TRB Webinar: Creating an Innovative Workforce



Augmenting Words, Equations, and Data with Visualization

Today's Presenters and Moderator



Michael Manore, Vispective Management Consulting



John Messner, Penn State University



Shashi Gowda, Federal Highway Administration



Sean Brennan, Penn State University



Creating an Innovative Workforce:

Augmenting Words, Equations, and Data with Visualization

Michael Manore, P.E.
Principal & Founder
Vispective Management Consulting
Chair – TRB Visualization in Transportation Committee

Cracking the Door



Terms

Invention

- 1st occurrence of idea, new product or process



Innovation

- 1st attempt to carry it out / put into practice



Innovative Workforce

- Inspired Learners, Creators, Doers
- Contributors (belonging)
- Diverse…able to:
  - Communicate
  - Collaborate
- Balanced Thinking
  - Linear (vertical)
  - Nonlinear (lateral)
- Transfer Knowledge
- Ideas Into Action



The Vis Family

Generally:

- 2D Imagery / Maps / Dashboards / Diagrams / Graphs
- 3D Models / Graphs
- 4D Animation / Simulations
- 5D (3D + Time + Resources)
- Rendering / Texturing
- Simulation (as in driving)

With Ties To:

- Interactivity / UI
- Multimedia
- Social Media
- Mobile
- Vehicle Guidance
- Virtual Worlds

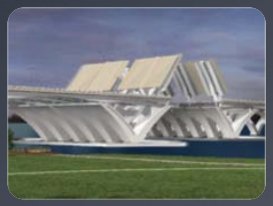
Shifts

Planning



PLACEWAYS, LLC

Public Involvement

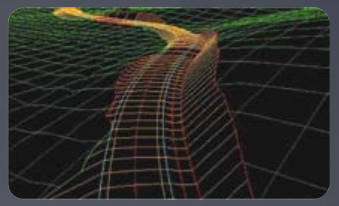


URS

LIDAR / Survey



3D Design



Mark Taylor - FHWA

Human Factors



ARRIVA





HNTB

BrIM



Digital Construction

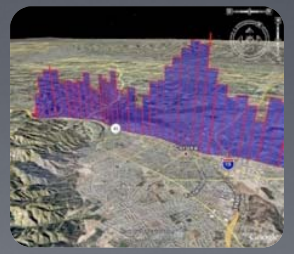


Social Networking



U of MD CATT Lab

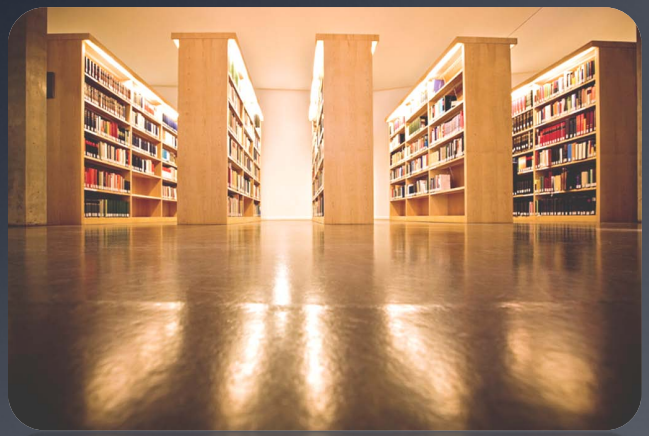
Education & Training



Karl Petty - BTS, Inc.

DATA

Shifts

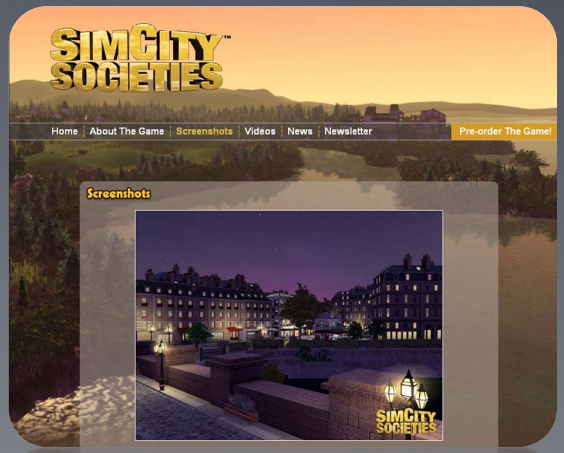


- Tom Watson
- Sean Dromgoole
- Derek Robertson

2009 gamebasedlearning







Shifts

Serious Games?



FHWA Turner Fairbank

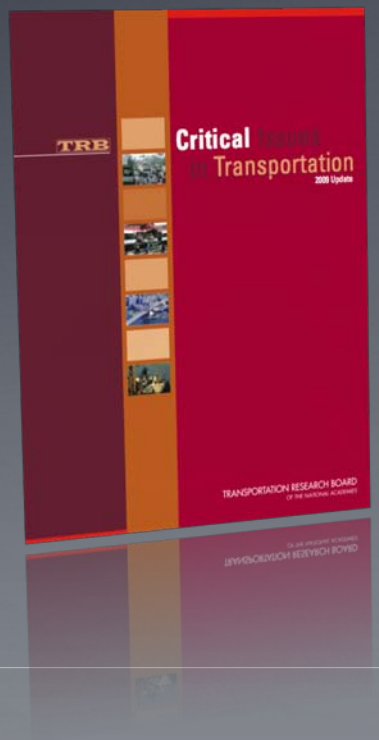




AT DAY'S END:

We deliver Linear Systems…

…that have Non-linear Complexities.



- **CONGESTION:** increasingly congested facilities across all modes;
- **ENERGY, ENVIRONMENT, AND CLIMATE CHANGE:** extraordinary challenges;
- **INFRASTRUCTURE:** enormous, aging capital stock to maintain;
- **FINANCE:** inadequate revenues;
- **EQUITY:** burdens on the disadvantaged;
- **EMERGENCY PREPAREDNESS, RESPONSE, AND MITIGATION:** vulnerability to natural disasters and terrorist strikes;
- **SAFETY:** insufficient improvement;
- **INSTITUTIONS:** 20th century institutions mismatched to 21st century missions; and
- **HUMAN AND INTELLECTUAL CAPITAL:** inadequate investment in innovation.



