Using Collaborative Virtual Environments for Simulation Based Acquisition

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Simulation Based Acquisition

- SBA--DoD wide
  - Reduce: cost, risk, and development time
  - Improve: life-cycle quality and utility
  - Use: Integrated Product and Process Development (IPPD)
- SMART--U.S. Army version of SBA
  - Share: a common system design
  - Shape: new capabilities for all stakeholders and communities
- SimTLC--TACOM implementation
  - Use: Integrated Product Teams (IPTs) and Virtual Collaborative Environments (VCEs)

Introduction

- Goals / Objectives:
  - Shrink product development time by 50% (now 8-15 years) and substantially reduce costs
  - Improve process and build better systems
  - Move into synthetic VCE / 3D technologies
    - Also known as virtual reality
  - Partnership academic / commercial / military
- Some key issues:
  - What are the advantages / disadvantages of VR technologies?
  - Which VR system(s) to use?
  - How best to use the technology and when?

Introduction (cont)

- Several commercial VE products available
  - But little empirical comparison testing
- Widespread use but acceptance not yet fully achieved
  - Cost problem?
  - Unsure of how to use and why?
- Importance of VE applications
  - Boeing -- reduced by 60-90% design of 777
  - DaimlerChrysler -- $75 M cost savings and 20% reduction in design time

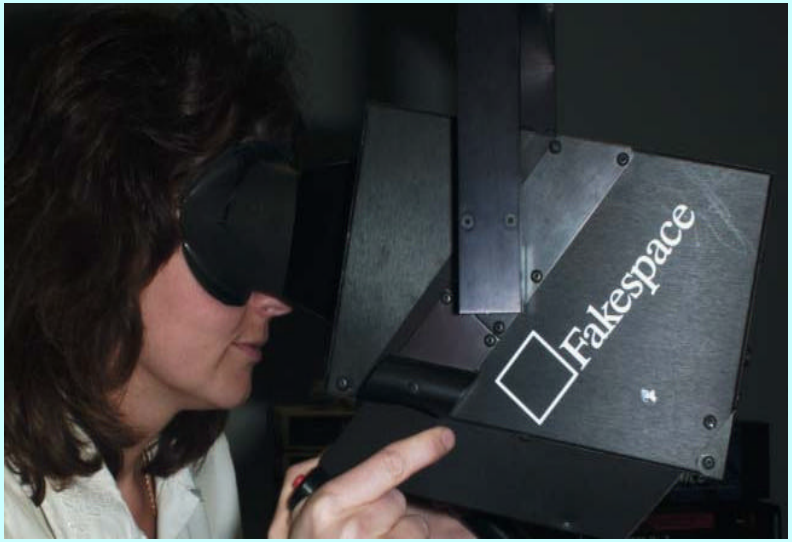
Product Design and Development

- A process to evolve a product from idea conception to release to customers
  - Has been “Throw it over the wall”
- Concept design reviews:
  - 10% of project funds spent, 90% of development costs established
  - Period where design errors are least expensive to fix
- Now:
  - IPT teams, reduced life-cycle time, and local and distributed CVE product reviews
  - Anticipated reduced life-cycle time / costs

The VE Study Environment (1st Generation Systems)

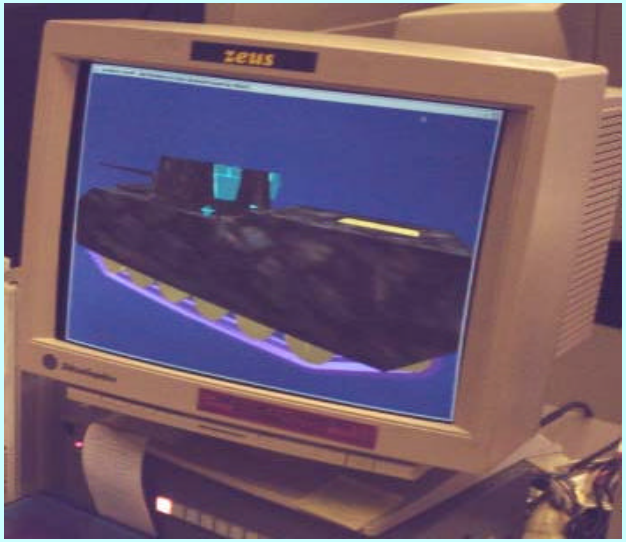
- VE devices tested:
  - Helmet Mounted Display (HMD)
  - Binocular Omni-Orientation Monitor (BOOM)
  - Stereoscopic shutter glasses and monitor
  - Monoscopic (2-D) CRT monitor (for comparison)

