



National Energy Center of Excellence



BISMARCK
STATE COLLEGE

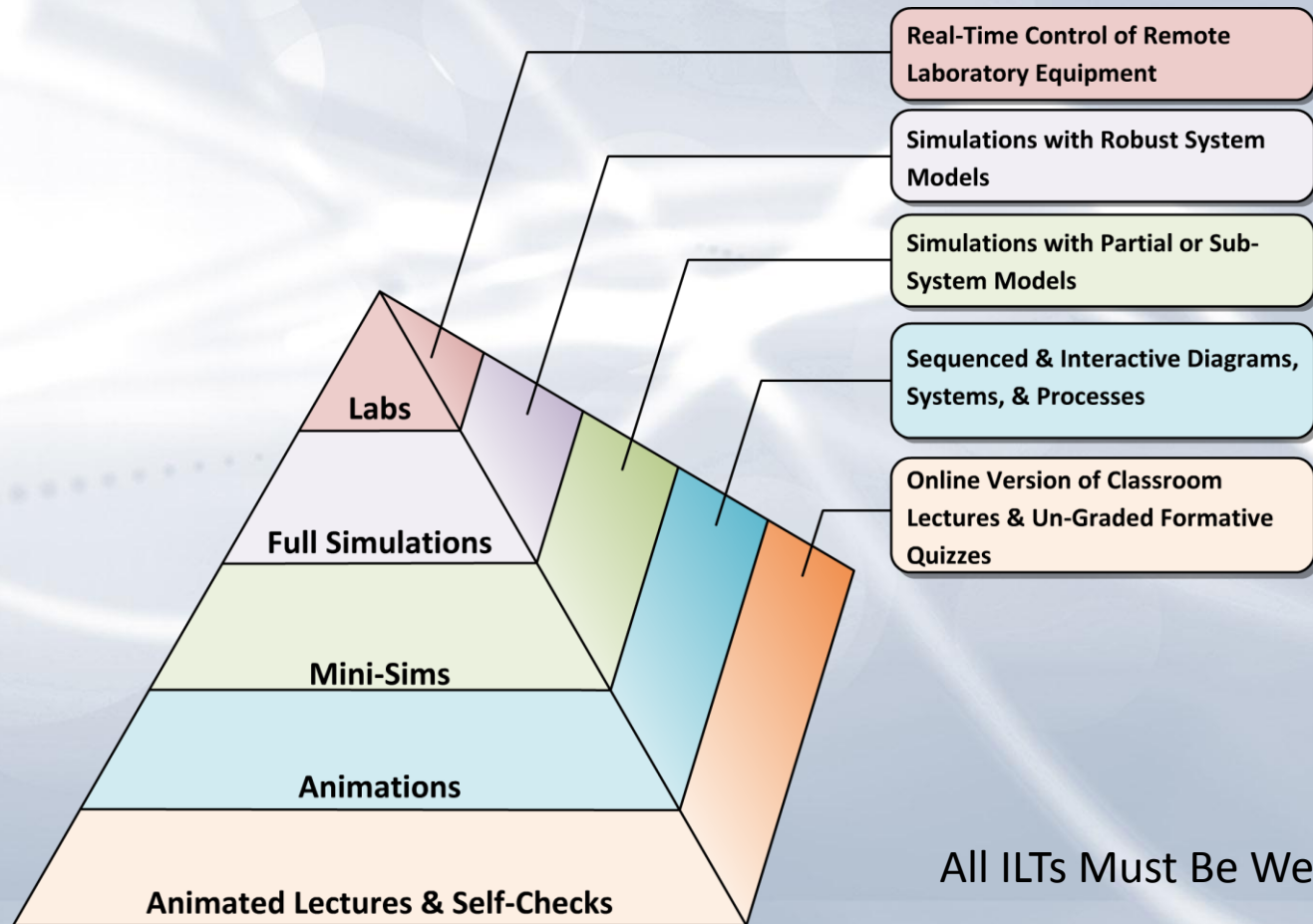


Remote Laboratories

- Lessons Learned
- 03/03/2011



Interactive Learning Tools at BSC

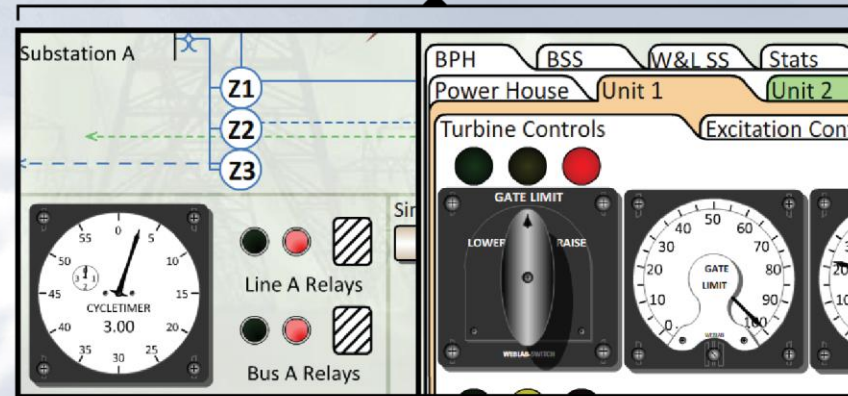
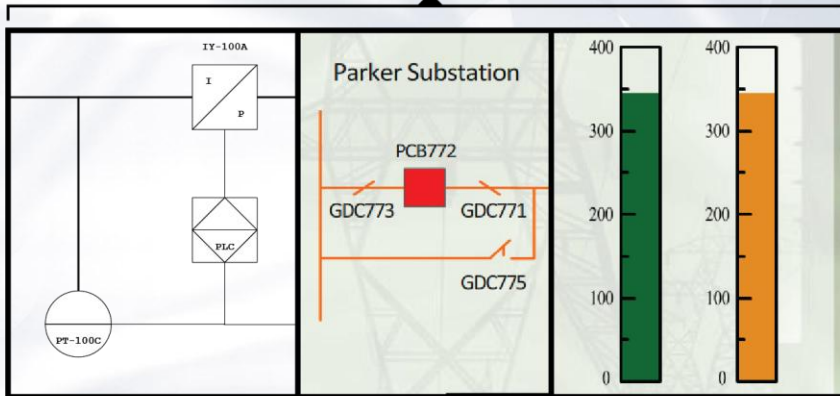