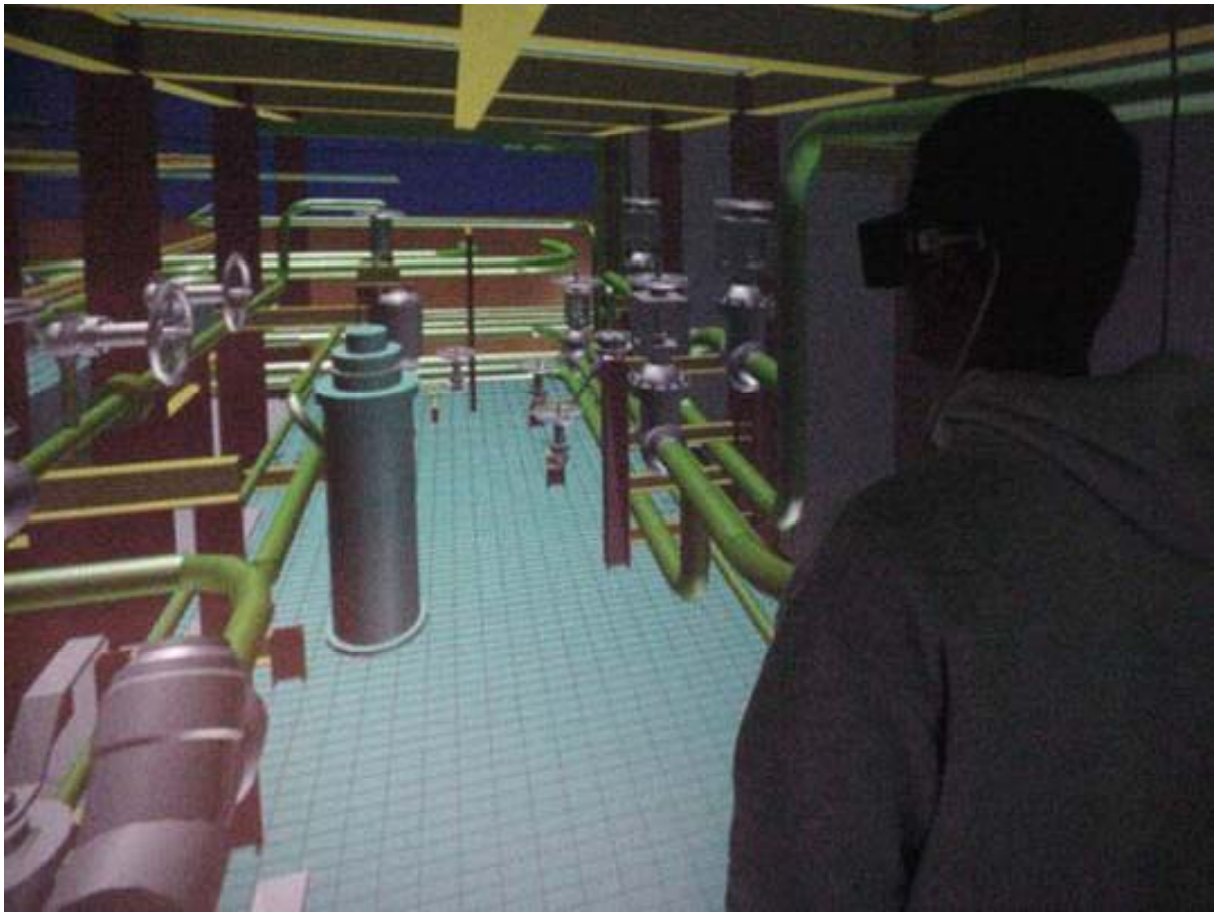
Creating an Innovative Workforce:

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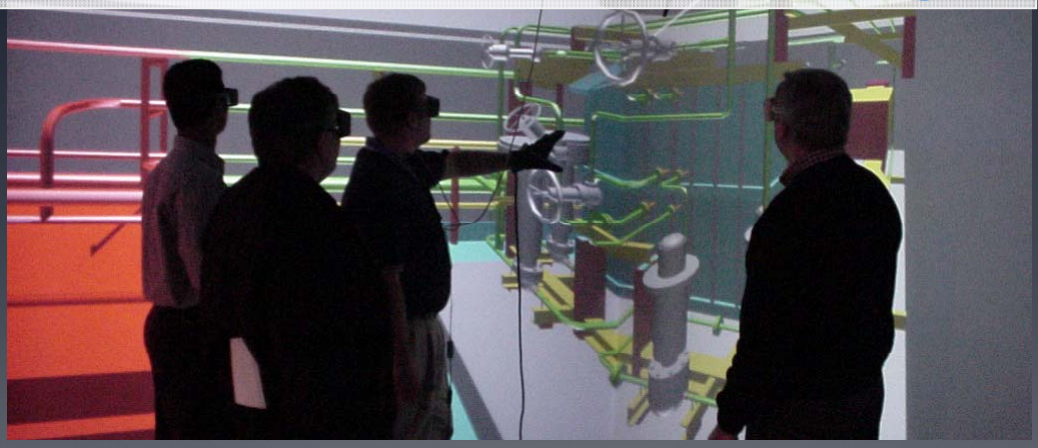
John Messner, Ph.D.
Associate Professor of Architectural Engineering
Director, Computer Integrated Construction Research Program
The Pennsylvania State University
www.engr.psu.edu/ae/messner
jmessner@engr.psu.edu

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PENNSTATE



Virtual Facility Prototyping



"… the value of prototyping arises from how people behave around prototypes."

- Michael Schrage from Serious Play (2001)

Virtual Facility Prototyping

The Model

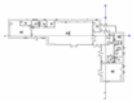
Representation of the Product & Process

The Media

Method for viewing & interacting with the model

Virtual Facility Prototyping

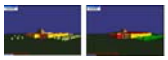
The Model



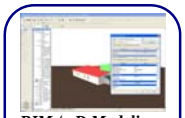
2D Model
(Provides diagrammatic representation of space and details)



3D CAD Model
(Adds 3D perspective of physical components)



4D CAD Model
(Adds temporal dimension for construction process visualization)



BIM / nD Modeling
(Adds attribute information, e.g., cost, material properties, etc.)

The Media

Method for viewing & interacting with the model

Immersive Construction (ICon) Lab

3 Screen Immersive Display



- 3 screen
- Stereo projection
- Off-the-shelf hardware
- Interactive Whiteboard
- 20 Tablet PCs
- Familiar interface
- Seats up to 30 people



