

Virtual Simulation and Training Inc.

Simulator Performance For Driver Training

Forum8 Design Festival 2010

Administrative Offices
2790-A Indian Ripple Road
Beavercreek, OH 45434
937-431-1193
www.virtualsimulation.com



William L. Curtice III
937-287-0871
wcurtice@virtualsimulation.com

Overview

- Introduce VSAT
- Research Interests
- Training Focus
- Immersive Training
- Simulation Requirements
- Summary

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VSAT Virtual Simulation and Training Inc.

- Dayton Ohio Small Business
- Founded in 2000
- Training System Analysis House
- 20 Employees
 - Core Staff of 12
 - Most Work Part-Time
 - Six Consultants
 - Co-Op – Interns



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Located In The Russ Research Center



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What We Do

- Training System Requirements Analysis (TSRA)
- Training System Effectiveness Studies
- Tool Development for Training System Analysis
- Simulator Testing and Evaluation
- New Initiatives
 - Novice Driver Training
 - Firefighter Training
 - Visualization Environments

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Recent Contracts

- Simulator Fidelity Analysis Tool for Navy Aircraft
- F-35 Aircraft Simulator Flight Fidelity Evaluation
- Training Systems Test & Evaluation Procedures
- C-17 Aircraft Simulator Handling Qualities Analysis
- Cobra g-Queing System Analysis and Performance Evaluation
- Altitude Chamber & Centrifuge – Purchase Specifications
- KC-X Advanced Tanker Aircraft
 - Aircrew Training System Requirements Analysis
 - Maintenance Training System Requirements Analysis

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VSAT Driver Training Research Interests

**Novice
Automobile Drivers**

Age 15-19

**Emergency
Vehicle Operators**

Fire -- EMS – Police

Age 18-60

Reduce Crash Rates

The Crash Rate Problem.....

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Ohio Drivers – Age 15 – 25

- Each Year In Ohio
 - 450 Deaths
 - Over 45,000 Injuries
 - Over 179,000 Crashes
 - Over 100,000 Drivers Age 16-25 Found at Fault!
- Insurance Industry Payouts
 - Exceed \$1.5 Billion*
 - For These Ohio Crashes
- Nationally.... Crashes Kill:
 - Over 19,000 People Age 16-25
 - In over 8 Million Crashes!

Police – Fire - EMS

- Each Year in USA
 - Crashes cause 25% of Deaths
 - Over 170 Deaths
 - Over 7300 Injuries
 - Over 26,000 Crashes
- 60 Crashes – Beaver Creek Only (40,000 population)
- Criminal & Civil Litigation
- Loss of Services
- Loss of Personnel
- Poor public image

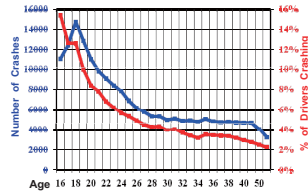
*Based on average costs shown in U.S. Department of Transportation, National Highway Safety Administration study *The Economic Impact of Motor Vehicle Crashes 2000*

Unchanging Crash Rate Curve

Virtual Simulation and Training Incorporated Comprehensive Training Systems Analysis

- Despite numerous initiatives to improve driver training.....

Ohio Drivers Crashing – Drivers In Error



- Graduated Licensing
- Avoidance Skills Training
- Big Brother
- Attitude Modification
- Use of Simulators
- More training hours
- Many Others

- The crash rate remains unchanged!
- Most authorities acknowledge.....
.....Existing U.S. driver training ineffective!

U.S. Driver Training Stagnant > 40 Years

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- State mandated programs have changed little
 - Familiarization
 - Operation of vehicle
 - Driving rules
 - Passing the test
- NHTSA – DeKalb Georgia Study – 1970s
Driver Training had no long term impact on crash rates
- Most High Schools--- dropped the program
- No significant use of simulation in driver training

As Training Technologists.....We had to Ask..... WHY?

