2011 Military Health System Conference

Air Force Medical Modeling and Simulation

Bringing Virtual Reality to Reality

The Quadruple Aim: Working Together, Achieving Success

Colonel Deborah N. Burgess, MD, FACP

26 January 2011

Medical Modernization Division
Headquarters, Air Education & Training Command

Report Documentation Page		Form Approved OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE **26 JAN 2011**	2. REPORT TYPE	3. DATES COVERED **00-00-2011 to 00-00-2011**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Air Force Medical Modeling and Simulation: Bringing Virtual Reality to Reality	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Headquarters, Air Education & Training Command,Medical Modernization Division,Randolph AFB,TX,78150**	8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
presented at the 2011 Military Health System Conference, January 24-27, National Harbor, Maryland

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**45**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

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Overview

- Program Review

- Medical and Simulation Training Limitations

- AFMS Cloud Architecture

- Projects and Resourcing

- DoD MM&ST Consortium

- Strategic Partnerships

- San Antonio Medical Simulation CoE

Program Review

Mission

Integrate Simulation and Emerging Technologies into Education, Training and Sustainment Platforms

Vision

Build a Distributed Simulation Network, Create Centers of Excellence, and Exploit Technological Innovation

Battlefield Trauma, Critical Care Air Transport, In Garrison Care, Patient Safety, Humanitarian Missions, CBRN, Disaster, Homeland Defense and Pandemic Response

Targeted Training Areas

- Combat Casualty Care

- Critical Care Air Transport/Aeromedical Evacuation

- Patient Safety & Team Training

- Currency, Competency, Sustainment

- Graduate Medical Education

- Nurse and Allied Health

- Natural Disaster & Homeland Security

- Pandemic Response
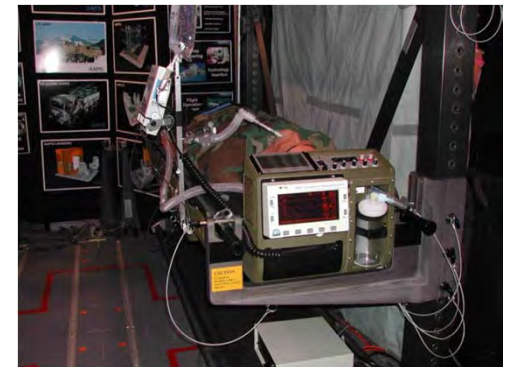
A Call for Change

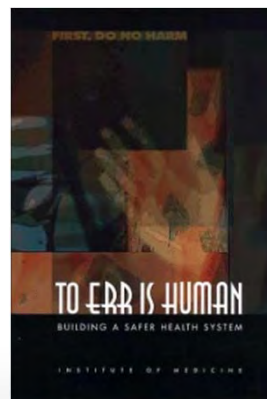November 1999

I N S T I T U T E OF M E D I C I N E

Shaping the Future for Health

TO ERR IS HUMAN:

BUILDING A SAFER HEALTH SYSTEM

Recommendation 8.1:

"Patient safety programs should…establish interdisciplinary team training programs for providers that incorporate proven methods of team training, such as simulation."
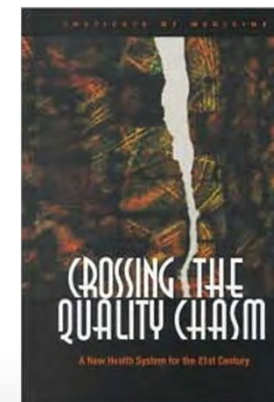
March 2001

I N S T I T U T E OF M E D I C I N E

Shaping the Future for Health

CROSSING THE QUALITY CHASM:

A NEW HEALTH SYSTEM FOR THE 21ST CENTURY

"Faced with such rapid changes, the nation's health care delivery system has fallen far short in its ability to translate knowledge into practice and to apply new technology safely and appropriately"

One Decade Later…

Department of Health and Human Services
OFFICE OF INSPECTOR GENERAL

ADVERSE EVENTS IN HOSPITALS: NATIONAL INCIDENCE AMONG MEDICARE BENEFICIARIES

Daniel R. Levinson
Inspector General

November 2010
OEI-06-09-00090

- 13.5% Medicare inpatients have at least 1 unexpected adverse event
  - 1.6M harmed per year
  - 180,000 fatalities per year

- 44% "clearly or likely preventable"
  - 707,000 harmed per year
  - 79,000 fatalities per year

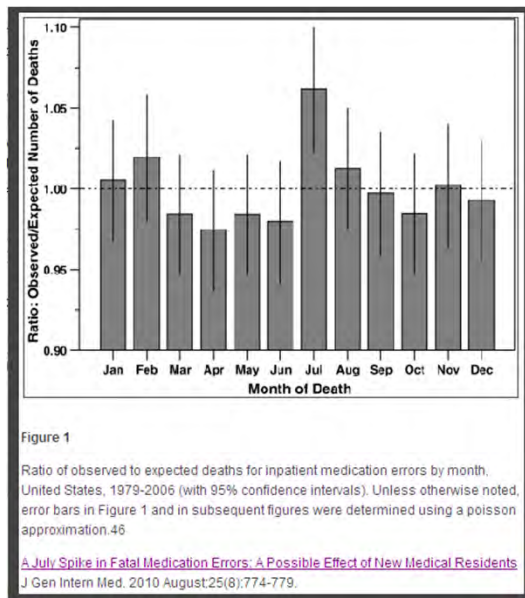**Over $4 billion added to Medicare health care cost!**

One Decade Later…

A July Spike in Fatal Medication Errors: A Possible Effect of New Medical Residents

David P. Phillips, PhD[1] and Gwendolyn E. C. Barker, BA[2]

[1]Department of Sociology, University of California at San Diego, La Jolla, CA, USA; [2]School of Public Health, University of California at Los Angeles, Los Angeles, CA, USA.

Figure 1

Ratio of observed to expected deaths for inpatient medication errors by month, United States, 1979-2006 (with 95% confidence intervals). Unless otherwise noted, error bars in Figure 1 and in subsequent figures were determined using a poisson approximation.46

A July Spike in Fatal Medication Errors: A Possible Effect of New Medical Residents
J Gen Intern Med. 2010 August;25(8):774-779.

J Gen Intern Med. 2010 Aug;25(8):774-9

- 10% increase inpatient deaths from medication errors in counties with teaching hospitals

- Death rate NOT decreased despite patient safety concerns and decrease in resident work hours (cut in 2003)

Surgical Workload
(Comparison to US Trauma Center*)

US Level One Trauma Center	332 EMDG/AFTH Balad
~2000-7500 admission/year	~8000 admissions/year
<30% penetrating trauma	>90% penetrating trauma
High velocity GSW – rare	High velocity GSW – rule
Blast injury – rare	Blast injury – very common
<10% trauma pts need surgery	>80% trauma pts need surgery
Most pts need one procedure/one surgeon	Majority pts require multiple procedures and specialists
Multiple casualty event – rare	Mass casualty event – common
Trauma – nominal workload	Trauma – majority of workload

US trauma care unlike battlefield trauma. Medics must combine hands-on with simulation training to achieve and maintain currency and competency

* May 2007

"On-The-Job-Training" Not An Option

Central Program Office

- Program established Jan 2008

- Developed/executed CONOPS, strategic plan

- ID requirements, develop standard curricula

- Manage resources: Staff, equipment, support

- New technology development

- Program for sustainment

Central Program Office

- Assets $59.3M, 48.5 FTEs 80 sites worldwide*

- "DoD Center of Excellence" by the ASD/HA

- Lead Service, DoD MM&S Training Consortium

- Lead Service, Joint Technology Coordinating Group-1 Modeling & Simulation subgroup

- USAF SG designated SPO vs MEFPAK for medical simulation E&T

*Current Jan 2011

"Hub & Spoke" Simulation Network

Facilities grouped into 4-tiered system based on training requirements and simulation capability

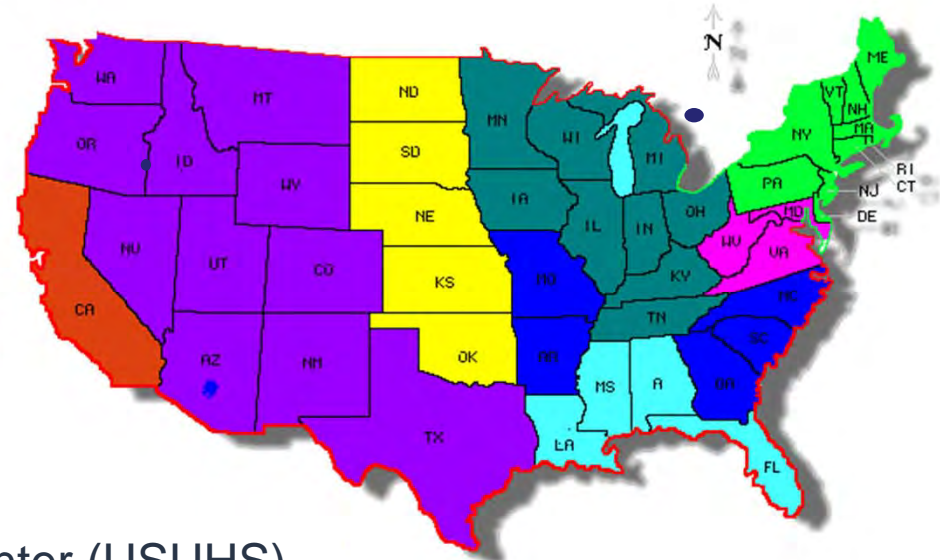| Category	Characteristics
TIER 1: Centers of Excellence	Curriculum and scenario development, Mentor/train Tier 2 sites, qualified instructors, full-time simulation staff, training GME/RSV/Phase II/Annual/Critical Care/Formal Courses
TIER 2: Core Simulation Programs	Execute training and disseminate curriculum/scenarios to Tier 3 sites; Mentor Tier 3 sites, qualified instructors and part-time support staff, training GME/RSV/Phase II/Annual/etc
TIER 3: Regional Simulation Programs	Execute simulation training for assigned staff, additional duty simulation staff, training RSV/Annual
TIER 4: Program Initiation or Drawdown	Execute RSV, Life Support Training as needed; utilize local hospitals or the VA to support training