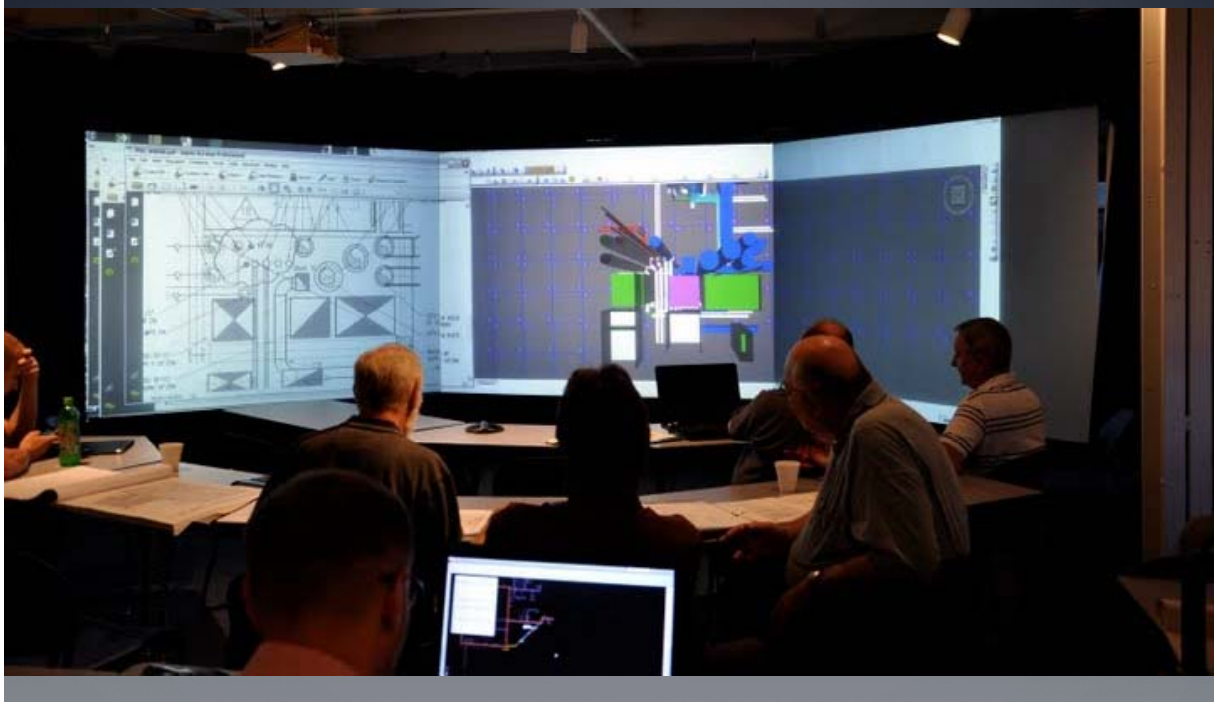


Virtual Courtroom Prototype

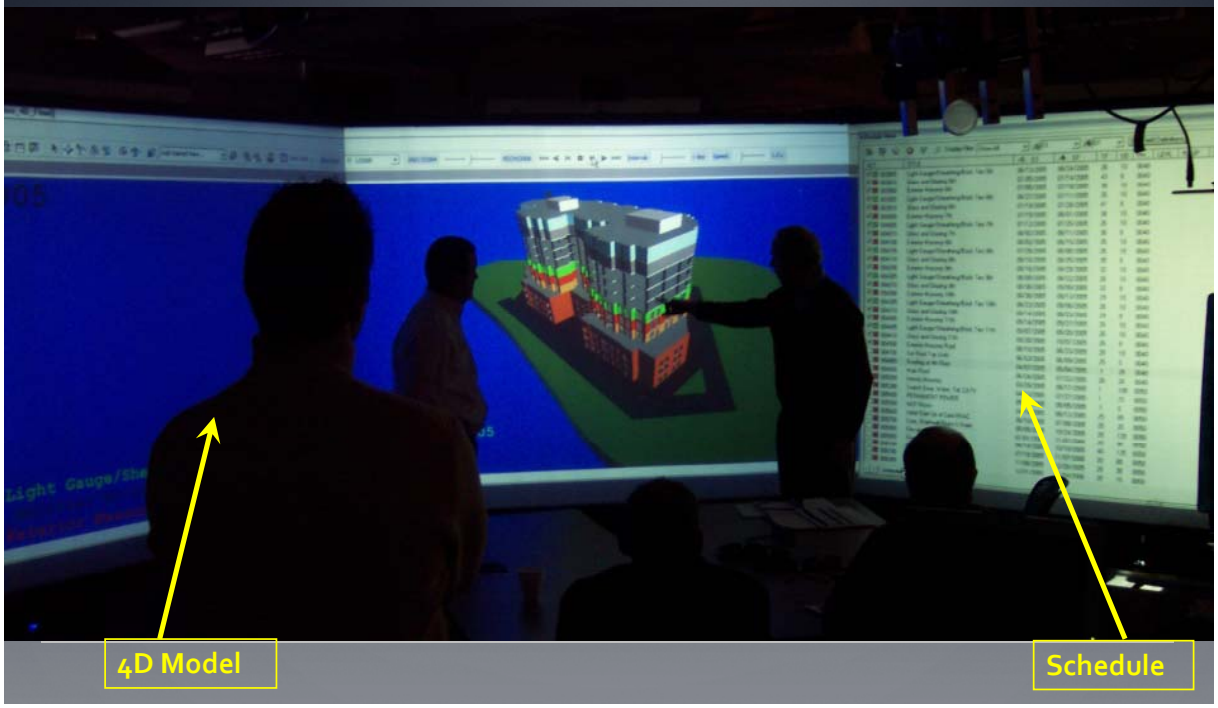




Design Coordination Prototype



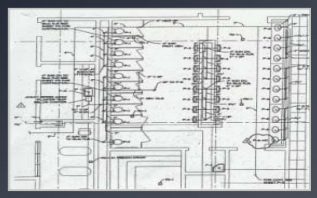
Construction Planning Prototype



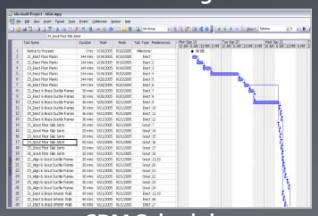
Impact of Virtual Facility Prototyping

- Engages the project team
- Improves design comprehension
- Aids in construction plan visualization
- Impacts the type of conversation / coordination
- Allows for the identification of more time / space conflicts
- Adds to the degree of confidence in final decisions
- Facilitates the identification of innovative planning solutions

Future Workforce Educational Challenges



2D Drawings



CPM Schedule

Visualization skills

To "see" the problem…



Site visits

Design and Decision-making skills

To design, plan and manage…

Virtual Facility Prototyping

The Model

Representation of the Product & Process

The Media

Method for viewing & interacting with the model

Applying Virtual Prototyping Concepts to Electronic Educational Initiatives

The Learning Content

Model or Application which Communicates the Educational Content

The Learning Space

Physical Environment for Interacting with the Learning Application

A Place to Learn

The Learning Space

Media Environments

Immersive Displays at Penn State



SEA Lab CAVE



Immersive Construction (ICon) Lab



Immersive Environments Lab

Tools to Support Education

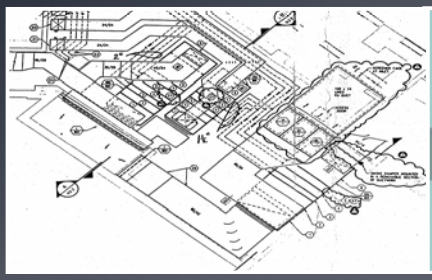
The Learning Content

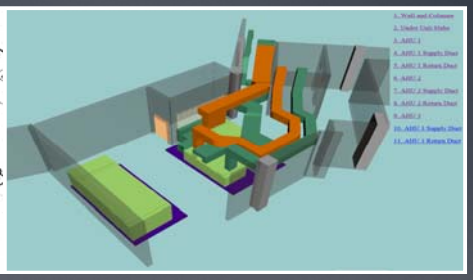
A Picture is Worth a 1,000 words

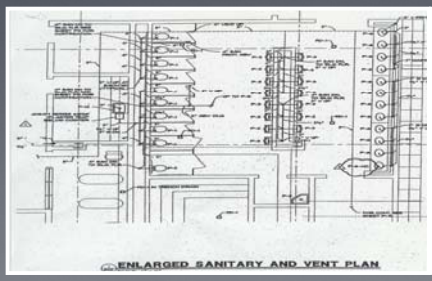


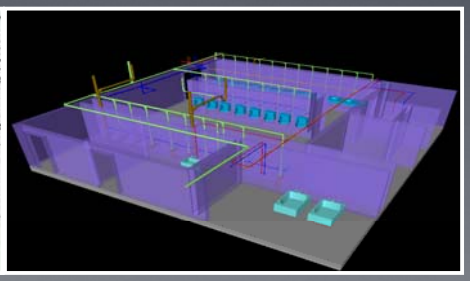


What is the value of a prototype?

