

## *Applying Usability Engineering to the NEES Tsunami/Wave Basin*

*Oregon State University collaboration:*  
Dept. of Civil, Construction, and Environmental Engineering  
Hinsdale Wave Research Lab  
Northwest Alliance for Computational Science & Engineering (NACSE)

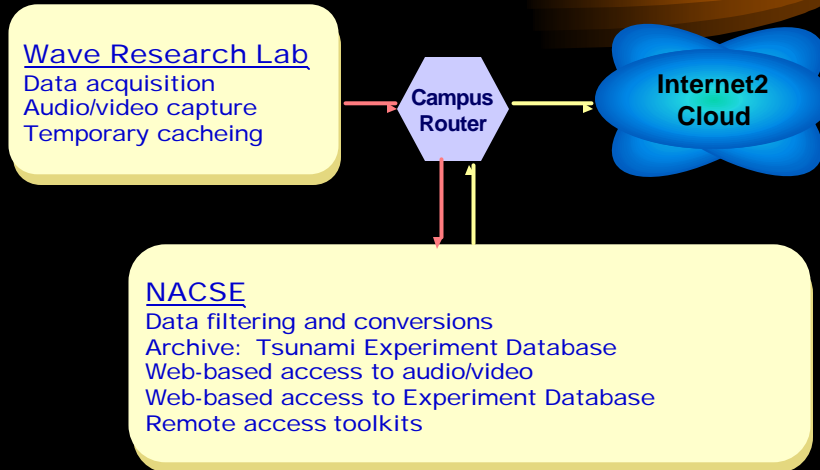
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## *Re-Engineering the Wave Research Lab*

- Extend the capacity of the physical facility
- Create an Information Architecture that
  - Enables remote access in real-time
  - Captures and preserves all relevant information
  - Facilitates re-use of knowledge gained from experiments
- Enhance effectiveness of WRL researchers through usability engineering

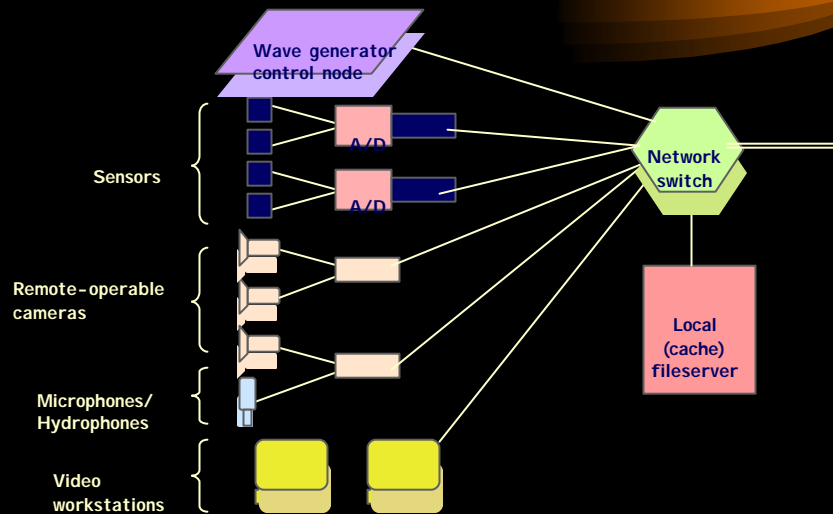
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## Adding an Information Architecture



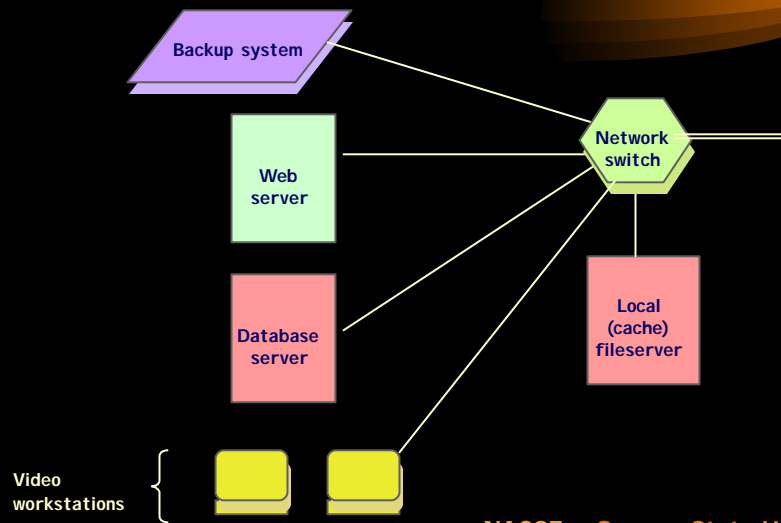
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## At the WRL



