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)
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 PowerPoint 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