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- VSAT has extensive experience in training similar military tasks
- Comparable military training
 - Accomplished quickly (a period of weeks)
 - Highly Effective
 - Similar age groups
 - Wide range of venues... (Pilots, Soldiers, Truck Operators, etc)
- Analysis showed a strong correlation
 - Driver crash rates
 - Historical military pilot crash rates

Historically, Both Student Pilots....AND Student Drivers....

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Were Taught:

- Rules and Regulations
- How to operate their equipment (fly airplane, drive car)
- How to pass the test

Were NOT Taught

- Response to threats (Combat tactics)
- Situational Awareness
- Cognitive Operator Skills
- Team play – interaction with other players

BOTH Experienced SIGNIFICANT Losses

Fighter Pilot Loss Data

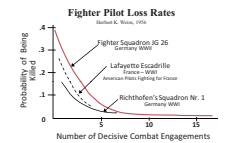
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• Pilot Combat Losses

- WW1 -- > 30%
- WW II -- = 50%
- Vietnam -- > 50%

• A Green Pilots' Chance of Survival:

- 50% if opponent green
- Almost no chance..... If opponent had 5 or more encounters



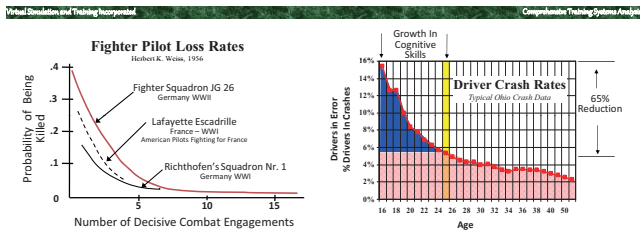
• In Early '70s – Vietnam War -- Pilot Losses Raised Concern

- Both AF and Navy loss rates exceeded 50%
- Navy started "Top Gun"
- Air Force started "Red Flag"
- Intensive – Range Based – Live Combat Training Exercises

• Live Combat Training Dramatically Changed Loss Rates

- Navy 50% → 13%
 - Air Force 50% → 25%
- And Today ... Pilot Losses Much Lower Distributed Mission Training**

It's About – Learning Experiences



- **In the first:**
 - 5 missions ... Pilots Learn the Skills to Survive
 - 10 Years Drivers Learn the Skills to Avoid Crashes 100,000 miles

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Rapid Decision Making Under Stress

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- When a child learns to play basketball....
- And he receives the ball
- He has a decision to make..
- Fast!

- Do I shoot?
- Do I pass?
- Do I run the ball?
- Do I hold.... Until I can pass?



- He makes a quick decision.... Based on:
 - His past experience
 - Knowledge of the situation around him – who is where
 - Capabilities of his team mates – himself – his opponents
 - Past successes and failures
 - Transient opportunities

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Survival -- Can Be Taught

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Key to Survival
Enable Quick Decisions
Right Factors
Usually Correct

- Recognize threat
- Understand situation
- Compare to past experience
- Understand current options
- Take timely action –
- To survive - avert accidents
- Skill Depends On:
 - Heightened Situational Awareness
 - Learned from Practicing Complex Tasks
 - Rich environment
- NOT an automatic, fixed response
- An Automatic Decision Making Process
Yielding Correct Decisions

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Existing U.S. Driver Training Programs

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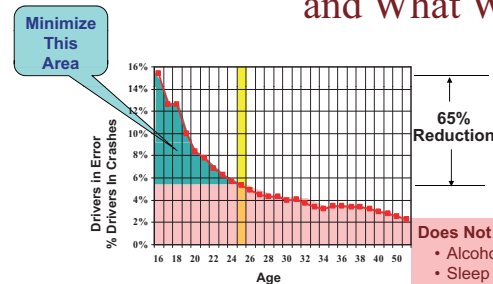
- Are NOT teaching the RIGHT things
To prevent crashes
- Provide no “immersive training” experience
- Do not exploit training technology effectively
- Do not train survival skills

