Remote Laboratories

- Lessons Learned
- 03/03/2011
Interactive Learning Tools at BSC

All ILTs Must Be Web Native
Interactive Learning Tools at BSC

CLIENT BASED

- Lecture
- Animation
- Mini-Sim

CLIENT BASED Attributes:
- Client Based = No Scheduling
- Hosted Via any LMS/Web Site
- Requires Only Generic Modeling
- Reduced Development Time with Properly Trained Faculty
- Animations & Mini-Simulations Are Best Value for $$$

SERVER BASED

- Full-Simulation
- Remote Lab

SERVER BASED Attributes:
- Physical Equipment & Accurate Modeling Increase Cost
- Requires Coordination with Campus/State IS
- Limited Equipment = Mandatory Scheduling
- Requires Ongoing Operation & Maintenance
- May Eliminate Students’ Need to Be On-Site

National Energy Center of Excellence
WebLab Architecture

Laboratory Control Systems
Application Servers
Databases
Video Systems
Campus Network
Front End Web Servers
Internet
Instructors
Students

National Energy Center of Excellence
What is WebLab?

- Architecture for Remote Laboratory Development
- What are Remote Laboratories?
  - Physical Equipment at a Set Location
    - Similar to Traditional Laboratories
  - Usable from Any Location with Internet
    - Use Advanced Control Systems (Safety & Reliability)
    - Use Real-Time Telemetry & Video Feeds
    - Log User & Laboratory Data
- What Are Good Candidates for Remote Laboratories?
  - Think Automation
  - If a System/Process/Experiment Can Be Automated Then It Is a Good Candidate for a Remote Laboratory
Lessons Learned

- Technical:
  - Integration
    - Campus/State Information Services
      - Who Will Host and Maintain and What Is the Impact?
      - What Shared Services Will Be Needed (i.e. Directory Integration, Campus Solutions)?
      - Reliability and Scalability
  - LMS
  - Bandwidth Issues
    - Where Can Bandwidth Be Optimized?
      - Client Application
      - Client Downloads
      - Server Data (XML versus HTTP) – Separate Real-Time and Static Data
      - Video
  - Firewall Issues
    - Port 80 Is Your Best Friend
  - Corporate Policy Issues
    - Can a Student Install a Client Application?
  - Cross Platform Functionality/Compatibility
Lessons Learned

• Development
  ▪ Resource Commitment
    ▪ Developers, Graphic Designers, Programmers, Engineers, and Subject Matter Experts (SMEs) May Be Needed
    ▪ ILTs Are an Investment; Proper Time and Budget Need To Be Allocated for Successful ILT Development
  ▪ Sound Academics
    ▪ Educational Objectives Must Be Clearly Defined Before Starting Project
    ▪ Lessons & Assessment Need To Be Created For All ILTs
      ✓ Faculty Champions Will Help Considerably With This
      ✓ Can Determine Difference Between ILT Success or Failure
  ▪ Documentation
    ▪ Required for Successful O&M
  ▪ Safety & Reliability
    ▪ Labs May Be Run 24/7
    ▪ Safety Needs to Be Addressed for People and Equipment
Lessons Learned

• Delivery, Operation, & Maintenance:
  ▪ Additional Support Materials May Be Required Based on Delivery Method
    ▪ Classroom
    ▪ Online Individual
      ✓ May Require Chat Functionality
    ▪ Online Group
      ✓ Will Require Chat Functionality
  ▪ Physical Maintenance
    ▪ Laboratories Will Have Failures if Not Properly Maintained
  ▪ Infrastructure Maintenance
    ▪ Hosting Information Systems Will Require Ongoing Maintenance
  ▪ Online Laboratories Will Require Scheduling
    ▪ This Can Be Automated
Remote Laboratory Examples

- Power Grid Laboratory
- Process Laboratory
- Wind Laboratory
- Smart Grid Laboratory
Questions & Contact

- NECE Website:
  - http://www.bismarckstate.edu/energy

- WebLab Website:
  - http://server01.energy.bsc.nodak.edu

- Contact:
  - Zachery Allen
    - zachery.allen@bismarckstate.edu
    - 701-224-2524