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## At NACSE



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## Special Need for Reliability

- Experiments must be captured as they happen
  - Very expensive
  - Typically destructive in nature
- Lead researcher must have “instant feedback”
- Reliability is key part of architecture
  - Combination of redundancy, over-design, and alternative paths
  - Builds on previous experience with fully interactive, network-based video

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## Applying Usability Engineering

- Human factors
  - Characteristics, capabilities and limitations of human beings
  - How these affect our use of technology
- Usability engineering
  - Addresses human factors explicitly during design process
    - To improve system effectiveness and safety
    - To improve user productivity

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## Why Is Usability Engineering Important?

- A system that doesn't
- Respond to user needs
  - Align with user processes
  - Accommodate user expertise

... may be worse than no system at all!



Mozart writing the digital version of his symphony No. 38 in D major

## *Usability Engineering and NEES*

- UE can make it possible for researchers to
  - Control and observe experiments from remote sites
    - Reduce requirement for on-site presence
  - Gain more from experimental processes
    - Exploit technology to enhance human observation
  - Share experiments with colleagues and students
    - Broaden participation in experiments
    - Extend useful lifetime of experimental processes
  - Exploit corpus of experimental results
    - Facilitate re-use of previous experimentation
    - Support integration of computational and experimental modeling

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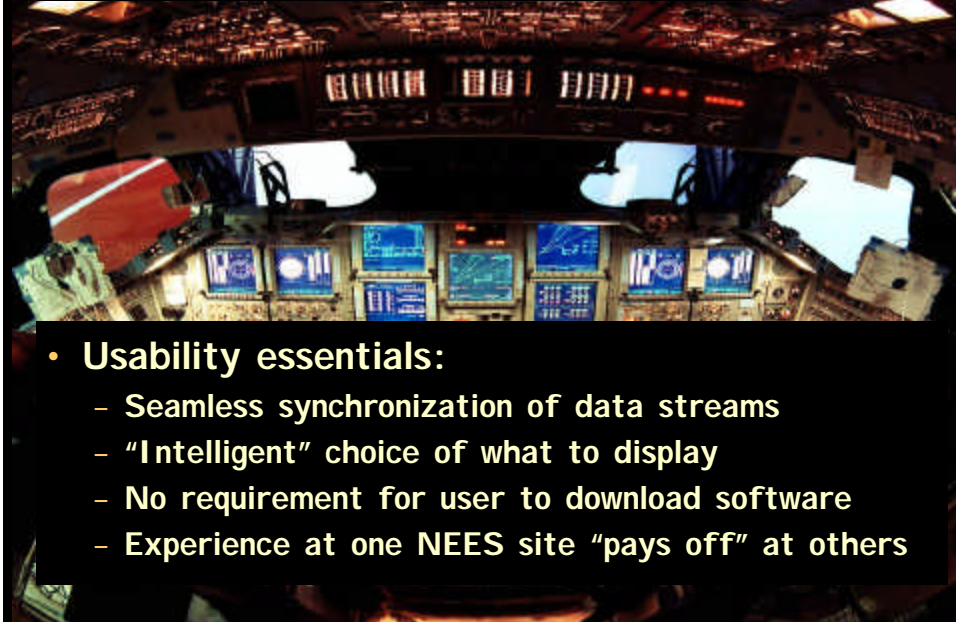
## *Telepresence: The Raw Ingredients*

- Sensor data: raw, filtered, graphical summaries
  - 10s to 100s of devices operating concurrently
- Data streams from remotely operable cameras and microphones
  - 10s of devices at eye level, suspended from roof, and underwater
- Robotic controls
- Use of computation to merge/analyze real-time data streams

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## *Without attention to usability*

...