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What We Can Train

Virtual Simulation and Training Incorporated Comprehensive Training Systems Analysis

and What We Can't



- Does Not Address:**
- Alcohol & Drugs
 - Sleep Deprivation
 - Youthful Stupidity
 - Distractions In Car
 - Cell Phone & Texting
 - Re-directed anger

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About Training: Not Age or Attitude

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- It's NOT about age....
 - Pilots of WWI and WW2 Spanned a 10 Year age group
 - Vietnam pilots primarily age 23+
 - Older, experienced pilots moving from Cargo Pilot duty to Combat duty... experienced same learning curve
 - Older drivers... learning to drive for the first time... experience high crash rates
- It's NOT all about emotional maturity.....
 - Pilots... good or bad... at all ages... tend to do irrational things
 - Stunts, flying through arch, buzzing canyons, "hot-dog" behavior, drugs, alcohol, etc.
 - Drivers... at all ages... do irrational things
 - Road rage, cell phone use, drugs, alcohol, venting anger and emotional stress on road, etc.
- It's NOT about the training venue or location.....
 - On an instrumented training range (for drivers or airplanes)
 - In a high fidelity simulator
 - Or..... for real.... in the natural threat environment – on the road or in the air
- It **IS**.... About Living the Learning Experiences
 - The first 10 air combat encounters
 - The significant driving experiences occasionally encountered which teach!

We Believe.....

- Survival Skills Can Be Taught.....
 - Quickly
 - Cost Effectively
 - Using Immersive, Simulator-Based Training
- Crash Losses Can Be **Significantly** Reduced
 - Between **40%** and 60% for Ohio Drivers Age 16-25

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Immersive Training

- U.S. Military Initially Used Live Flight Training
 - Top Gun & Red Flag
 - Training Range
 - Very Costly
- Now Use Simulation-Based Training
 - Distributed Mission Training (Distributed Mission Operations)
 - Multi-Player – Networked
 - Far Less Expensive than Live Training
 - Simulation costs falling rapidly

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For Driver Training ---- We See.....

- Lots of simulators out there
- No comprehensive training systems
- No programs with proven track record
To **significantly** reduce crash rate
- Very poor use of available simulation
- Simulation technology – just now affordable
- for mass training applications

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Driving Simulators – 3 Levels

- High End Research Devices
 - Cost \$\$Millions
 - Research facilities staffed by engineers & scientists
- Commercial Devices
 - Costly >\$200K
 - Inflexible
 - Focused on military, EMS, truck fleet operations
 - 60,000 Fire & Police Departments in US
 - Only Largest Departments (<1%) Can Afford Simulation
- Table-top PC
 - Low cost
 - Gaming steering wheels & pedals
 - Useful for training rules – procedures - operations

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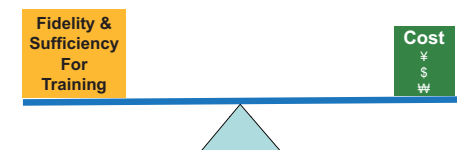
Forum8 Offers New Possibilities

- \$\$\$\$ • Research Devices
- \$\$ • Forum8 Simulator (win-Road with DS)
 - Powerful
 - Flexible
 - Moderately priced
 - Supports Business Case for both Teen and EMS Driver Training
 - **Research Questions: Can it provide required cues?
Is it “immersive” enough?**
- \$\$\$ • Commercial Devices
- \$ • Table-top PC Based

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Immersive Training

- Visual Environment
- Field of View
- Vehicle Dynamics
- Force Cueing
- Cab Fidelity - EMS
- Instructor Controls
- Student Performance Metrics



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Visual Environment

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- Key to Immersion
 - Realistic roads, countryside, urban surroundings
 - Weather – including snow and water on road
 - Traffic, people, animals, obstructions, distractions
 - Traffic controls, lights
 - **Ability to change and modify quickly & inexpensively**
- Past - Commercial Driving Simulators
 - Minimal, fixed environments
 - Fixed scenarios
 - Limited ability to change
 - Authoring tools expensive, complex, high learning curve
 - Image generators expensive – multiple PCs