All ILTs Must Be Web Native

Interactive Learning Tools at BSC

CLIENT BASED

SERVER BASED



Lecture

Animation

Mini-Sim

Full-Simulation

Remote Lab

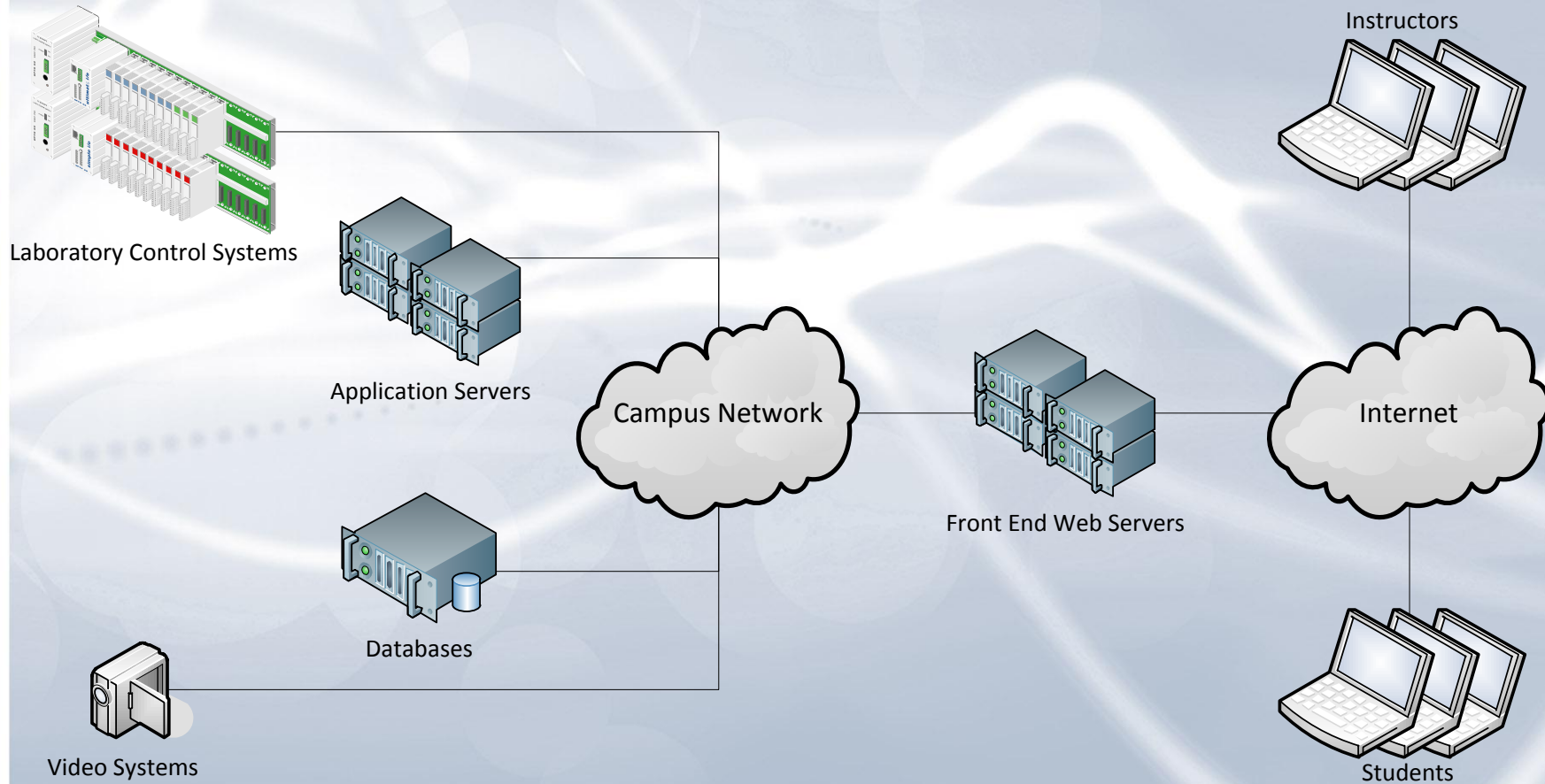
COST/TIME



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 \$\$\$

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

WebLab Architecture



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**

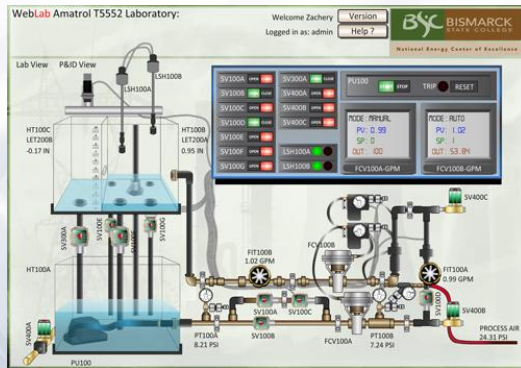
Lessons Learned

- **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