Tier I Site Selections

- Wilford Hall *

- Keesler *

- Travis *

- C-STARS Saint Louis

- C-STARS Baltimore

- C-STARS Cincinnati

- USAFSAM - EMEDS *

- Lakenheath UK

- National Capitol Area Simulation Center (USUHS)

- Defense Medical Readiness Training Institute (DMRTI)
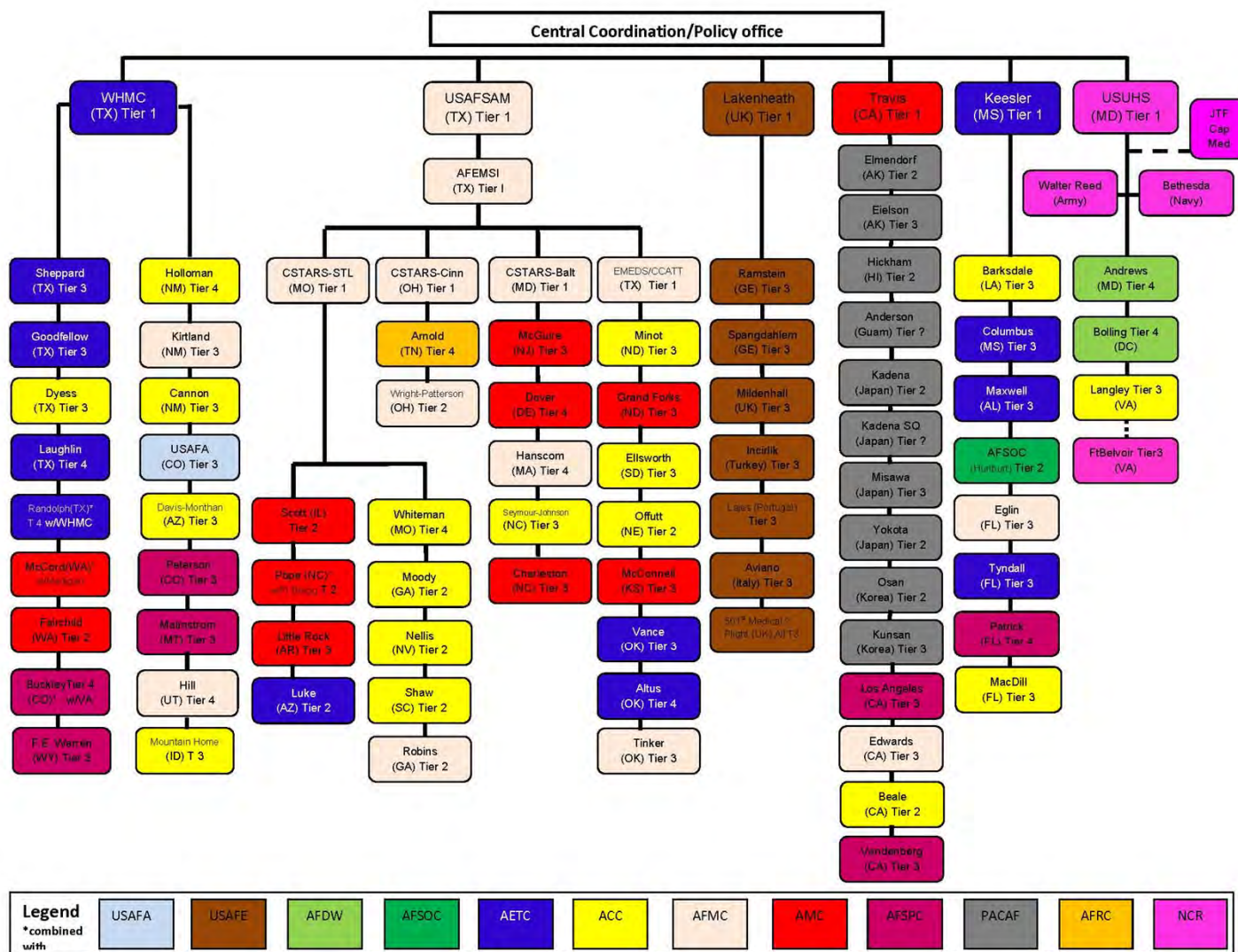
  * Simulation Operator Course

AF Simulation Regions

- Travis Region
- USAFSAM
- Cincinnat.
- Lackland Region
- St. Louis
- Baltimore

- USHUS
- PACAF/USAFE
- KEESLER

Luke, Nellis, WP

Luke AFB, AZ

Tier 1 Organizational Structure

Simulation Training Network

Central Program Office

Tier 1

Students

Tier 2

Knowledge Sharing

Standardized Curriculum and Scenarios

Tier 1

Tier 2

Students

Tier 3

Tier 3
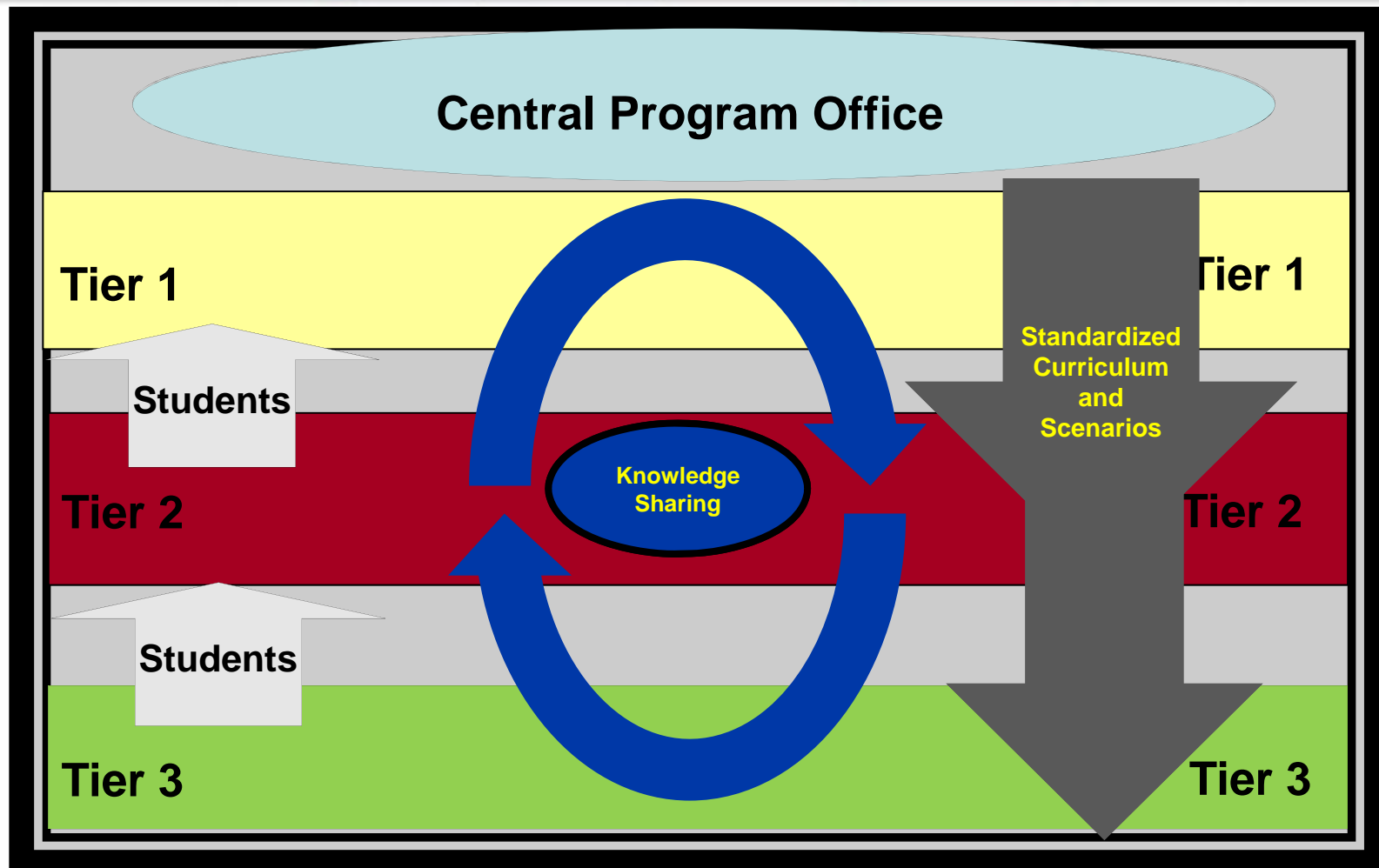
Dynamic Network for information Sharing

Aligning Currency & Training

- In the last 10 years, over 50% of 522 U.S. airline accident fatalities linked to simulation training errors

- *"Far easier than in the real world"*

- Poor training = catastrophic mistakes

- Simulation is only as good as the data, knowledge and expertise used to train

Simulator flaws tied to airline crashes

Flight training cited in half of fatalities

By Alan Levin
USA TODAY

Flaws in flight simulator training helped trigger some of the worst airline accidents in the past decade, according to a USA TODAY analysis of federal accident records.