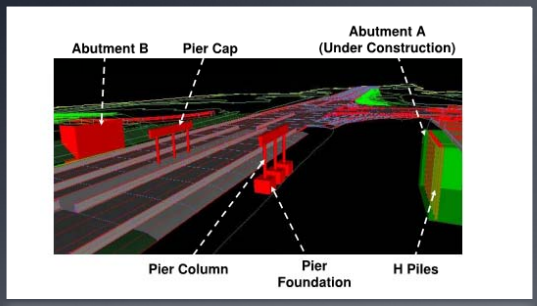


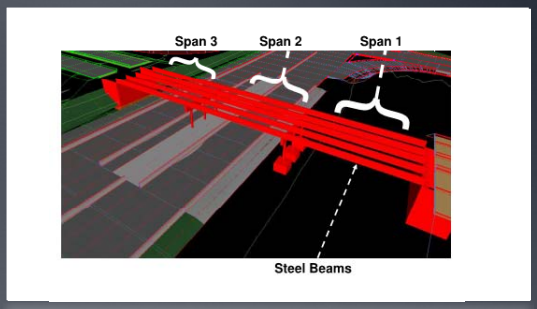


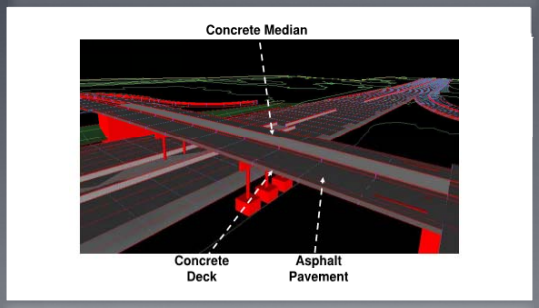


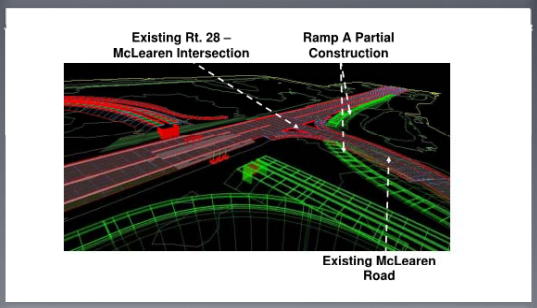


Student Generated Prototype







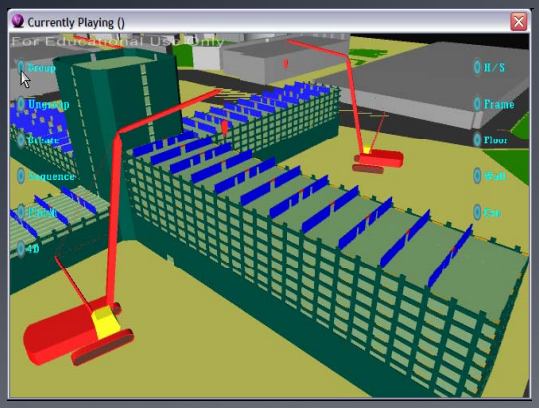


Source: Adam Platt (2007) "4D CAD for Highway Construction Projects", MS Thesis, The Pennsylvania State University, University Park, PA.

Virtual Construction Simulation

Interactive Simulation Application

VCS



The Learning Content (VCS)



The Learning Space (The ICon Lab)

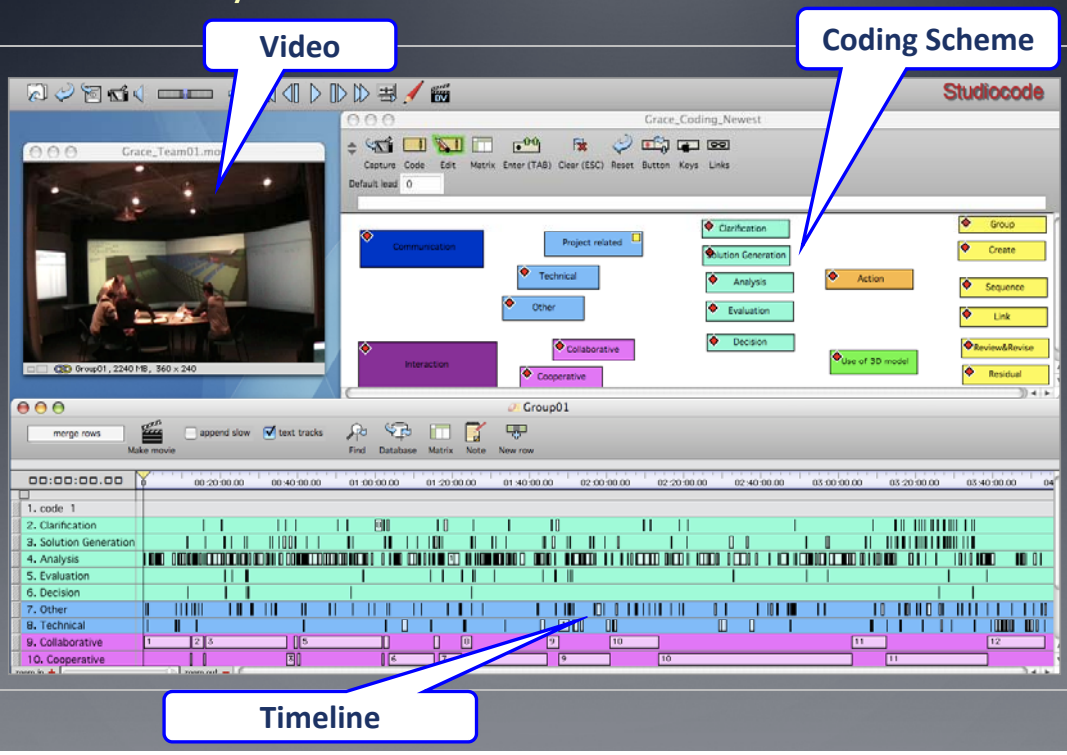
Measuring the Impact

Assessment Metrics

	Assessment Metrics	Data Collection Methods
Process	Group Communication Group Interaction	Direct Observation Video Recording
Product	Solution Quality	Scoring Rubrics
Perception	Opinion	Survey

Measuring the Impact

Video Analysis - Studiocode



VCS Implementation Conclusions

- More effective collaboration



- Higher quality schedule development



- Improved student perception
  - Perception of more learning
  - More enjoyable

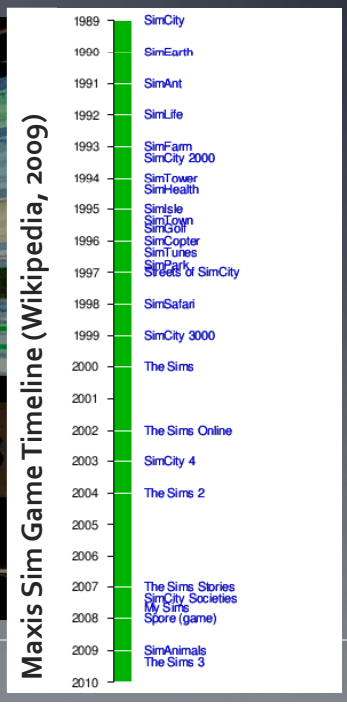
The Next Generation



Educational Games are Not New



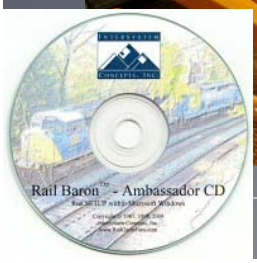
SimCity Cover Art (Maxis, 1989)



Educational Games are Not New

(Especially if we consider Board Games)







Developed in the 1970's

Virtual Construction Simulation 3D

Simulation game

VCS

Simulation	Serious Game
Model of reality/process	Goal directed
Task specific	Competitive
Test/predict performance	Risk/Rewards
Repetitive	Rules/Constraints
Feedback	Uncertain outcomes
	Discovery
	Performance feedback
	Engagement
	Motivation