Helmet Mounted Display (HMD)



Binocular Omni-Orientation Monitor (BOOM)

Stereoscopic Shutter Glasses with Monitor



Monoscopic CRT Monitor

The VE Study Environment (1st Generation Systems)

- Involved U.S. Army teams (project, operators, design, human factors, logistics, maintenance, training, etc.)
- Four equal 3-person teams
- Orientation, testing, observation, evaluation over one week at U.S. Army TACOM -- Warren, Michigan
- Tracked fuel trailer system design
  - Three subassemblies
  - At least three equal problems/subassembly

The VE Study Metrics and Measures (1st Generation Systems)

- Metrics:
  - Number of errors detected
  - Time to detect a design error
  - Time to resolve the problem
- Subjective Perceptions
  - Participant judgements about strengths and weaknesses of each system
- Subjective Preferences
  - Comparison rankings of most useful, difficult to use, practical, and beneficial

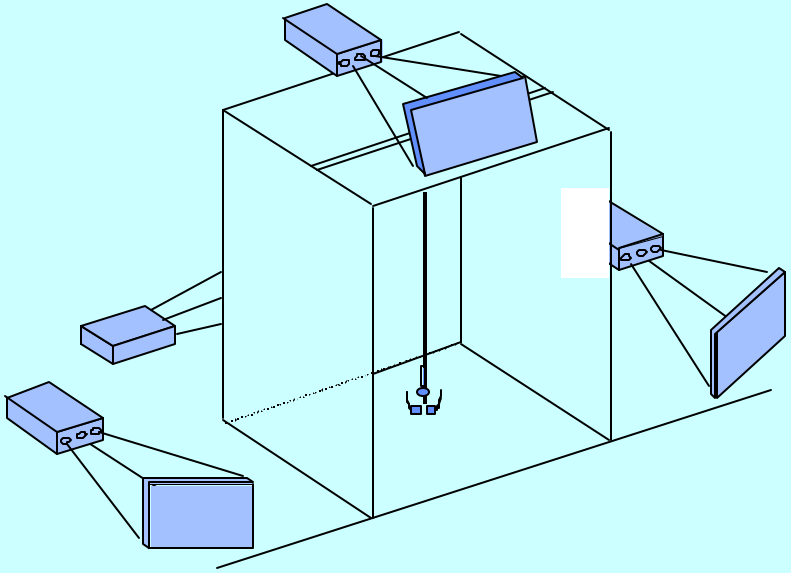
The VE Study Results (1st Generation Systems)

- No single technology met all individual and team needs
- A combined technology approach is needed/suggested
  - A specific technology should be used depending on phase of the review process
- Face-to-face discussion still very important
- Testing of 2nd generation systems needed

The VE Study Environment (2nd Generation Systems)

- CAVE™(Tested)
  - CAVE Automatic Virtual Environment
- Immersive WorkWall™
  - Stereoscopic screen wall systems
- ImmersaDesk™
  - Portable semi-immersive desk-type systems