More than half of the 522 fatalities in U.S. airline accidents since 2000 have been linked to problems with simulators, devices that are used nearly universally to train the nation's airline pilots, the records show.

Simulator training is credited with saving thousands of lives. But the problem, according to National Transportation Safety Board (NTSB) case files and safety experts, is that in rare but critical instances they can trick pilots into habits that lead to catastrophic mistakes.

Last month, the NTSB blamed deficient simulator training in part for the Dec. 20, 2008, crash of a Continental Airlines jet in Denver.

The Boeing 737-500 skidded off a runway at high speed and burst into flames because of the

USA TODAY
31 Aug 2010

Medical Training Limitations

- Curricula and training materials not standardized
- Quality variable and inconsistent in/out MTF
  - # patients, surgical cases, staff experience and availability
- Lack validation of skill acquisition, performance
  - Metrics not established, tracked or archived
- Measures of quality and competency flawed?
  - Exams, # cases, errors, complications, malpractice
- No enterprise IT architecture or interoperability
  - Multiple info sources, servers, databases, passwords
  - Difficult to access/unknown, local servers, no mobile app

Simulation Training Limitations

- Lack uniform use of standard tools
- Quality variable - Instructor SME, know simulation?
- Not formally integrated into curriculum
- Poor for surgery, invasive procedures, live tissue
- High student-instructor ratio
  - Limits individual instruction and # didactic sessions
- Low throughput
  - Set-up/breakdown, space availability
- Feedback inconsistent (verbal vs taped)
- Performance metrics not measured or tracked

Health Care Innovation Surge

- Current health care system is unsustainable
- Advances in treating disease and trauma
- Technology innovation has changed how we live
- Little application to improve health system efficiency
- Rising health costs push responsibility onto patients
- New generation of computer-savvy doctors/patients
- Ubiquity of high-speed Internet, mobile devices
- Influx of interest from technology entrepreneurs
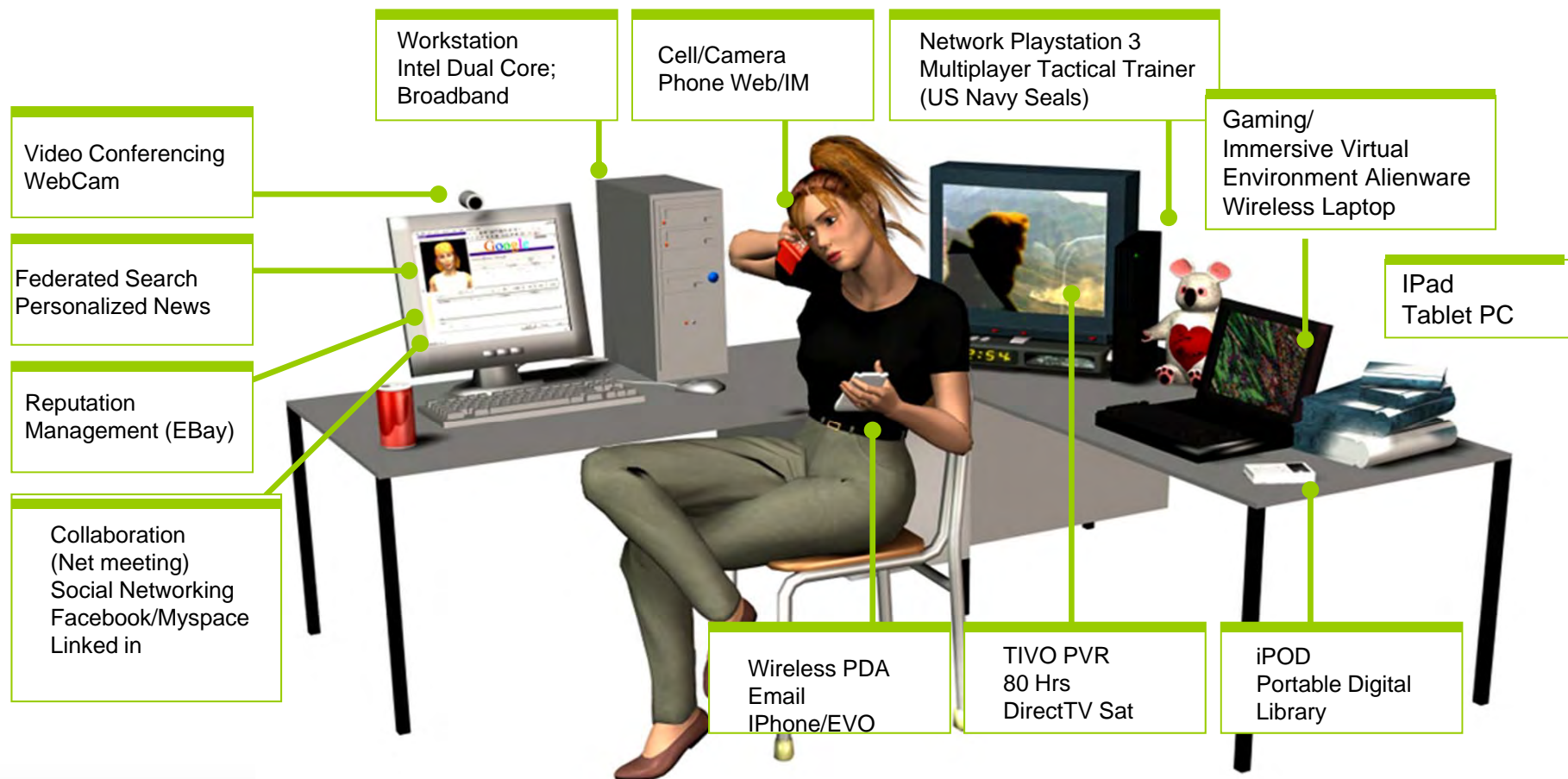- DoD and the Federal Government forces for change

GE and Intel team up to develop Telehealth gadgets for chronic disease management, independent living, and assistive technologies

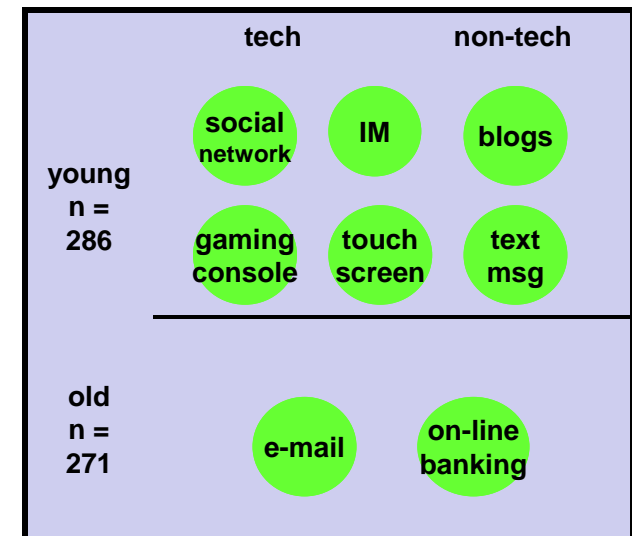# The Future Airman

Today's Cyber Teenager = Tomorrow's Airman

Video Conferencing
WebCam

Federated Search
Personalized News

Reputation
Management (EBay)

Collaboration
(Net meeting)
Social Networking
Facebook/Myspace
Linked in

Workstation
Intel Dual Core;
Broadband

Cell/Camera
Phone Web/IM

Network Playstation 3
Multiplayer Tactical Trainer
(US Navy Seals)

Gaming/
Immersive Virtual
Environment Alienware
Wireless Laptop

IPad
Tablet PC

Wireless PDA
Email
IPhone/EVO

TIVO PVR
80 Hrs
DirectTV Sat

iPOD
Portable Digital
Library

Digital Natives

Future Learning Survey
Airmen & Technology*

Young vs Old: Statistical difference in use of technology

- Strategy for E+T technology
- Knowledge, attitudes, views
  - Legacy: PCs, cell-phones, e-mail
  - Newer: virtual worlds, gaming
- 557 participants in two categories
  - *Age: Young (18-21)* 286, Old (22+) 271
  - Excluded (*40+*)

- 93% - view of bases online beneficial
- 60% - virtual operational exercises online enhance readiness
- 58% - avatars could be effective mentors
- 65% - online gaming provides encouragement to join military