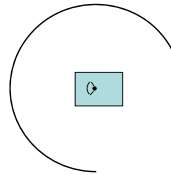


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Visual Field of View

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- Present critical cues
- 180 degrees forward
- Rear view mirrors
- Over shoulder glance view
- Perspective change – response to head movement



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Vehicle Dynamics

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Automobile

- Generic vehicle
- Basic dynamics
 - Center of Gravity
 - Front-Wheel vs. Rear Wheel Drive
- Road conditions
 - Pavement
 - Low μ (wet, snow, ice)
 - Wheels off road (Split μ)

Fire/EMS Vehicle

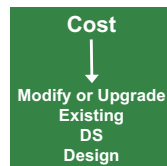
- Vehicle types (pumper, ladder...)
- Different vehicles within type
- Multiple brake systems
 - Hydraulic – Air – Anti-Locks
 - Engine – Transmission – Jake (Jacobs)
- Steering forces
- Road conditions
 - Gravel, Pavement
 - Low μ (wet, snow, ice, mud)
- Split μ
- Variable Center of Gravity
 - Fluid slosh
 - High CG
- Multi-axel
- Dual wheels

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Force Cueing

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- Training task dependent
- Wheel, brake, seat
- On-set cues
- Sufficient to sense
 - Road conditions
 - Loss of traction
 - Loss of control
 - Side slip
 - Roll-over
 - Spin
 - Normal acceleration/deceleration
- VSAT Pursuing Force-seat approach



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Instructor Controls

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- Independent of student display
- Control of
 - Scenarios
 - Start pre-scripted events
 - Simulation freeze
 - Weather
 - Time of Day
 - Road Conditions

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Fire-EMS Cab Fidelity

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- Unique Emergency Vehicle Controls
 - Gear Shift
 - Braking Controls
- Mirrors
- Multi-Task (Radio, Computer)

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Performance Evaluation Capabilities

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Evaluate student performance

- Drive track
- Acceleration, speed and braking
- Hazard proximity
- Response to threats
- Head tracking & eye tracking
- Response to distractions
- Parking
- Reaction Times

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Simulator Performance Growth

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- In some areas – need more than now exists
- Initial research – use what we have
- Realize needed changes:
 - Use of Software Development Kit (SDK)
 - Hardware modifications
 - Enhancement requests
 - Use of 3rd Party Products
- Forum8 *Is* Up and Coming!
 - Many VSAT needs addressed by Forum8 just in last year
 - Vehicle dynamics in Version 5

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VSAT Project Status

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- Building local environments
- Designing initial scenarios
 - Teen Driver
 - EMS
- Implementing student performance metrics
- Brake pedal modifications
- Seat force cue modifications
- Expect first student runs – Summer 2011

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Team

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D & D Driving School



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We Believe.....

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- The Training Theory... is Correct
- Proof of Concept... is Achievable
- This *Will* Start a Revolution... in Driver Training
- Potential for National and Global Deployment

Exploit Proven Military Training Technology

To Address A Critical Societal Training Need

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VSAT Points of Contact

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Richard J. Heintzman
President
937-431-1193 Alt: 937-426-3681
rheintzman@virtualsimulation.com

William L. Curtice III
Vice President for Development
937-431-1193 Alt: 937-287-0871
wcurtice@virtualsimulation.com

John F. Lethert
Executive Vice President
937-431-1193 Alt: 937-879-4183
jlethert@virtualsimulation.com

Ellen G. Dyson
Director of Contracting and Corporate Administration
Corporate Secretary-Treasurer
937-431-1193 Alt: 937-278-7454
edyson@virtualsimulation.com

Virtual Simulation and Training, Inc.
Russ Research Center
2792-A Indian Ripple Road
Dayton, OH 45440
www.virtualsimulation.com

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