

# Transforming Education to Meet Global Challenges

---

*Public Services Summit  
@ Nobel Week 2006*

*Charles W. Steger  
President, Virginia Tech  
December 9, 2006*



# Faculty Development Institute

Motivate faculty to re-think teaching and learning.

- Explore specific instructional technology applications.
- Investigate, create, and use alternative instructional activities.
- Faculty who have transformed teaching practices share their experience.

# Faculty Development Institute

- Recurring voluntary participation to update knowledge, skills and technology.
- Faculty scheduled to attend summer FDI “tracks” once every four years.
- Voluntary program with nearly 100% participation.

# Faculty Development Institute

Year	Spring		Fall	
	Workshops	Participants	Workshops	Participants
2004	92	888	94	730
2005	140	1,847	144	2,214
2006	190	2,927		

- Significant cultural shift in attitude toward technology.
- Skill levels of faculty, staff, and students continue to grow and diversify.

# Graduate Education Development Institute

- Transforming traditional teaching and learning paradigm
- Engage current graduate student teachers and future faculty in rethinking traditional pedagogy
- Discovering how Problem/Inquiry based learning engages 21<sup>st</sup> Century learners

# Information Technology Used Locally

## ■ COSMOS

- Southwest Virginia
- Connect Health and Human Service organizations
- Open Source software, duplicated or enhanced by other software developers

# Information Technology Used Across the World

## ■ India

- Master of Information Technology
- S.P. Jain Institute
- Based on award-winning domestic,  
distance-learning program

# Information Technology Used Across the World

## Three-University Consortium -- ATLANTIS

- Virginia Tech, United States
- Kungliga Tekniska högskolan, Sweden
- Technische Universität Darmstadt,  
Germany

# Information Technology Used Across the World

## Three-University Consortium

- Accredited dual Bachelor of Science in Mechanical Engineering degree
  - Graduates prepared to engage in global engineering economy
  - Students:
    - Fully immersed in two languages, limited training in a third language
    - Attend all three universities

# Information Technology Used Across the World

## Three-University Consortium

- Students will meet BSME requirements in two countries with no delay in reaching degree.
- Students can transition into potential master's program (Bologna process, cycle 2).