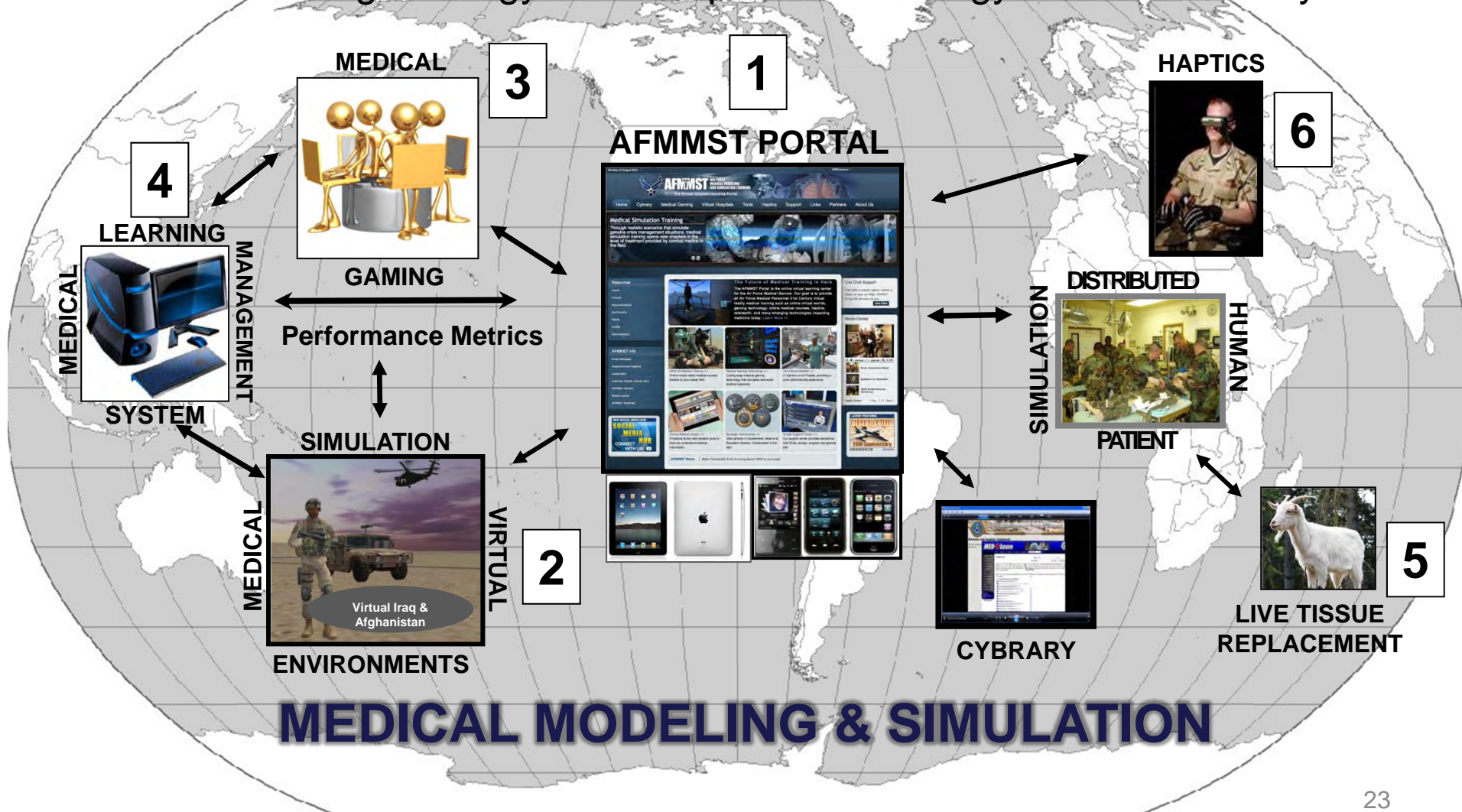|	tech		non-tech
young n = 286	social network	IM	blogs
	gaming console	touch screen	text msg
old n = 271		e-mail	on-line banking

* Keesler AFB June 2008

AFMS "Cloud" Architecture

AIR FORCE MEDICAL SERVICE
Overarching Strategy for Enterprise Technology Service Delivery

MEDICAL MODELING & SIMULATION

# Cloud Computing: Software as a Service (SAAS)

- SAAS applications managed from a central server vs on site
- Enables remote access to applications via a web browser
- Eliminates the need to download patches and upgrades
- "Turn-key" access to software and services
- Multiple users access the same app (multiplayer gaming, mobile)
- Affordable, pay-as-you-go, à la carte menu of software
- Eliminates IT infrastructure and software sustainment costs
- Reduces the number of data centers, IT systems, contractors
- Better IT application performance
- Alternative to investing in hardware

Focus shifts from managing IT infrastructure to strategic projects

DoD and Federal Government Technology Alignment

- Cloud computing a new business model for DoD and federal government

- Access to emerging technology and high value data

- Cost savings and greater efficiency
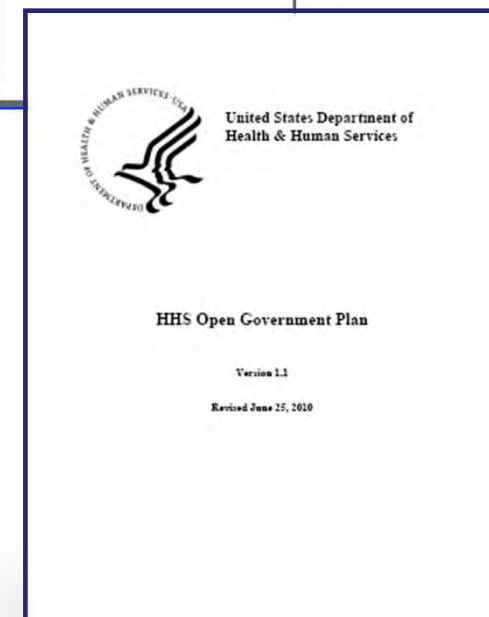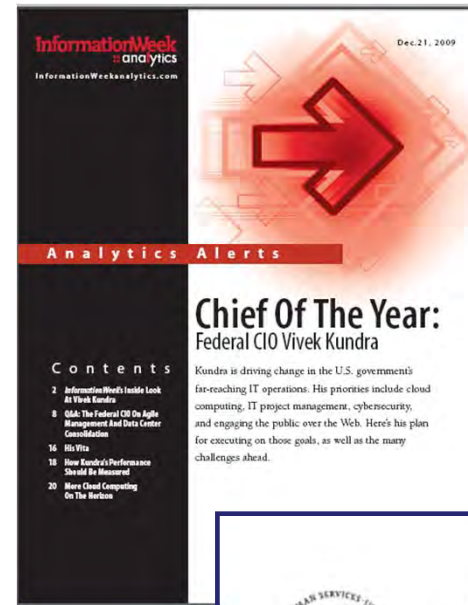
AFMMST Portal 360°

The Air Force Medical Modeling & Simulation Training Portal

VR Medical Training Online

- Web-based Virtual Reality Medical Training Portal for AFMS
- AFMS CBTs Online
- AFSC Specific Training
- Online Communities
- CAC Enabled
- Mobile Device Ready
- Industry & DoD Standards

Project Integrations

- Medical Training via Gaming Simulation
- Virtual Hospitals
- Virtual Sick-Call Training
- Haptics Technology
- LMS Integration
- Reports/Transcripts
- Web-Teleheath SimTool
- Medical Cybrary (docs/blogs, DBs)

Cloud Computing Strategy

- DoD Hosting Center
- Hosted Microsoft SharePoint 2010
- Network Security
- Managed Bandwidth
- IA Compliance
- Enterprise Storage Solution (SAN)
- Live Chat Support
- Virtualization

Strategic Partnerships

- CSC-A, CSC-N, USUHS
- Army RDECOM/STTC
- Air Force (Line/AETC)
- UCF Medical School
- Texas A&M (Pulse)
- TATRC, MHS, OASD/HA, VA
- OSD/DDR&E
- PEO-STRI
- METC
- AMEDD C &S MS/MSTC/BCTC
- USMC TECOM

Screenshot: AFMMST — Air Force Medical Modeling and Simulation Training — The Virtual Clinical Learning Portal

Monday, 23 August 2010 — EMS\manny

Navigation: Home | Cybrary | Medical Gaming | Virtual Hospitals | Tools | Haptics | Support | Links | Partners | About Us

Medical Gaming Simulation
Existing game applications, modified for educational purposes, use the characteristics of video/computer games to create immersive learning experiences for delivering specified learning goals, outcomes, and experiences.

Resources: Home, Forums, Documentation, Community, Media, Profile, Administrator

AFMMST Info: Press Releases, Requirements Pipeline, Leadership, Learning Center Virtual Tour, AFMMST Metrics, Media Center, AFMMST Webmail

The Future of Medical Training is Here
The AFMMST Portal is the online virtual learning center for the Air Force Medical Service. Our goal is to provide all Air Force Medical Personnel 21st Century virtual reality medical training such as online virtual worlds, gaming technology, online medical courses, haptics, telehealth, and many emerging technologies impacting medicine today. Learn More >>

Live Chat Support — Chat with a support agent, submit a ticket, or look up FAQs. AFMMST brings the answers to you. Live Chat

AFSC VR Medical Training >> Online virtual reality medical courses tailored to your career field.

Medical Gaming Technology >> Cutting-edge medical gaming technology that simulates real-world medical scenarios.

The Virtual Hospital >> In Garrison or In-Theater, providing a vivid online training experience.

Virtual Medical Library >> A medical library with dynamic tools to help you understand medical information.

Strategic Partnerships >> Vital partners in Government, Medical & Education Sectors. Collaboration is the key!

Virtual Support Center >> Our support center provides assistance with FAQs, access, program and general info.

