couplers incorrect; swapped conn; recommend labeling pr	MINOR
15-A000062	CUTRIGGER BOARDS TOO SHORT	Trailer outrigger boards unstable during off loading cargo, Safety 19-C	MAJOR
15-G000042	WATER FUEL SEPARATOR LEAK	Fuel/water separator leaking; separator replaced	MINOR

- Automated Document Creation
- Automatic Attribute Assignment
- Automatic Task Assignments
- Easy Tracking

Not Approved

PM Approver

Close

CARB

Public Relations



Sending a Fixed Message with Current Data



Where Do We Go From Here?



Connecting in the Virtual World

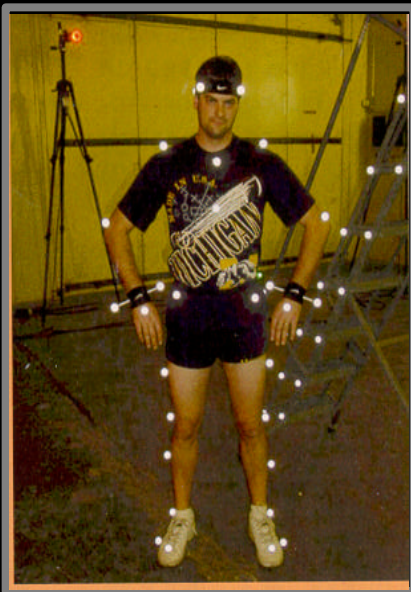


Networked Virtual Collaborative Environments

Integrating ACE with Other Technologies



Voice Recognition



Motion Capture




Augmented Reality / Body Worn Computing



Realistic Motion

TARDEC NAC ACE -- Our Working Strategy

- Provide Technical Guidance/Support to the Army -
 - “show what’s possible using ACE technologies”
- Evolutionary Model
 - focused on deployment/growing vs. development
 - focused on how People collaborate vs. tools/models
- Training/Mentoring/Use to achieve buy-in
- Tool Integration into existing ACE Infrastructure -
 - focus on tools with real impact
- Fast-Start ACE Implementation
 - transition after 6 to 12 months to production service



Future Direction for TARDEC-ACE and Army Collaboration

- Focus and Expand Collaborative Technologies Development
- Create an Army Collaboration Test Bed
 - Leverage established partnerships & resources
 - Specialize to various communities
- Continue to Transition ACE Technologies to the Army and Industry
- Develop the FTTS-ACE as a Showcase App

Challenges

Technology Related

- Lower cost, more portable VE systems and computers
- Faster Graphics at lower cost supporting more geometry/behaviors
- ? More natural wireless input devices in VE
- ? Reduced tailoring for application of Web Framework

Process Related

- ? Easily link physics based models to virtual models
- ? Traceability from requirements, to system model, to sim models
- ? Support Rapid Change Propagation

Other Challenges

- ? Shortage of capable and trained technical people in VE and Web IT
- ? Cultural Acceptance in System Processes takes time
- ? Examine traditional data rights in a Collaborative WebIT environment
- ? Examine information security consequences of linked information resulting from the use of a WebIT environment

Hot Tips, Lessons Learned, & Things to Keep in Mind

- Requires committed leadership who will rely on it
- Willing to **try** at all levels of the organization
- Don't be led astray by "flavor of the month" web tool providers
- If detailed information with **configuration management** is not part of the solution - then it's not worth the effort
- Be patient - it takes cultural changes, it takes process changes, it takes discipline, it takes trust, it takes time - but the payoffs are worth it
- Still very few qualified professionals/vendors that can provide ACE services at a reasonable cost -- too many developers -- not enough practitioners -- not enough mentors -- those who have done it before.

TACOM...
Advanced Collaborative Environments Supporting

**THE ARMY
TRANSFORMATION
TRANSFORMATION**

Web-based Information
Framework



Three Vectors to Transformation

3D Virtual Environment



ACE POC

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