# Information Technology Used Across the World

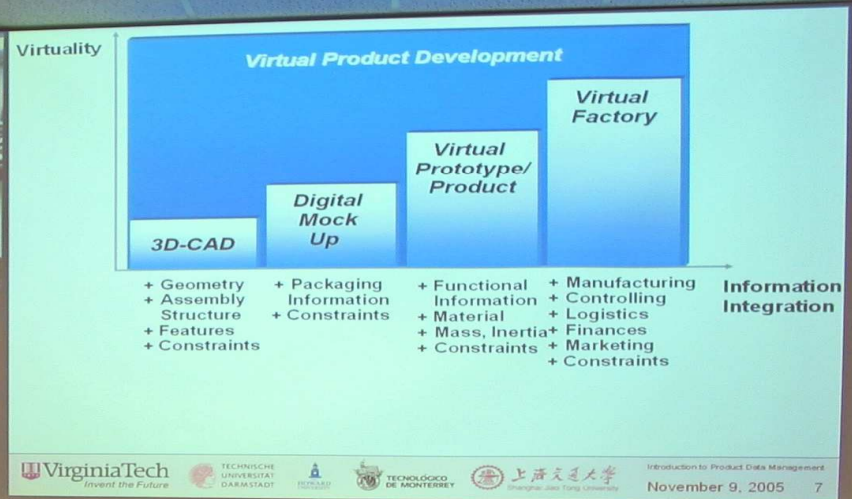
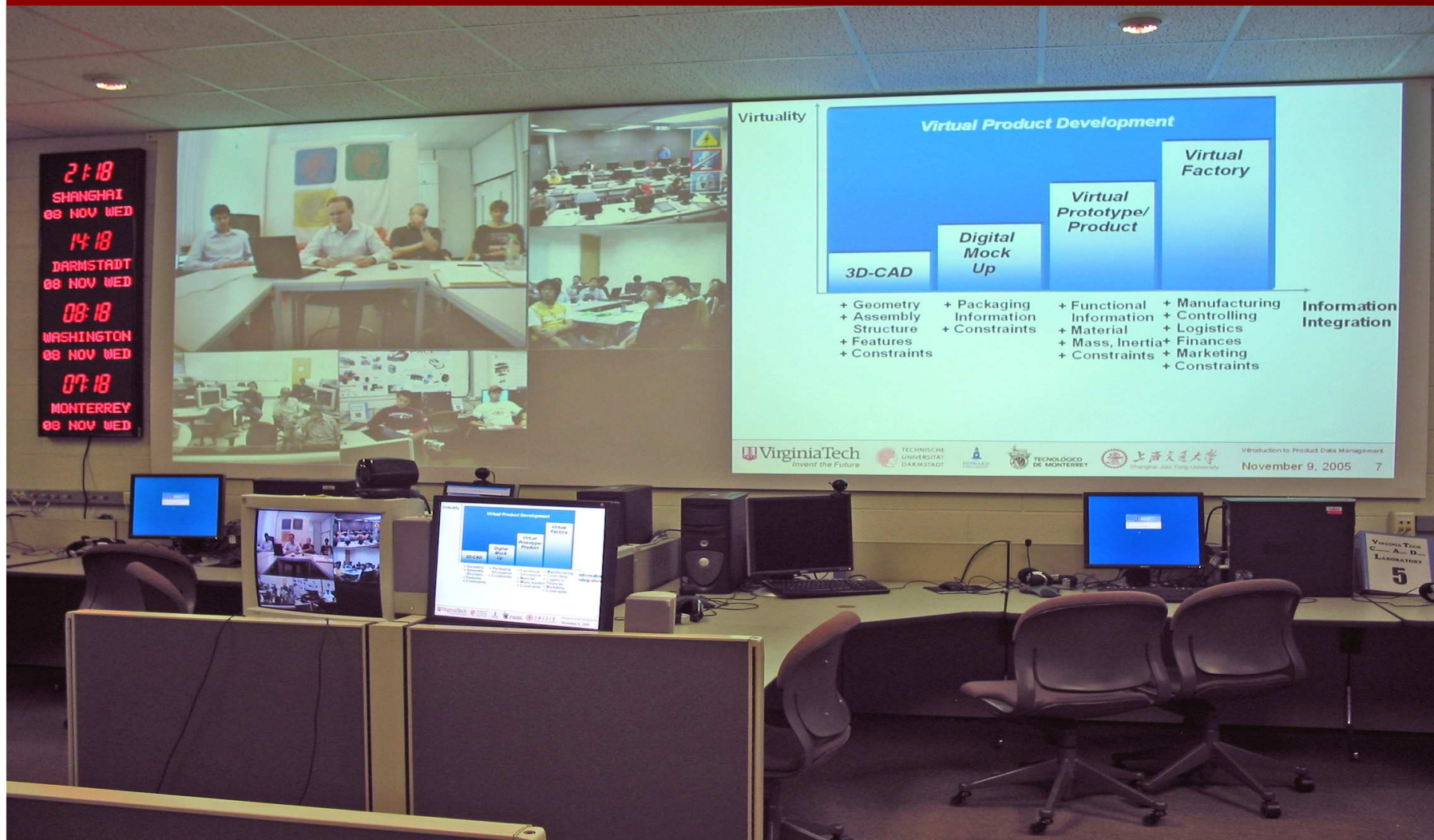
## Three-University Consortium

- First transatlantic dual Bachelor of Science degree contained entirely within field of engineering and the first cycle of Bologna process.
- Virginia Tech students in Germany and Sweden work together on joint projects.

# Information Technology Global Learning

- Five Universities: Joint, team-taught course on global collaborative engineering
  - Technische Universität Darmstadt, Germany
  - ITESM, Monterrey, Mexico
  - Jiao Tong University, Shanghai
  - Howard University, Washington DC, USA
  - Virginia Tech, USA
    - Hope to add Indian university next year