Media Center — Brain Awareness Week, Question 21 Reminder, 2010 Remembrance Ceremony — « Prev 1/7 Next »

LATEST FEATURES — OPERATION RAVEN DEW GREENLAND — ARCHIVE »

MHS SOCIAL MEDIA HUB — SOCIAL MEDIA HUB — CONNECT WITH US!

AFMMST News — AFMS partners with Army RDECOM / STTC for Virtual Sick Call Training

| 4th Quarter FY 2010	1st Quarter FY 2011	2nd Quarter FY 2011	3rd Quarter FY 2011	4th Quarter FY 2011
• Requirements Process • Funding Allocated • Staffing Acquisitions • Strategy Development • Partner Evaluations	• Infrastructure Acquisitions • AFMMST Portal Devt • Content Mgmt • Hardware Setup	• Development • IA Process • Project Integrations • Online CBTs	• Virtual Hospitals • Medical Gaming • Web-Telehealth • Video Library • Cybrary, Blogs	• Achieve IOC • Continued Development • Ongoing Sustainment
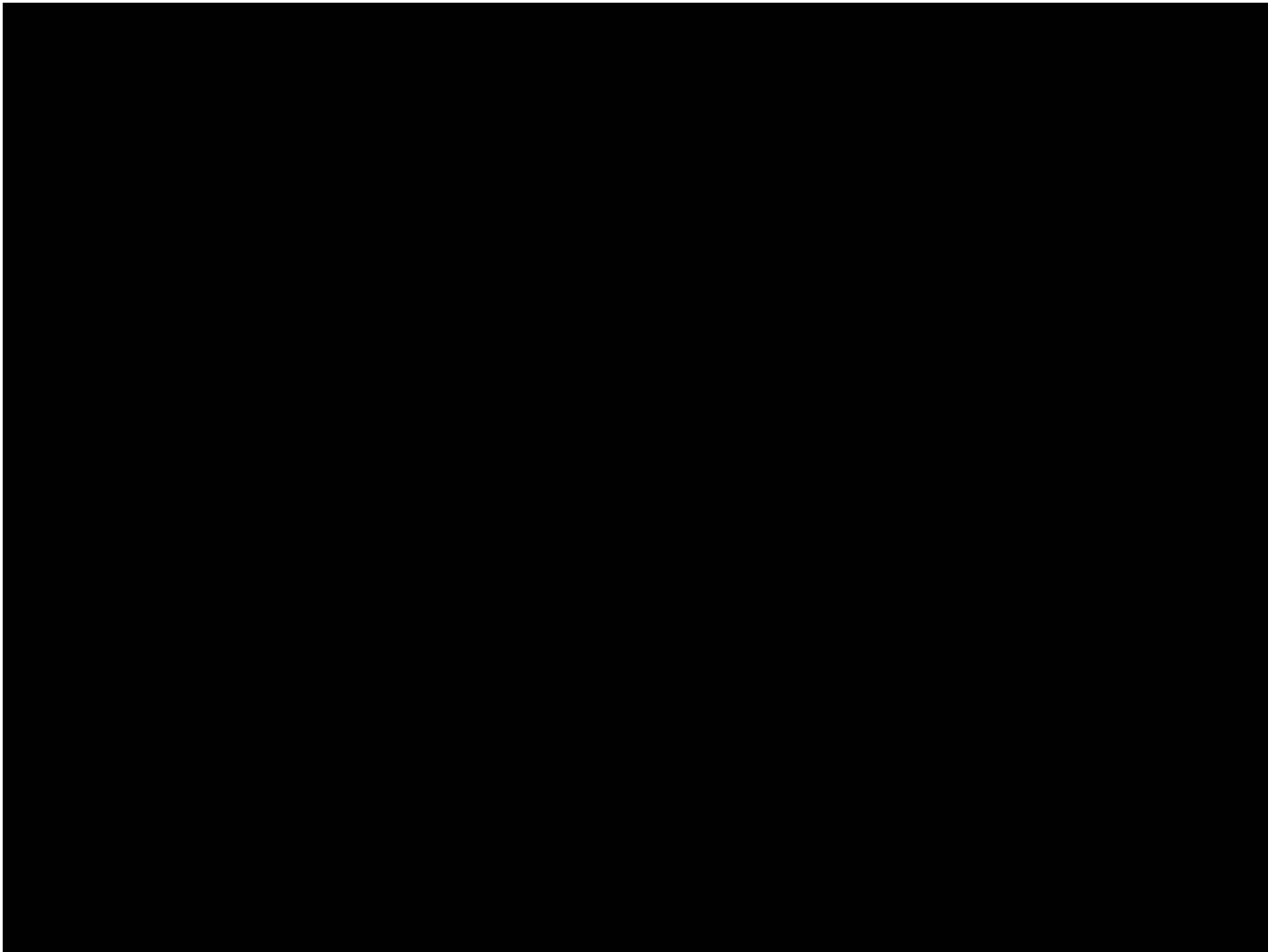
New Technology via AFMS Cloud

- AFSC and UTC specific training
- Virtual Hospital/EMEDS/C-17
- Virtual Medical Campus
  - Staff and Patient Education
- Medical Gaming – single/multi
- Cybrary, Professional Blog, CoPs
- Mobile application ready
- Web-based Education & Training System
- Defense Connect Online
- Center for Excellence in Multimedia
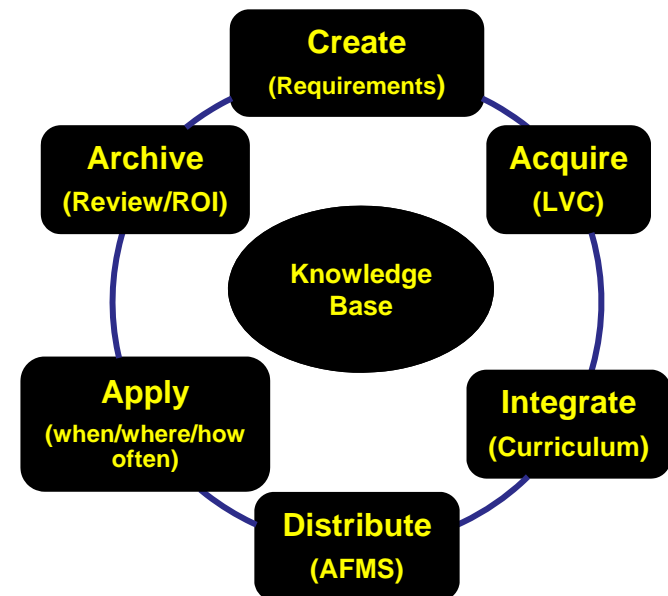
Virtual Iraq &
Virtual
Afghanistan
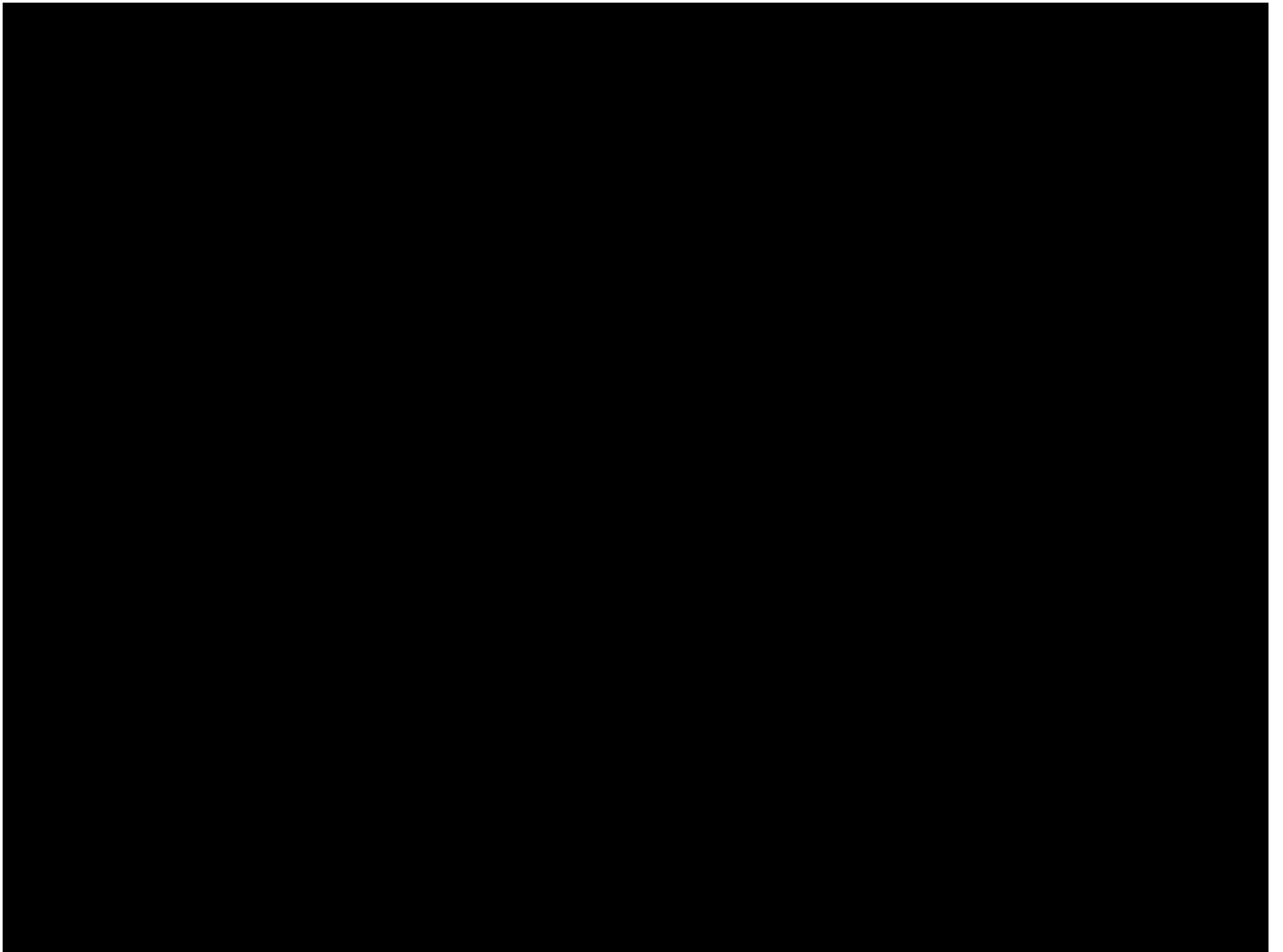
Knowledge Management Strategy