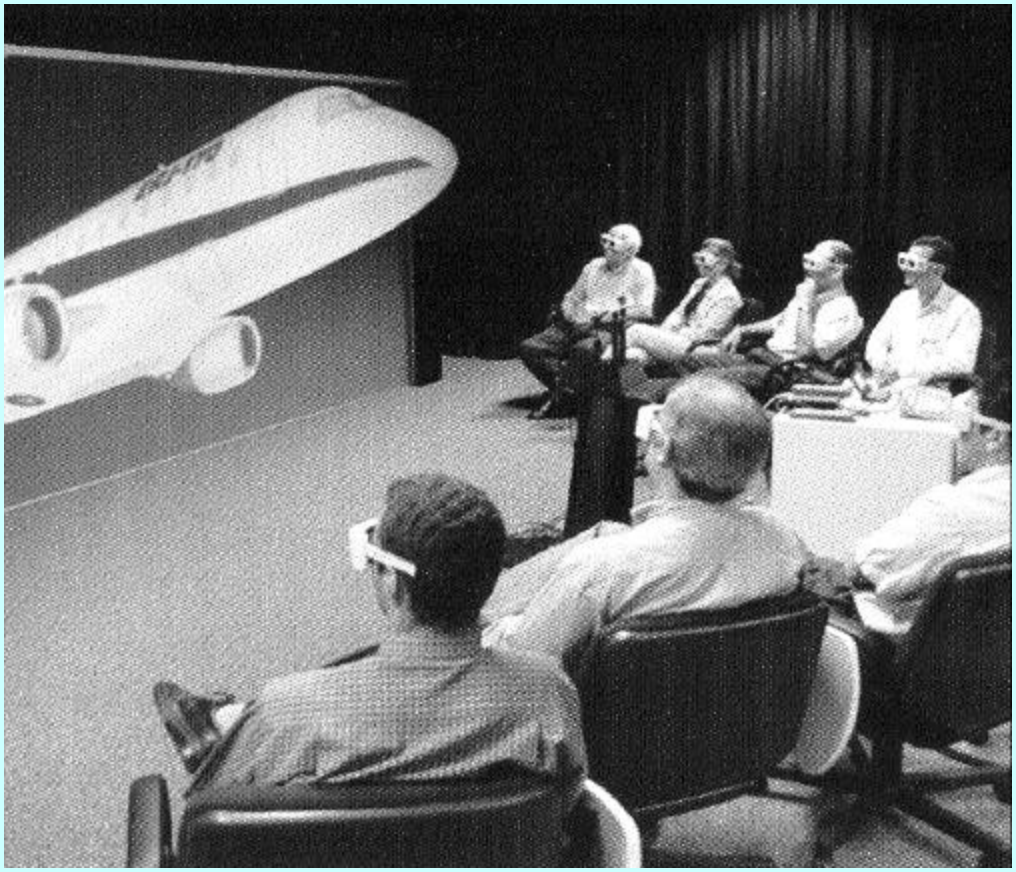
The VE Study Environment (2nd Generation Systems)