# Five-University Collaboration



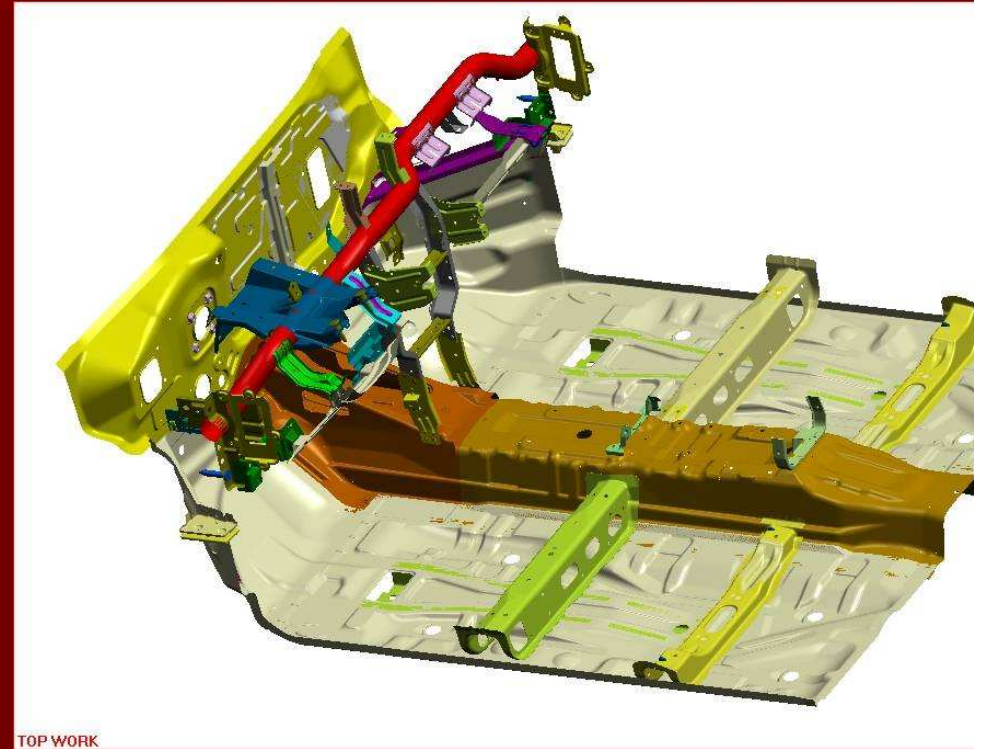
# Information Technology Global Learning

## ■ Five-University Collaboration

- Use state-of-the-art video conference hardware and collaboration software in lab -- accessible 24/7– can share desktops.
- 12-person team
  - 3 sub-teams
    - 2 pairs of students from two different universities in different countries.
- Teams have same assignment.
- Majority of team must design for foreign market.

# Global Learning

- Team Presentation
  - Using all available technologies.
  - Viewed by high-level industry representatives.
  - Viewed in all five collaborating countries, plus other nations.
  - Industry jury awards prizes.



***Assignment: Design center console for Buick Excelle***

# Trend -- Information Sharing

## Open Source

- Non-proprietary software.
- Available to software developers regardless of locale.
- Software developers will release their software as open source when they wish to make the product—and often any future improvements to it—available as a free public good.
- Profound implications for developing countries.

# Trend -- Information Sharing Open Source

- Virginia Tech – 2006 Mellon Award for Technology Collaboration
  - “Virginia Tech combines a seemingly endless willingness to contribute tangible resources to the Sakai effort, and at the same time uses its unique position to be an ambassador helping connect Sakai to other open source efforts and to an entire generation of software engineers. . .to develop educational materials.”

~ Charles Severance, Exec. Director, Sakai Foundation

# Trend -- Information Sharing Open Source

## ■ Sakai

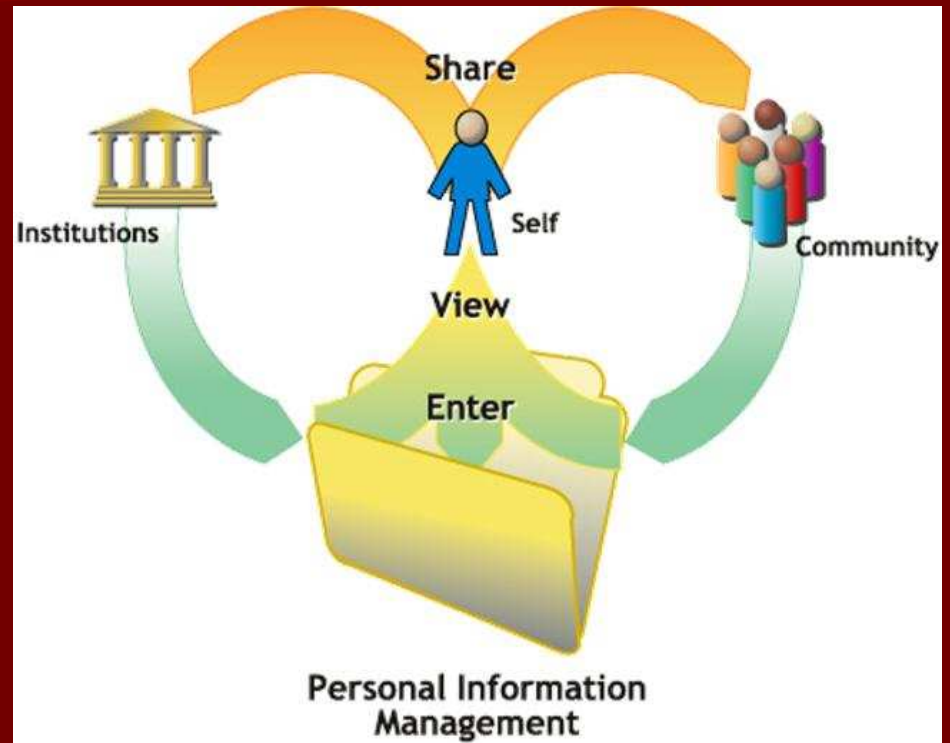
### – New Environment for Learning, Collaboration