- Knowledge Management
  - Overarching Framework
  - Data tracking (performance metrics)
  - Enables archiving/historical documentation
  - Facilitates knowledge sharing

- Continuous Learning
  - Recruitment through retirement
  - Integration of learning and ops
  - Training, education, experiential learning

- Precision Learning
  - Persistent environment (24/7 access)
  - Tailored to individual styles and needs

Create
(Requirements)

Archive
(Review/ROI)

Acquire
(LVC)

Knowledge Base

Apply
(when/where/how often)

Integrate
(Curriculum)

Distribute
(AFMS)

Standardized knowledge-centric framework

Standard framework that is knowledge-centric not network-centric

Blended Learning by Environment
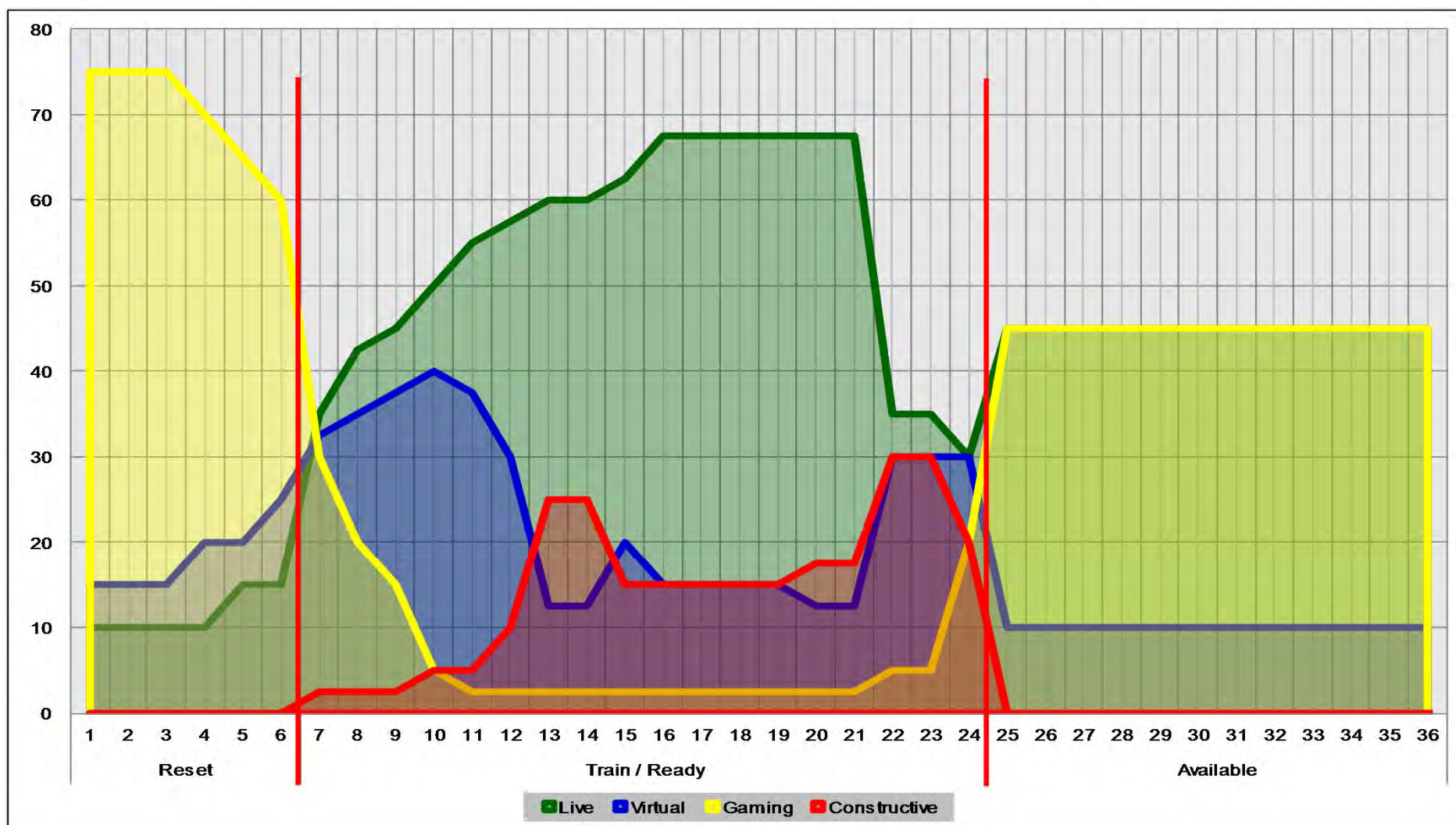
Training by environment across ARFORGEN

Current Program

Aeromedical Evacuation C-17 Virtual Walkthrough
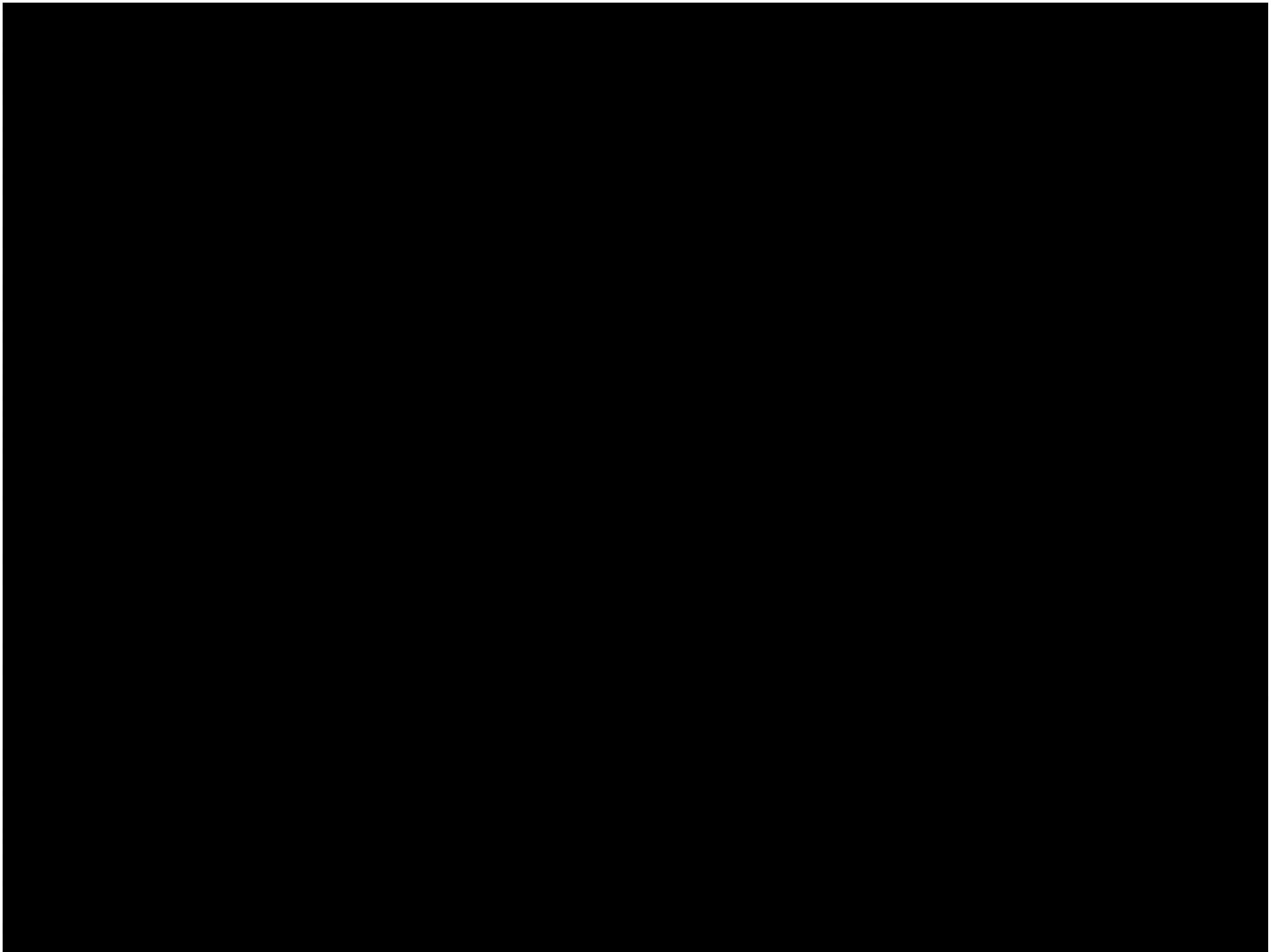
Internal External