Simulation Game

Virtual Construction Simulation 3D

Educational Focus

VCS

Construction Planning

Core knowledge
- Methods
- Activities
- Resources
- Sequence
- Cost

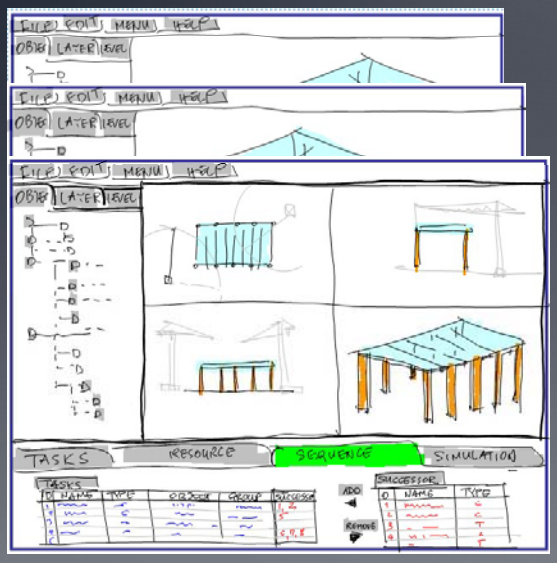
Management skills
- Leveling resources
- Cost/Time trade-offs
- Risk factors
- Productivity factors
- Project reports
- Safety / Owner satisfaction

Virtual Construction Simulation 3D

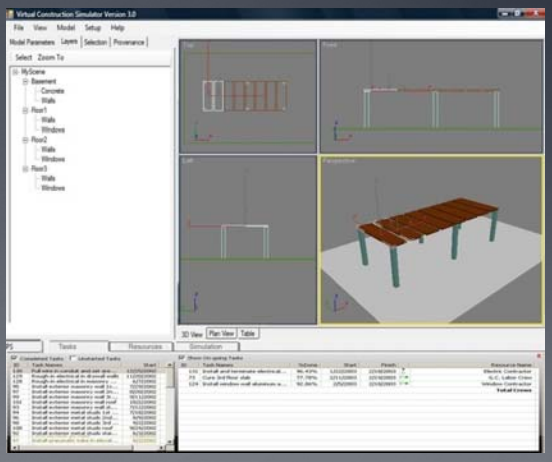
Development

VCS

User Interface



User case scenarios; Storyboarding



Prototypes

Concluding Thoughts

- Visualization and modeling skills are in high demand
- Visual, interactive applications can improve education
- The learning space should be planned
  - does it support the visualization process?
- More visual and interactive methods improve innovation

It's ok for learning to be fun

And it's ok to have fun teaching…



Acknowledgements

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  - National Science Foundation
  - The Charles Pankow Foundation
  - The Construction Industry Institute
  - Nuclear Engineering Research Initiative, DOE
  - The Partnership for Achieving Construction Excellence
- Industry Partners

Any opinions, findings, conclusions, or recommendations expressed in this presentation are those of the presenter and do not necessarily reflect the views of the National Science Foundation or other sponsors.

"Without motivation, there is no learning".
James Paul Gee

CIC Website: www.engr.psu.edu/ae/cic

"Tomorrow's innovators will invest more in playing with prototypes, modeling marketplaces, and simulating scenarios because that will become the best way to create new value and profitably deliver it to customers. Innovative models inspire innovative behavior.

… the value of prototyping arises from how people behave around prototypes."

- Michael Schrage from Serious Play (2001)

CIC Website: www.engr.psu.edu/ae/cic



Creating an Innovative Workforce:

Augmenting Words, Equations, and Data with Visualization

Shashi Gowda
Project Manager
Sevatec, Inc. (contractor for)
Federal Highway Administration
U.S. Department of Transportation
email: shashi.gowda@fhwa.dot.gov
office: (703) 235-0542
cellular: (703) 980-7748
fax: (703) 235-0593

U.S. Department of Transportation
Federal Highway Administration

NHI

SEVATEC
A Commitment to Service

Introduction

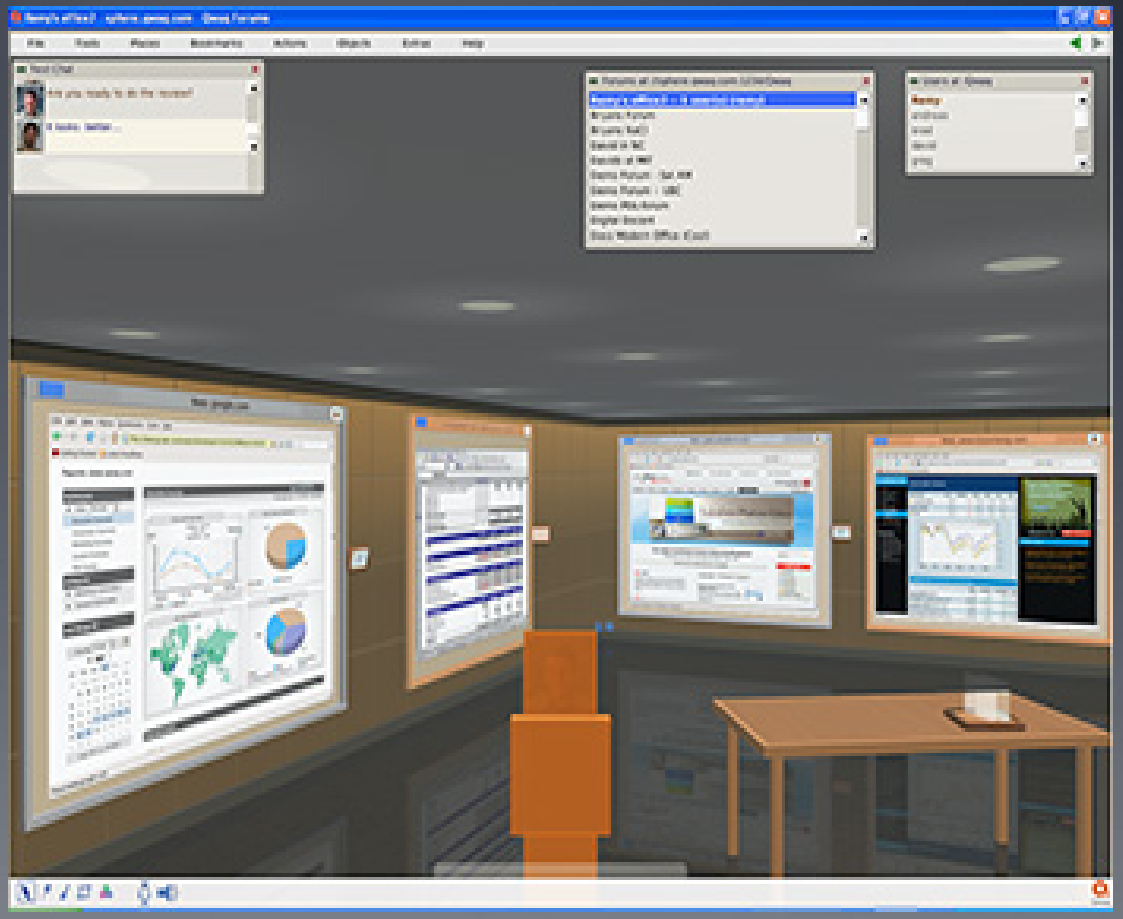
The Federal Consortium for Virtual Worlds (FCVW) consists of members from government (federal, state & local, & international), academia, and corporate sectors. The Consortium supports individuals and organizations to improve government collaboration through the use of virtual worlds to enrich collaborative online experiences.