- Assignments
- Course documents
- Web resources
- Discussion
- Assessment

- *Future: develop new digital lab notebook that "plugs into" Sakai.*

# Virginia Tech Electronic Portfolio

- Individual-centric software to support a process:
  - Collection
  - Selection
  - Reflection
  - Connection



# Aspects of ePortfolio

- Personal Information Documentation
- Personal Interests
- Mentors, Role Models
- Personality Inventory
- Education
  - History
  - Academic Record
- Graduate/Professional Students
  - Thesis/Dissertation
- Examination Committee Members
  - Type of Committee
  - Major, Minor Courses
  - Additional Courses

# ePortfolio Opportunities for Higher Education

- Student and career development
- Documentation of learning outcomes for the accreditation process
- Faculty development and evaluation
- Bridging
  - From high school to college
  - From college to graduate school

# Information Technology Trends

---

- Computational power and data storage requirements growing dramatically.

# Innovative Technologies and Complex Systems

---

- Bioinformatics
- High-performance computing
- Power electronics and robotics
- Wireless
- Geographic Information Systems (GIS)



# Trend: Computational Power

---

- Advent of nano-scale research requires significant computing power for simulations, etc., and equally significant storage because of the vast amounts of data that must be stored and analyzed.

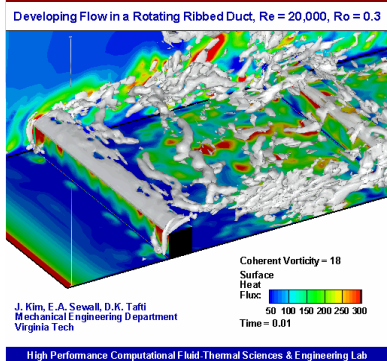
# Virginia Tech System X Terascale Computing Facility

---

- Third fastest computer in the World (November 2003)—upgrade completed in 2004
- First academic computer to break 10 teraflops
- “Best IT application in the world in science” -- 2004 Computerworld Honors Program



# High Performance Computational Fluid-Thermal Science



- Simulation of Complex Turbulent Flows
  - Turbulence encapsulates scales over 7 to 8 orders of magnitude
  - Simulations use 10s to 100s of processors of System-X
  - Utilized over 1.6 million CPU hours of System-X and generated Terabytes of data in the last year and a half.



# Information Technology Married to Biology

- Virginia Bioinformatics Institute (VBI)
  - Domestic – PathPortal
  - International – FIOCRUZ, Brazil

# VBI: Host-Pathogen-Environment Interaction

---

## ■ The Pathogen Portal Project

PathPort aids in the rapid detection, identification, and forensic attribution of high-priority pathogens, whether causing infectious diseases or potentially used as biological weapons.

PathPort includes:

- Genomic tools
- Microarray tools
- Mass Spectrometry & Proteomics
- Gene Ontologies

# VBI: EpiSims: Comprehensive Event Characterization for Biological Incidents

---

## **Example: simulate infectious disease spread via individual contacts**

- Methodology
  - Create proto-populations: humans, bacteria, animal reservoirs, ...
  - Refine population, adding attributes: health, demographics, behavior, ...
  - Simulate all individual interactions to develop relationships among attributes
- Represents many aspects of events in socio-technical systems
  - Examples: critical workers, cascading failures, detailed responses, ...
  - Assists reasoning about complex dynamics
  - Provides detailed information not present in traditional aggregate models
- Multiple uses for simulation-assisted reasoning
  - Planning: evaluating proposed mitigations
  - Situation assessment
  - Course of action analysis

# Computational Requirements for 1 Run

- Simulate infectious disease spread via individual contacts
- Typically 100 to 200 runs per study

(Totals are given in “()” for 200 runs below)

	Population (million)	Input Data (GB)	Output Data (GB)	Machine Hours System X
West Coast	43	35	30 (6TB)	0.8(160)
East Coast	75	60	50(10TB)	1.4(280)
United States	280	225	200(40TB)	5.2(1040)

# National Lambda Rail

- Dedicated nationwide ultra broadband (40 Gb/s) optical data network
- Consortium of industrial and university members
- Virginia Tech will manage the Washington, DC node
- Online and connected to Virginia Tech campus in 2004



- Global Communications Revolution



- World-class quality standard