Show Me External View

Goto Additional Information

U.S. AIR FORCE

0008
437TH AW
315TH AW

Image courtesy of Dorothy E Buckholdt Director, Advanced Distributed Learning USAF School of Aerospace Medicine
210-536-4671 Dorothy.Buckholdt@brooks.af.mil

USUHS and AFMS Research & Development Partnership

- **USUHS conducts USAF medical simulation training**

- **USAF R+D Asset**
  - PA Catheter Simulator
  - VR Cricothyroidotomy Simulator
  - VR Head Trauma Trainer
  - Wide Area Virtual Environment
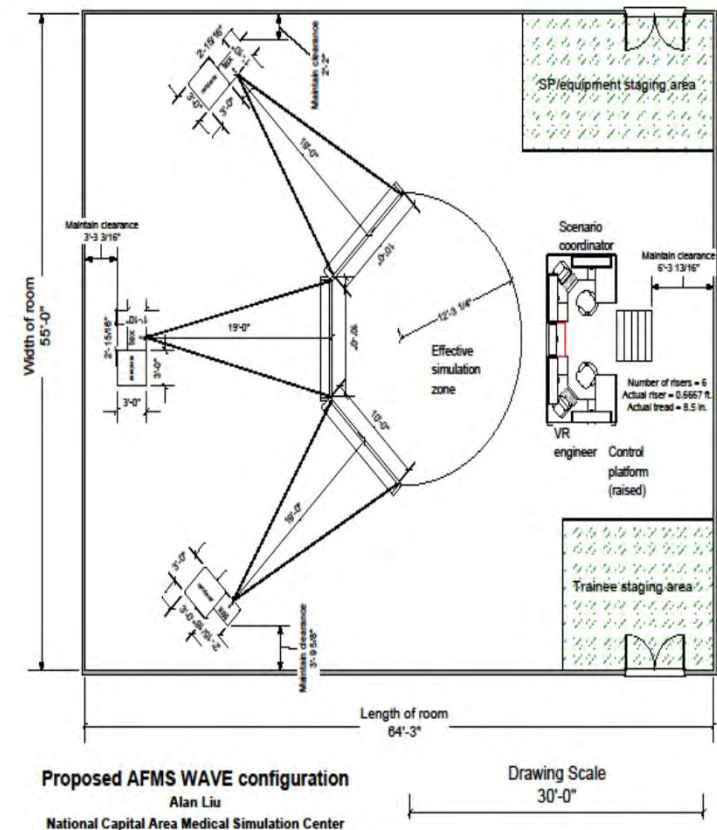
Proposed AFMS WAVE configuration
Alan Liu
National Capital Area Medical Simulation Center

New Technology Development

- **Congressional Projects**
  - Natural Disaster Response Gaming Simulation ($3.44M)
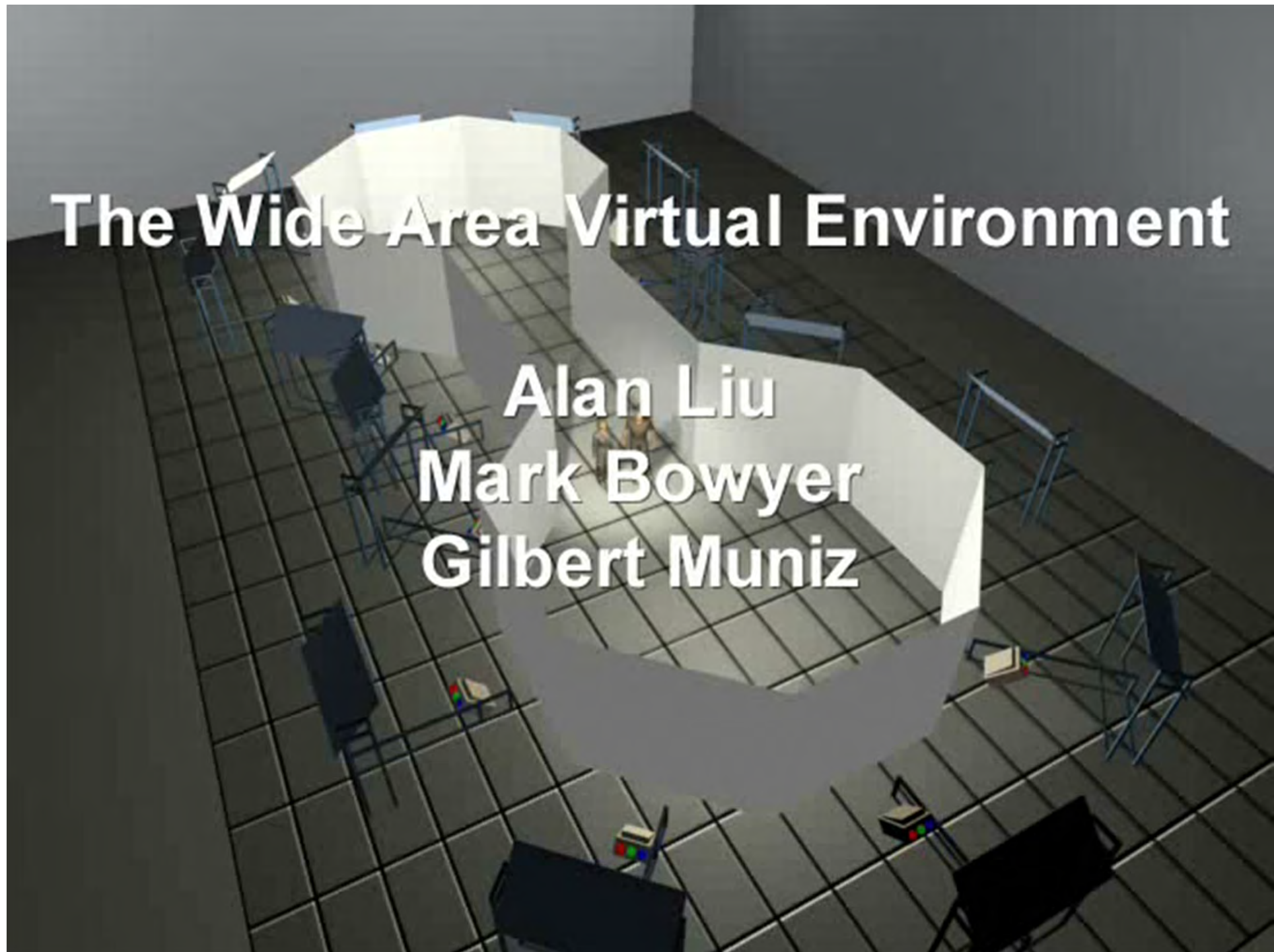 - Military Trauma Training ($708K) CSTARS Baltimore/UMMC
  - Spec Force Med Training – PJ/Combat Control Team ($2.9M)

- **Small Business Innovation Research ($300K)**
  - Medical Gaming +/- haptics - virtual surgery/invasive procedures
  - Virtual Environments - Hospital/EMEDS/CCATT
  - Synthetic Tissue to augment/replace live tissue – 1st in DoD

- **HQ AETC Advanced Tech Learning Demo ($400K)**
  - 4N0X1 Phase 1 METC Training Gaming Simulations

- **Defense Medical Research & Development (ROI)**
  - Tri Service Medical Simulation & Trng Curriculum Development and Validation Research ($5.5M) AF SGR is PI

Requirement	In-Place?	Initial Funding In-Place?	Partnership	ETA	AFMMST Portal & Cloud Strategy?
Medical Modeling and Simulation Training Portal (AFMMST Portal)	Yes	Yes	AETC/SGR USDA	July 2011	Yes
Virtual Reality Medical Gaming	Yes	Yes	RDECOM Texas A&M Univ	Mar 2011	Yes
Cloud Computing Hosting Partners	Yes	Yes	UCF RDECOM	Dec 2010	Yes
AFSC Based Medical Games	Yes	Yes	AETC/SGR RDECOM Mountain Top Tech	Jun 2011	Yes
Medical Scenarios VR Based Learning	Yes	Yes	AETC/SG RDECOM	Apr 2011	Yes
LMS Integration	Yes	No	AETC	TBD	Yes
AFMS Virtual World	Yes	Yes	RDECOM AETC	Jun 2011	Yes
Online TeleHealth VR Tools	Yes	Yes	SPAWAR	May 2011	Yes
Online Cybrary (Virtual Medical Research & Learning Lab)	Yes	Yes	AETC/SGR DKO	Apr 2011	Yes
AF Medical SME Online Communities	Yes	Yes	AETC/SGR DKO	Jun 2011	Yes
VR Training of Critical Medical Apps (AHLTA, TMIP, etc)	Yes	Yes	AETC/SGR	Mar 2011	Yes
Status of Emerging Technologies (Haptics, Live Tissue Replacement, Virtual Islands, etc)	Yes	Yes	AETC/SGR	Dec 2010	Yes

Bringing "Virtual Reality" to "Reality"