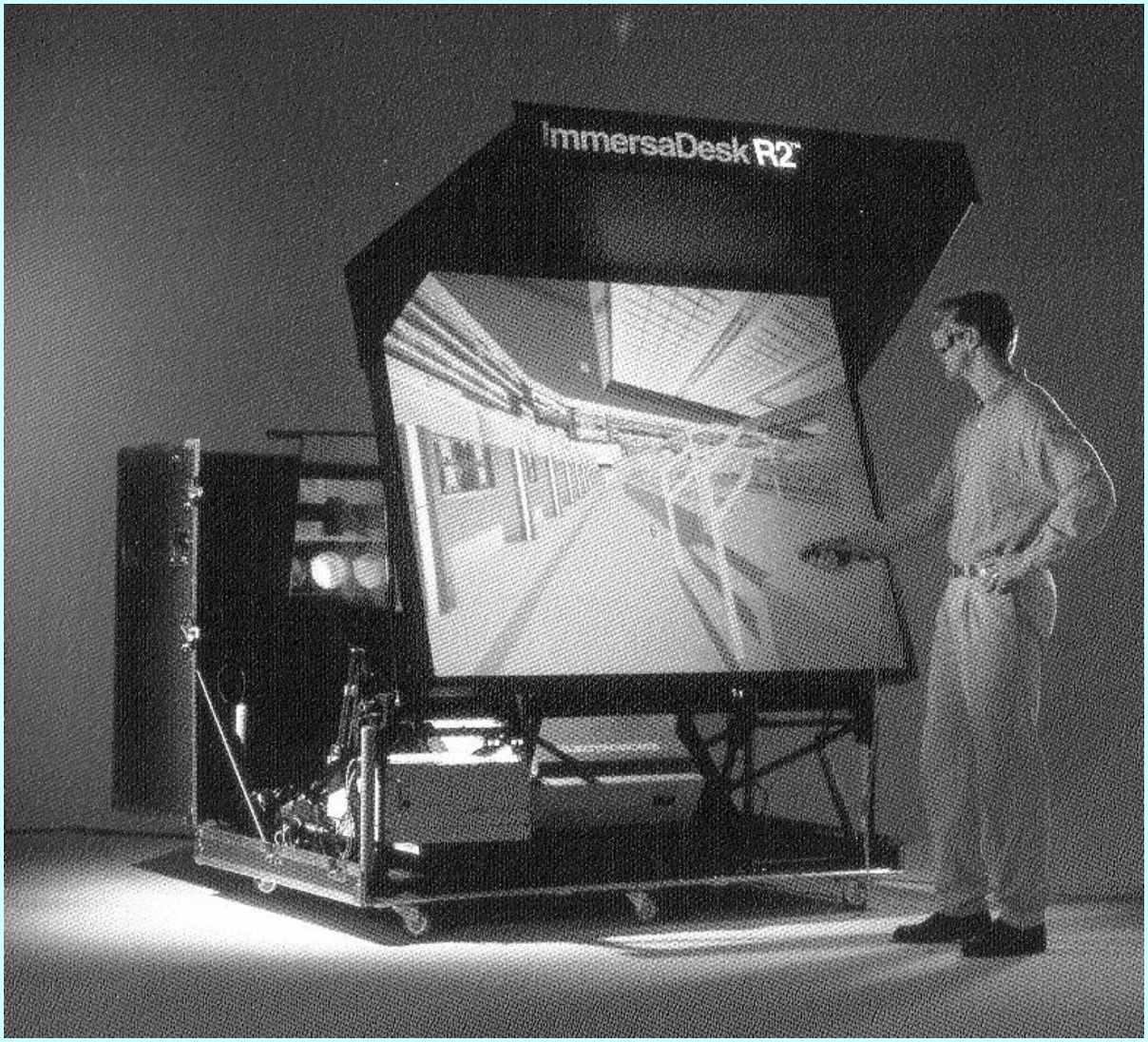
The CAVE™ projection-reflection system

The CAVE™ System

Immersive WorkWall™



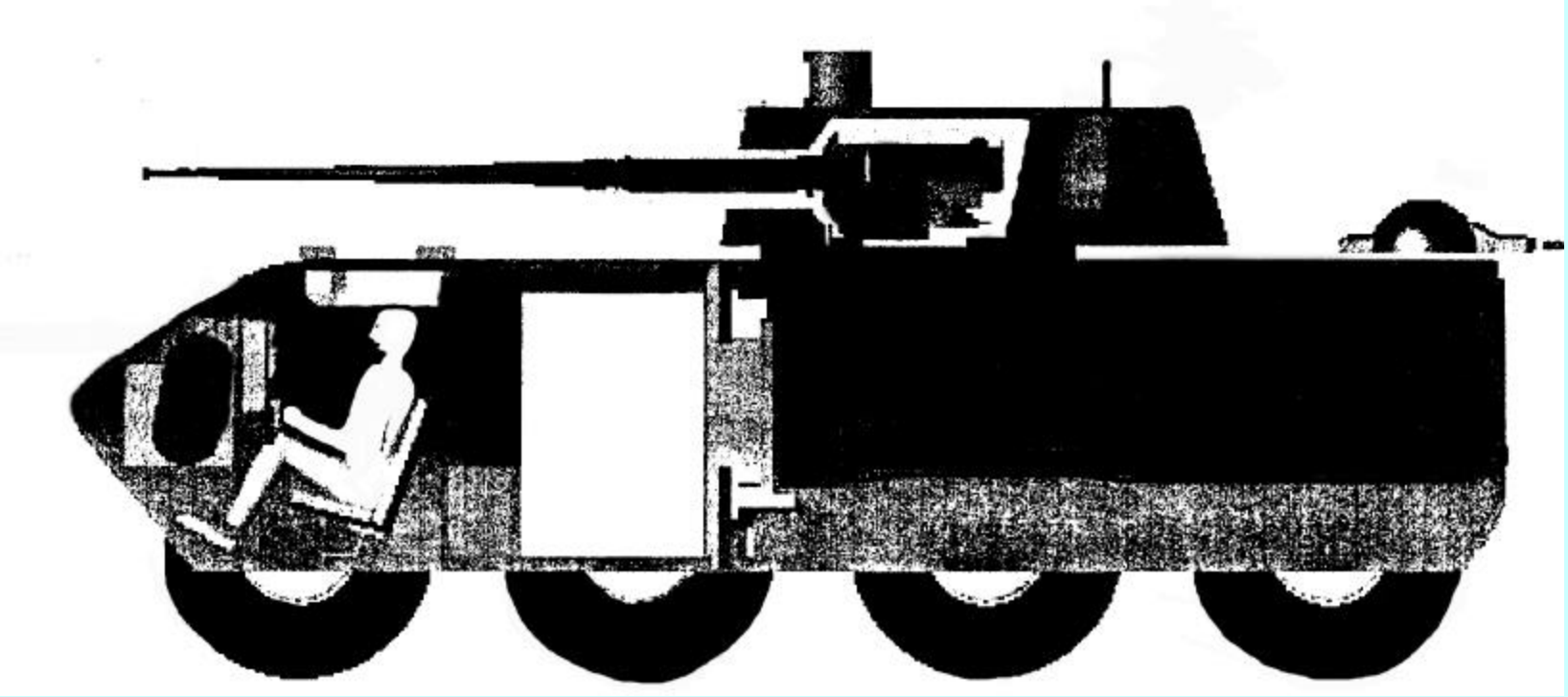
ImmersaDesk™



The VE Study Environment (2nd Generation)

- Involved U.S. Army teams (armor and artillery soldiers)
- Eight equal 5-person teams
- Comparison testing of traditional Power Point concept presentation vs. CAVE™
- Orientation, testing, observation at U.S. Army-Fort Knox, Kentucky
- RApidly reconfigurable VEhicle (RAVE) system under review

RApidly reconfigurable VEhicle (RAVE)



The VE Study Results (2nd Generation - CAVE™)

- The VE (CAVE™) generated significantly more involvement--questions and comments (greater than 600%)
- However, more traditional presentation resulted in more concept comprehension
  - Reasons now understood
- Test subjects much preferred the VE
- Face-to-face contact still very important during design discussions

Some Selected Operational Issues (Not in Paper)

- Team Composition / Size
  - Are knowledgeable / representative and team size not too small or too large
- Qualifying / Testing Participants
  - Not subject to cybersickness, not color blind, and are mobile
- Negotiating in 3D Virtual Environments
  - Pauses and cues important but limitations exist in VEs

Some Selected Operational Issues (cont)

- Networking Remote Sites
  - Distributed reviews offer advantages
  - Require special equipment and support
  - Proprietary / classified information security needed
- Synchronous Vs. Asynchronous Reviews
  - Same time best but later can review another team's design changes
- Operational Readiness
  - Reliable / dependable systems needed

Some Selected Research Issues (Not in Paper)

- Visual/Verbal / Body Language Communications
  - Better understanding and methods needed
- Collaboration Between Remote Participants
  - Need to overcome disadvantages of distance, time, and differences in organizational and native cultures
- Cost / Benefit Analysis / Justification
  - Purchase and use must be justified

Some Selected Research Issues (cont)

- Change Configuration Management Control
  - Automated systems needed to track and record changes along with rationale
- Integrating Product / Process Development
  - VE concept design reviews need integration into the total product life-cycle

Conclusion and Future Research

- Doing concept design correctly is important to overall product / system life-cycle costs
- 2nd generation VE systems now available have the potential to improve conceptual / functional design process productivity and effectiveness
- Preliminary research efforts answer several operational / research issues
- Other issues remain and more research / testing is needed for other SBA acquisition phases