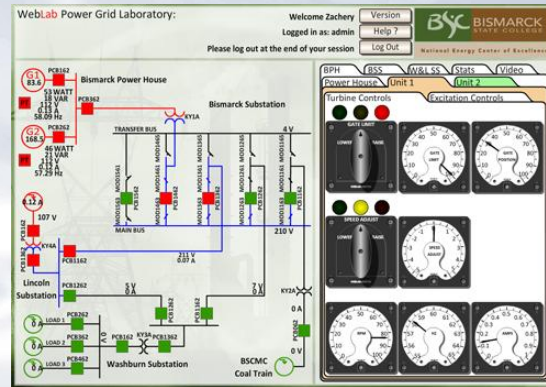
Lessons Learned

- 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

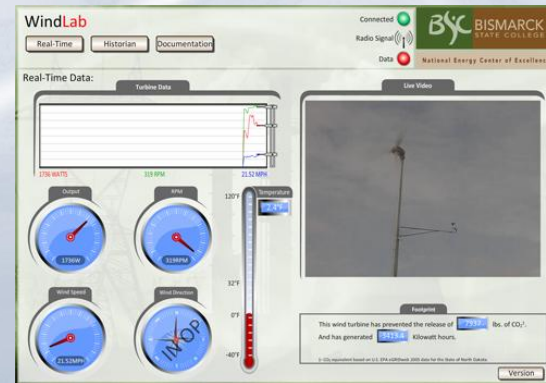
Remote Laboratory Examples



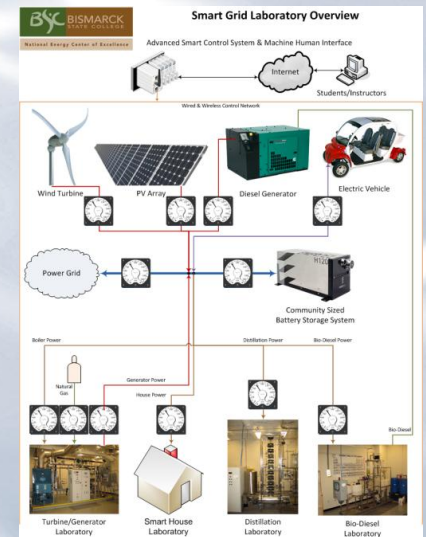
Process Laboratory



Power Grid Laboratory



Wind Laboratory



Smart Grid Laboratory

Questions & Contact

- NECE Website:
 - <http://www.bismarckstate.edu/energy>
- WebLab Website:
 - <http://server01.energy.bsc.nodak.edu>
- Contact:
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