Reach the Summit by October 2012

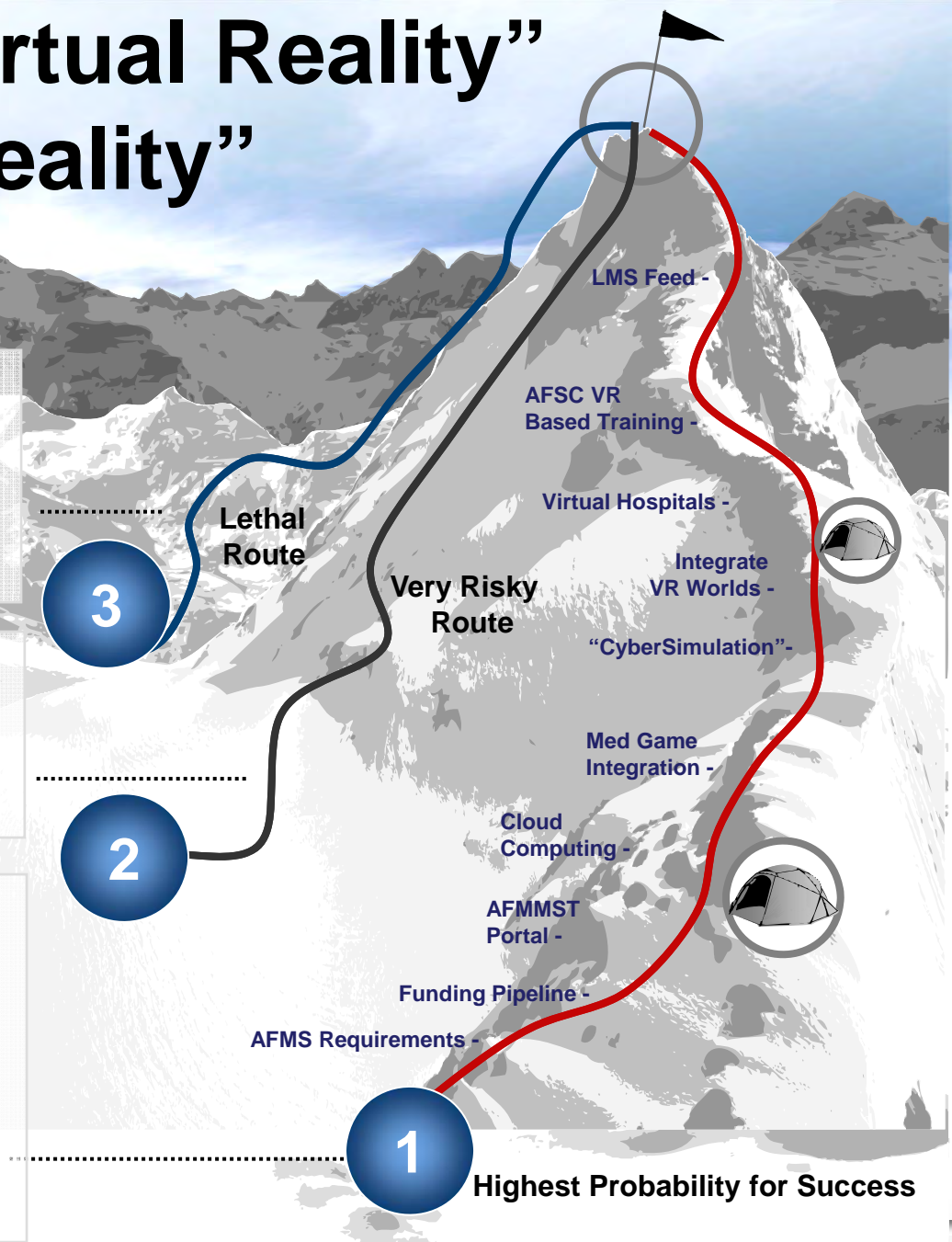## HIGHEST RISK / LEAST EFFECTIVE STRATEGY
- Medical Gaming Developed for Each Service Branch
- Hardware & VR Games Installed on Base LAN
- Game Enhancements / Updates Mailed to Customers
- Lengthy DIACAP Process Per Game
- From Requirements to Time to Deploy is Very Long

MODERATE RISK / LIMITED SUCCESS STRATEGY
- Stand-Alone PCs & VR Med Games at MTFs
- Too Many Users vs. Limited Computers
- Expensive, Not Practical, Accessibility Issues
- Local Hardware/Software Support Required

MINIMUM RISK / HIGH PROBABILITY OF SUCCESS
- Tri-Service Med VR Games Hosted (Cloud)
- Centralized Mgmt, Updates, DIACAP, Enhancement
- Rapid Availability of Med Training via Web
- No Local Hardware/Software to Maintain/Refresh
- Services Leverage from Each Other
- Centralized Metrics, Feed to TTMS, LMS etc
- Subscription "A La Carte" Service to AFMS
- Lower Costs, Rapid Deployment, Joint Med Approach

Lethal Route — 3

Very Risky Route — 2

Highest Probability for Success — 1

LMS Feed -

AFSC VR Based Training -

Virtual Hospitals -

Integrate VR Worlds -

"CyberSimulation"-

Med Game Integration -

Cloud Computing -

AFMMST Portal -

Funding Pipeline -

AFMS Requirements -

Operational Milestones and Partnerships

Technical Related	Personnel	Strategy	Funding Allocated
AFMMST Portal framework development	🟨	🟩	🟩
Portal Cloud Computing Strategy Set	🟨	🟩	🟩
Portal Cloud Computing Infrastructure Partner Selection	🟨	🟩	🟩
Funding for Portal Cloud Hosting and Sustainment	🟨	🟩	**need sustainment tail**
IT Staff Selections Complete	🟩	🟩	🟩
MIPR funding to USDA Complete	🟩	🟩	🟩
IT Equipment / Developer Computers Purchased	🟨	🟩	🟩
RDECOM business model change to AF Cloud Architecture	🟩	🟩	🟩
Web-Based Medical Gaming as a Business Model (SAAS)	🟩	🟩	🟩
AF Medical SME Online Communities	🟥	🟩	🟩
TC3, MSTC, CBTCS, Pulse to be Web-Based	🟥	🟩	🟩
Migration from CD Based Games to Cloud/MilGaming	🟨	🟩	🟩
AFMS Virtual World Strategy Set (User Entry Point)	🟩	🟩	🟩
IT Partnerships with UCF IST, AFAMS, CEMM and ECS	🟨	🟩	🟩
CEMM Integration to AFMMST Portal (Virtual Library)	🟨	🟩	🟩

DoD Medical Modeling & Simulation Training Consortium

- Develop Joint requirements and standardized curricula

- Create DoD medical training platforms, exercises

- DoD research and multicenter validation studies

- Build "The DoD Medical Cloud"

- Joint technology development

  – AFMM&S CIO imbedded with Army RDECOM/STTC
  – RDECOM changed business model to adopt the AF cloud strategy
  – ECS Corpsman trauma medical game adapted to AF req's/scenarios
  – Texas A&M and CSC-N– Pulse
  – NCA Sim Center USUHS Wide Area Virtual Environment– to AFMS

WAVE

Immersive Virtual Environment

DoD Medical Modeling & Simulation Training Consortium

DoD MM&S Partnerships

- AFSOC A5Z (Pararescue)
- AMEDD C+S EMS/MSTC
- METC
- CSC-A, CSC-N
- USMC TECOM
- OASD(HA)TMA
- OSD/DDR&E – ULAMETJAT
    - JTCG-1, JPC-1 (research)
- NCA Medical Simulation Center USUHS
- BAMC

Other Strategic Partnerships

- CEMM
- AMEDD C+S BCTC – Battle Combat Training Center
- RDECOM/STTC
- University of Central Florida
- PEOSTRI
- DMRTI
- TATRC
- HQ AETC CC
- American College of Surgeons
- USC Institute for Creative Technologies
- UC Davis

San Antonio Medical Simulation Center of Excellence

- DoD, Academia, Federal, State, Industry partners

- Assessed Joint training, space, staff req's

- Location?
  - 27.5K sq ft space close to Ft Sam Houston
  - New MILCON vs existing building refurbishment

- Resourcing and Sustainment
  - Budget, manpower, equipment
  - How do we insert, update new technology?

Liu A, Bowyer M, NCA Simulation Center USUHS

Strategic Roadmap

Theme:	*CENTER DEVELOPMENT*	*SERVICE SYNERGY*	*JOINT INTEGRATION*
Phase:	1. Simulation Centers	2. AFMS Distributed Simulation Network	3. Educate/Train Med War Games

Doctrine
- Joint integration for training/war games
- Service

Organization
- Primary Location/Med Facility → Consolidation → Integration of training sites

Training
- Standardized Joint → Standardized Joint Integration Updates
- Standardized Service → Standardized Service Synch Updates

Materiel
- Materiel Solutions → Materiel Solutions → Materiel Solutions
- Innovation Solutions

Leadership
- Joint
- Service

Personnel
- Service

Facilities
- Tier 1 Sites → Distributed Human Patient Simulation Network
- Tier 2 & Tier 3 Sites → Joint Simulation Centers: NCR/SAMMC

Jan 2008   Jan 2009   Jan 2010   Jan 2011

2011 MHS Conference

Contact Info

AFMMS Central Program Office

Col Deborah Burgess – Director

Ms Shae Peters – Deputy Director

Mr Ray Machacon – Program Manager

Office: (210) 652-9620

DSN: 487-9620

deborah.burgess@us.af.mil

shae.peters@us.af.mil

raymund.machacon.ctr@us.af.mil