The Future 3-D Face of Knowledge for Work

Three Perspectives:

- **Robert Dalton** – "Knowledge Management is about knowledge transfer…its about the people, not the technology."
- **Michael Macedonia** – "The secret to success is connecting real life to virtual worlds."
- **Jeff Morrison** – Using virtual environments (VE) to conduct intelligence gathering – use of "synthetic environments"



Accessing Virtual Worlds Across Federal Government Agencies

Methods of utilizing visualization . . .

- USDA Vision
- Hosting in an Enterprise Data Center Architecture
- Identity and Access Management
- Next Steps



Interested Federal Agencies

- I-95 Corridor Coalition with University of Maryland Center for Advanced Transportation Technology Lab
- CDC
- FMCSA
- FAA
- USDA
- US Military
- NOAA



Virtual Worlds: Benefits

- Create virtual reality to any specifications
- Lower cost and carbon emissions than travel
- Create simulations that provide opportunities to practice various skills, procedures and techniques in a non-threatening environment
- Available 24/7



Virtual Worlds: Challenges with Visualization

- Bandwidth
- Hardware
- Security
- Learning curve to participate
- Extensive simulation planning
- Trust (Who am I speaking with today?)



Common Objections Regarding Visualization . . .

- "I suffer from information overload already."
- "So much of what's discussed online is meaningless. These forms of communication are shallow and make us dumber. We have real work to do!"
- "I don't have the time to contribute and moderate, it looks like it takes a lot of time and energy."
- "Our clients don't use this stuff, the learning curve limits its usefulness to geeks."
- "Communicators [bloggers, tweeters] are so fickle, better to stay unengaged than risk random damage. We don't want hostile comments left about us on any forum."
- "Upper management won't support it/dedicate resources for it."
- "There are so many tools that are similar, I can't tell where to invest my time so I don't use any of it at all."

FHWA's Opportunities



- The USDA-IRM College trusted source hosting pilot project
- Develop proof-of-concept on existing DOT Island in Second Life



Creating an Innovative Workforce:

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Sean Brennan
Assistant Professor of Mechanical Engineering
Larson Transportation Institute
Penn State University
email: sbrennan@psu.edu
office: (814) 863-2430
fax: (814)865-9693



That’s me doing a demonstration for my Vehicle Dynamics course, Spring 2008!

See http://controlfreaks.mne.psu.edu for more info

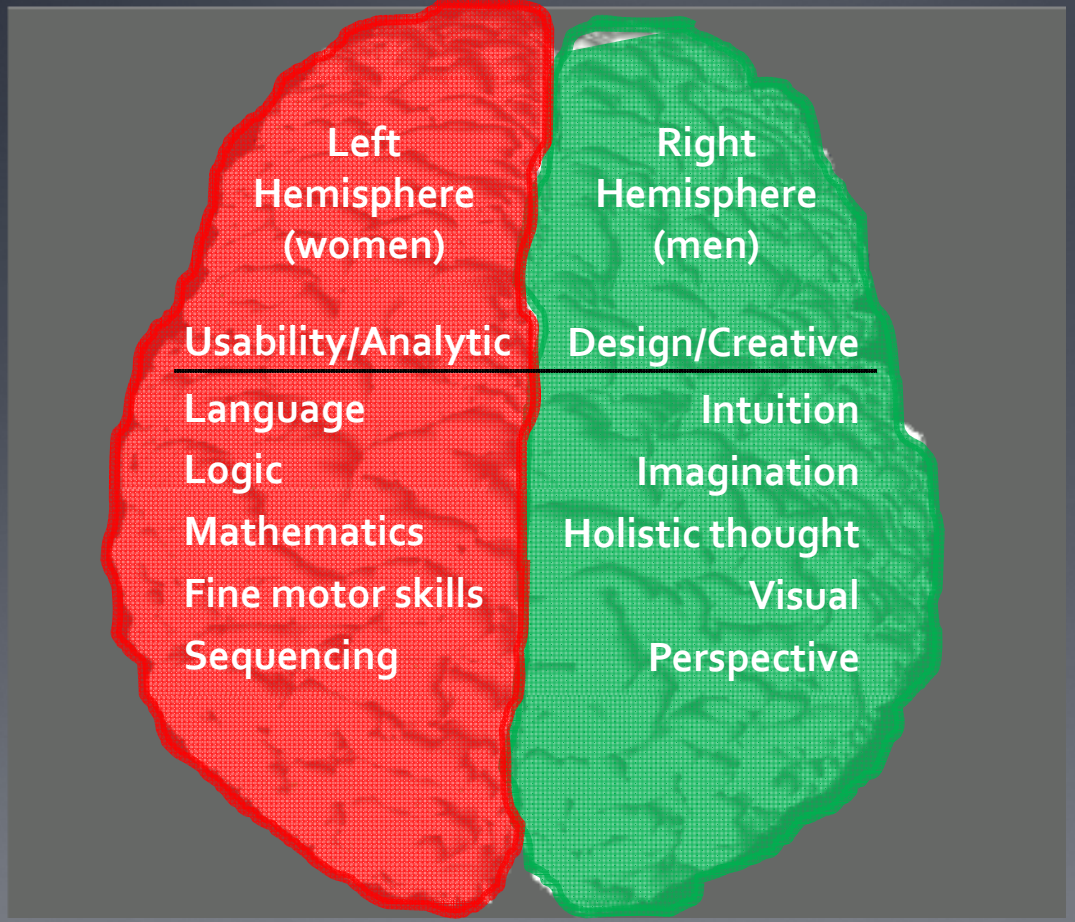


Predisposed Learning Based on Gender

- Most people are predisposed to one type of learning style
- Men typically have more developed RIGHT hemispheres in their brains
- Women typically have more developed LEFT hemispheres in their brains

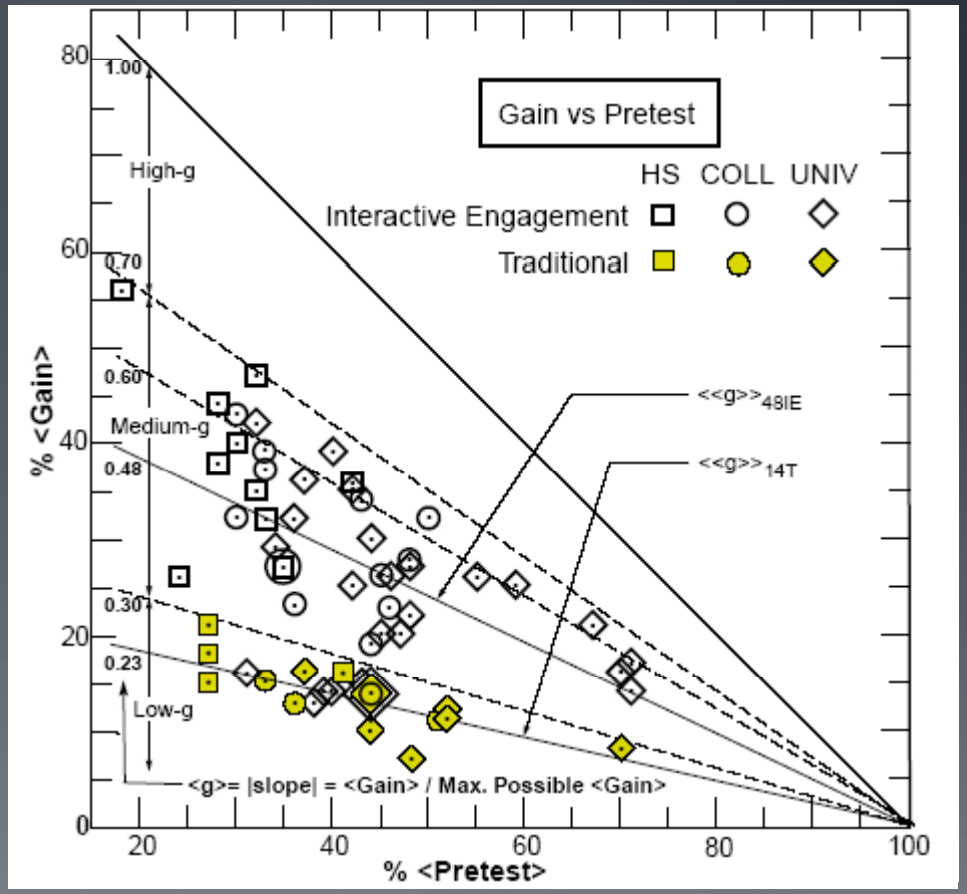


Predisposed Learning Based on Gender



Active Learning

Active learning has been shown to provide significantly higher retention levels (~40%) versus traditional methods (~20%)