- Usability essentials:
  - Seamless synchronization of data streams
  - “Intelligent” choice of what to display
  - No requirement for user to download software
  - Experience at one NEES site “pays off” at others

## *Engineering the User Experience*

- **Role 1: Steering and observing the remote experiment**
  - Researcher(s) sets up and directs experiment in near-real-time
  - Colleagues from same/other institutions participate
  - Observe/assimilate/discuss varying sets of data streams
- **Role 2: After-the-fact experiment replay**
  - Researcher(s) observe experiment in simulated time
  - Identify subsets of data streams for targeted uses

## *Issues in Remote Steering/Observation*

**Goal: Make remote experimentation efficient and useful**

- Helping PIs select optimal control settings
- Acquiring metadata only the PI can furnish
- Placing audio/video effectively
- Integrating sensor data into meaningful summaries
- "Intelligent" management of displays
- "Instant Replay" to improve on traditional viewing
- Electronic Lab Notebook: saving/annotating records for personal use

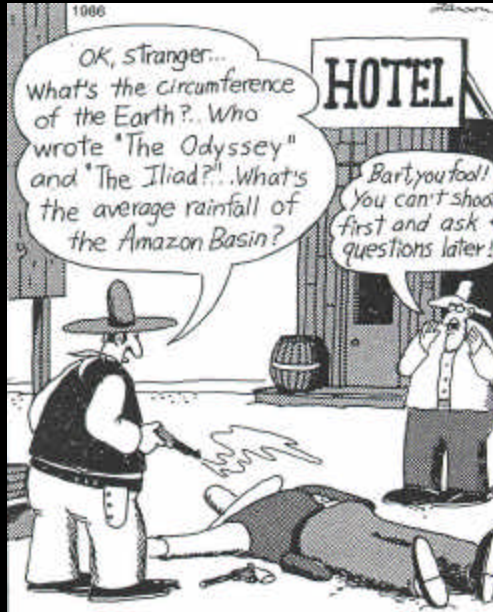
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## *Issues in Experiment Replay*

**Goal: Make it possible to derive real benefit from others' experiments**

- Generating markers for "interesting events" in sensor and audio/video streams
- Zooming forward through simulated time to next event, then slow-stepping through critical data sequences
- Synchronized access to raw/filtered/summarized data
- Ability to download arbitrary sequences of data

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- Usability engineering means working with users to identify their needs and preferences

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### *Data Exploration: The Raw Ingredients*

- Extremely large quantities of data must be archived and made publicly available
- Synchronization markers must be added
- Diverse data formats need to be integrated
- Metadata need to be standardized
- Must be possible to compare experimental data with data from simulations

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## *Engineering the User Experience*

- Tsunami Experiment Databank archives all aspects of NEES experiments
- **Role 3: Single or collaborative researchers use search-and-exploration interfaces**
  - So duplication can be eliminated
  - So models can be calibrated
  - So model results can be validated

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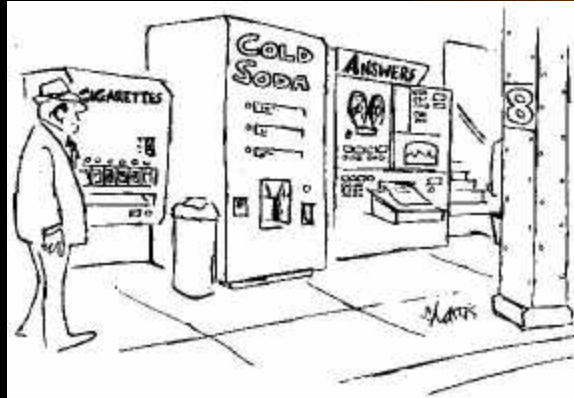
## *Issues in Databank Exploration*

**Goal: Make searching flexible enough to quickly locate appropriate experiments**

- Generating most metadata automatically during data acquisition/processing
- Multi-tiered interfaces that support typical user scenarios:
  - “Experiments involving certain wave configurations”
  - “Experiments involving certain types of models”
  - “Experiments yielding particular types of results”
  - “Find experiments similar to this one”

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## *What Users Really Want...*



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## *Key Issues for Tsunami Community*

- **Metadata will be essential**
  - **Who defines it?**
    - Must be community-based
    - Recommend that task force(s) be convened
  - **Most should be generated automatically during experiments**
    - Some must be defined by PI - need to make this easy
  - **"Incentive" approach to obtaining metadata from NEES researchers**
    - Require it before experiment can start
    - Carrot: "automatic experiment report" generation

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## *Key Issues for Tsunami Community*

- **Data formats**
  - Known formats needed for raw and first-order processed (filtered) data
  - Format standards?
- **“Publishing” experimental data**
  - Site will retain raw and first-order data
  - Quick-look (low resolution) data
    - Can't lead to publication - made available immediately
  - High-resolution data needed for publications
    - Made available after PIs have a chance to publish
  - PIs encouraged to deposit other processed data

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