Richard R. Hake, "Interactive-engagement vs traditional methods: A six-thousand student survey of mechanics test data for introductory physics courses". See http://www.physics.indiana.edu/~hake/

Learning Types

Learning Population of Students, ~ 1980's to 1990's





Feeling
(concrete experiences)

20% like "feel and do"

10% like "feel and watch"

Doing
(active experimentation)

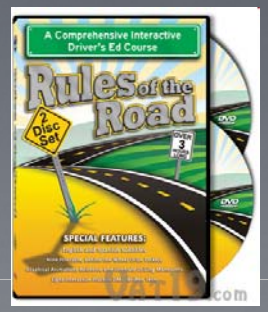
Watching
(reflective observation)

30% like "think and do"

40% like "think and watch"

Thinking
(abstract conceptualization)





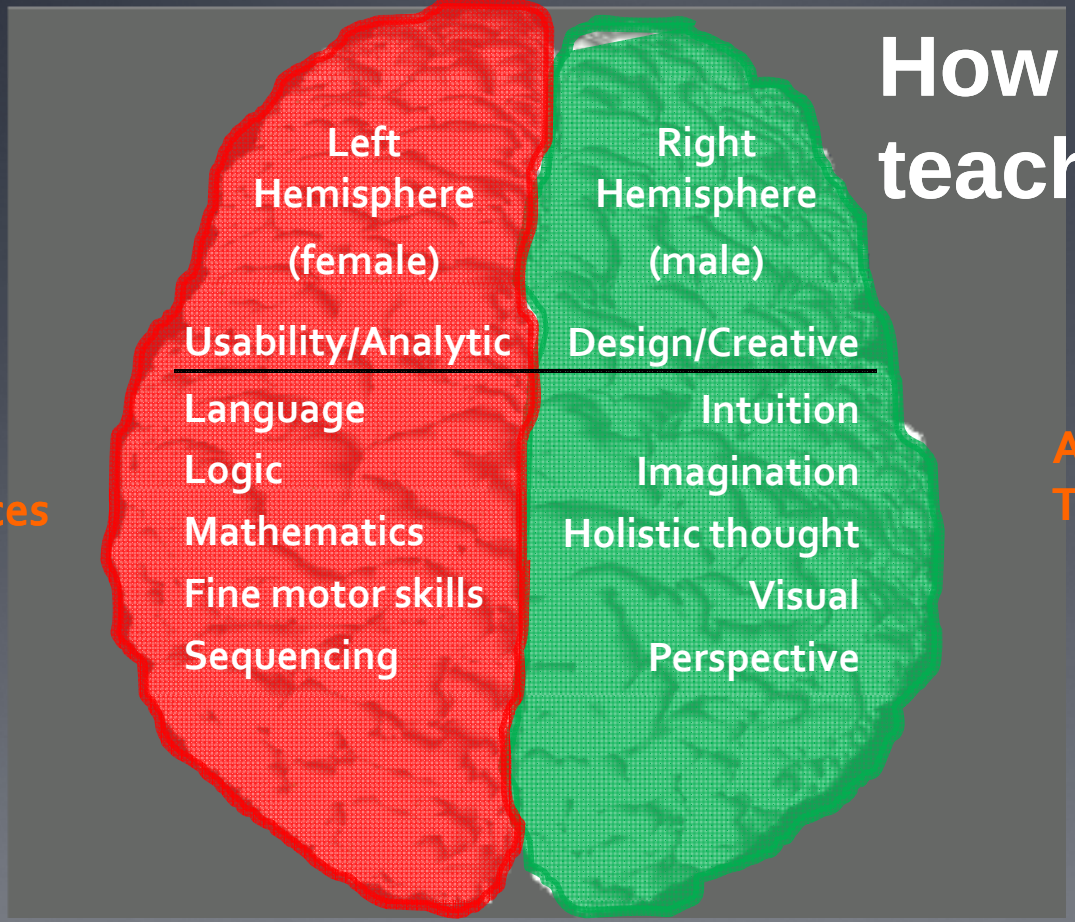
Take away point?

No such thing as a

"one size fits all"

visual

Predisposed Learning Based on Gender



Concrete Experiences

20%

Abstract Thinking

80%

Is this why the engineering realm has historically been dominated by men?

Innovative Visualization



Feeling

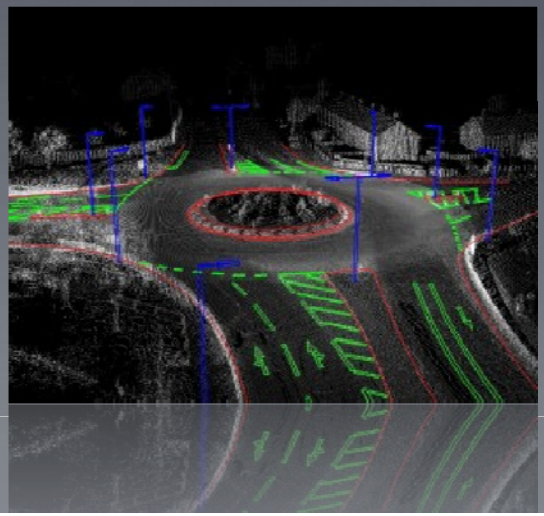


Doing

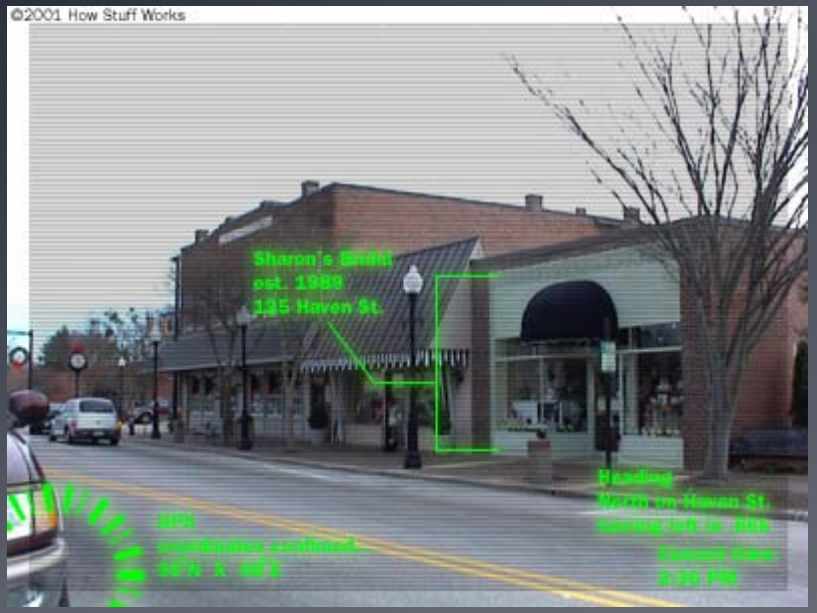
Watching

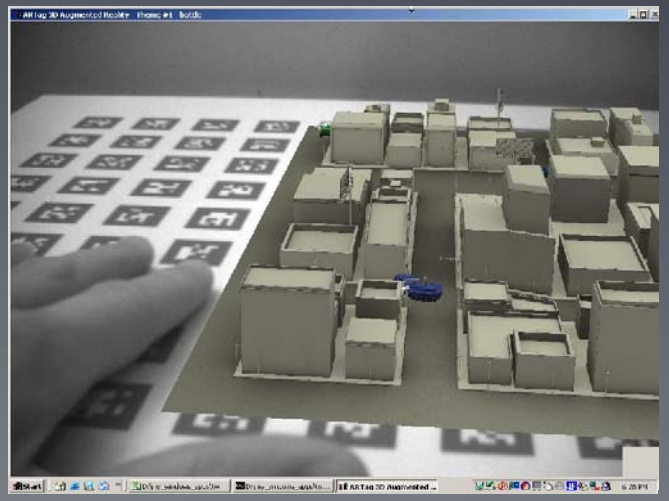


Thinking



Augmented Reality

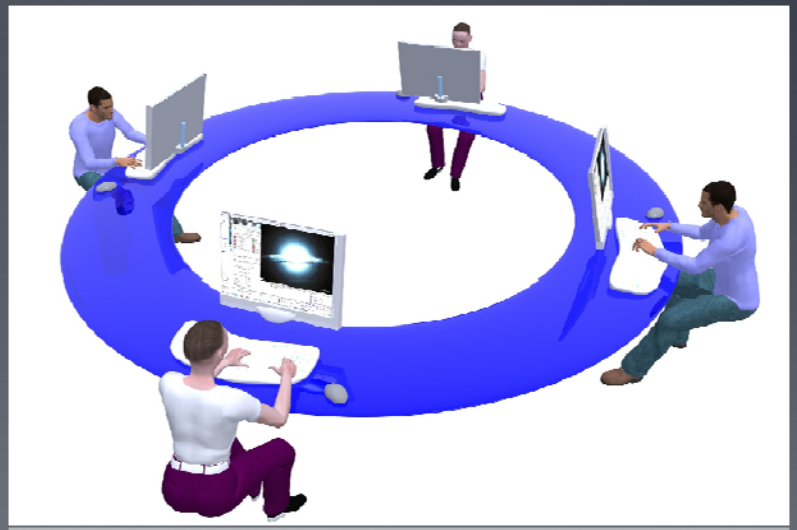





REAL
VIRTUAL

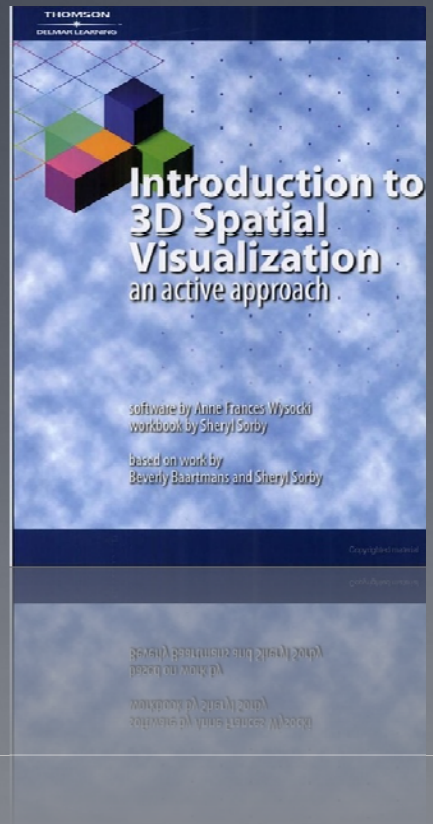
Innovation in Your Future





Why Vis Matters

- One of the Human Intelligences (Howard Gardener)
  1. Bodily-kinesthetic
  2. Interpersonal
  3. Verbal-linguistic
  4. Logical-mathematical
  5. Naturalistic
  6. Intrapersonal
  7. Visual-spatial
  8. Musical



EnVISIONS(NSF) **/ STEM**

- Veurink, Hamlin, Sorby

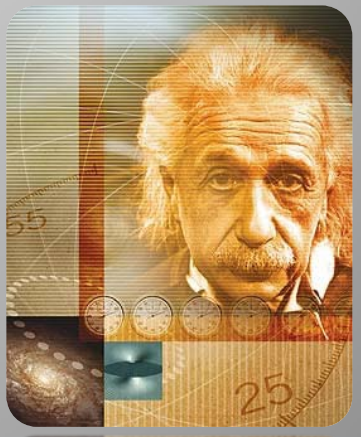
❖Arizona State University
❖Michigan Tech
❖Penn State – Erie
❖Purdue University
❖Virginia State University
❖Virginia Tech
❖University of Iowa

Closing

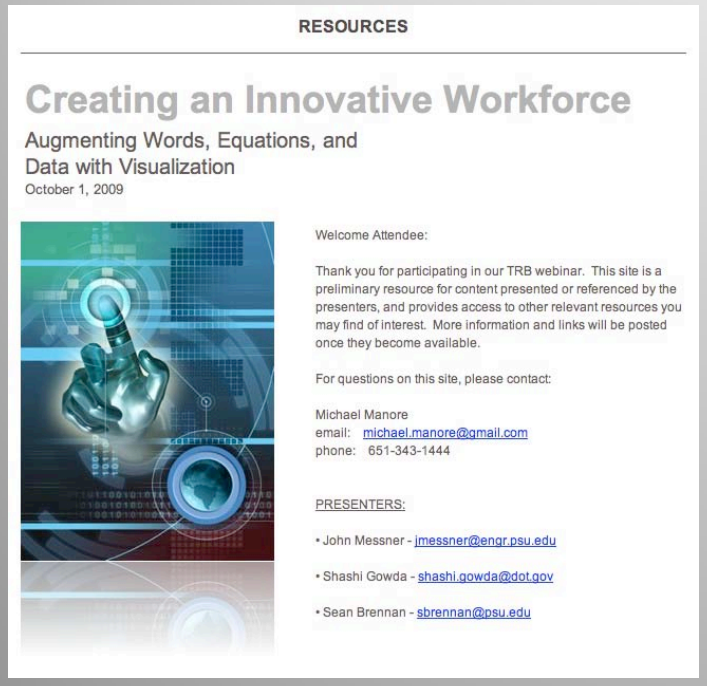


"We can't solve problems using the same kind of thinking we used when we created them."

- Albert Einstein



Thank You



RESOURCES

Creating an Innovative Workforce

Augmenting Words, Equations, and Data with Visualization

October 1, 2009

Welcome Attendee:

Thank you for participating in our TRB webinar. This site is a preliminary resource for content presented or referenced by the presenters, and provides access to other relevant resources you may find of interest. More information and links will be posted once they become available.

For questions on this site, please contact:

Michael Manore
email: michael.manore@gmail.com
phone: 651-343-1444

PRESENTERS:

- John Messner - jmessner@engr.psu.edu
- Shashi Gowda - shashi.gowda@dot.gov
- Sean Brennan - sbrennan@psu.edu

www.trbvis.org/IWF/RESOURCES.html